Adult degenerative scoliosis: Is it worth the risk?

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Degenerative Scoliosis

1. Surgery?
2. Complications
3. New directions

Reality check

Disclaimers:
HansJörg Wyss Foundation: Endowed Chair
Renovis: Stock Holder
AOSpine North America: Past Chair, Speaker, Board, Fellowship and Research support
Cervical Spine Research Society: Board Member
Evidence Based Spine Journal: Editorial Chair
Global Spine Journal: Deputy Editor-in-Chief
Spine: Deputy Editor
The Spine Journal: Editorial Board
IP:
• SpineSage.com
• Spine SCGAP
• Paintracker
Unanswered:
1. Why does this happen?
2. What to do?
Motion is Life, Life is Motion

Silver Tsunami

Systemic effects
- Pain
- Cardiopulmonary
- Digestive
- Neurologic
- Premature Death

The Collapsing Human Spine

Sagittal profile of the elderly

50 asymptomatic volunteers 70-85 yo
- Average kyphosis: 52° [29-79°]
- Average lordosis: -57° [-96° -20°]
- C7 plumb: 40 mm in front of Post. sup aspect of S1

The Osteoporosis Crisis

1.5 million osteoporotic fractures occur in the U.S. each year

90% of all women over the age of 75 are osteopenic
< 20% of orthopaedic surgeons are recommending osteoporosis follow-up after a hip fracture
Fact sheet: Primary Degenerative Scoliosis

- Average age of presentation: 60 y.o.
- Incidence (est.): 6% (cumulative)
- Natural progression: 3°/a
- Female/male = 70/30%
- Primary complaint: LBP + claudication (foraminal stenosis)

Adult scoliosis surgery: Towards a realistic risk assessment

Degenerative Scoliosis: Poor Prognosis

- Lumbar curve > 30°
- Dynamic instability
  - Axial
  - Sagittal
- Progressive neurogenic claudication
- Previous laminectomy at curve apex
- Lateral listhesis L3/4 > 20%
Nonoperative treatment

Bracing not feasible

Postural and functional treatment: Mandatory prerequisite

Degenerative Scoliosis:

Is a big time surgery really the only answer?

Degen. Scoliosis: Micro – decompression?

• Well intended
• Ineffective: lack of lateral decompression
• Dangerous: risk of further destabilization

Degen. Scoliosis: Focal fusion?

Limited invasiveness

Junctional collapse
Restoration of balanced spine impossible
Hardware complications
Revision reconstruction more complex
Multilevel fusion into Flat Back

DEGENERATIVE SCOLIOSIS:
Complications

- **Trammel 91**
  - 21-40 y/o 27% 6% MAJOR
  - 41-60 y/o 41% 14% MAJOR
  - 61-85 y/o 64% 24% MAJOR

DEGENERATIVE SCOLIOSIS:
Complications

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Complication</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-40 y/o</td>
<td>Trammel 80%</td>
</tr>
<tr>
<td>41-60 y/o</td>
<td>McDonald 41%</td>
</tr>
<tr>
<td>61-85 y/o</td>
<td>McDonald 64%</td>
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</tbody>
</table>

SRS Summary statement 2002
Complications of Adult Scoliosis –
Ant/Post

Spine. 2001 Apr 15;26(8):973-83
Long-term complications in adult combined surgery a comparison of primary to revision patients.
Lapp MA, Bridwell KH, Lenke LG, Derkatch A, Cavanaugh DA, Lee KH, Dupuis JY
• 44 patients: A + P
• Minimum 2-yr followup (avg. F/U 42 m)

• Major complications 12% (revision) 22% (primary)
  - deep wound infection
  - pseudarthrosis
  - transition breakdown
  - neurologic deficit
  - death

• Minor complications 22-23%
  - asympt. instrumentation failure (no loss of correction)
  - hardware removal
  - junctional kyphosis (5-10 degrees)
  - subsequent disc space narrowing of 2-5 mm without clinical symptoms.

942 patients
Any type of fusion > 2 levels
Age 54 a
Stay: 13.5 d
Complications 87 %
Mortality 14 patients (2%)
Intraoperative complications 10.5 %
Postoperative complications 73.5 %

High risk
High reward?

WHY?

103 patients 2003-2007
Avg age 68a
Stay: 12 d (ICU 2.7d)
Postop rehab 58%
1 year mortality 3%
Medical complications 12%
Surgical complications 35% (2yrs)
New radicular symptoms 17%
### Results

<table>
<thead>
<tr>
<th></th>
<th>LOS</th>
<th>ICU Days</th>
<th>DC to SNF</th>
<th>Medical Complication</th>
<th>Surgical Complication</th>
<th>Death</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>0.001</td>
<td>0.006</td>
<td>0.13</td>
<td>0.15</td>
<td>0.62</td>
<td>0.30</td>
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<tr>
<td>ASA Class</td>
<td>0.02</td>
<td>0.18</td>
<td>0.10</td>
<td>0.60</td>
<td>0.10</td>
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<tr>
<td># of Lumbar's</td>
<td>0.56</td>
<td>0.44</td>
<td>0.88</td>
<td>0.16</td>
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<tr>
<td># of Fusion Levels</td>
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<td>0.004</td>
<td>0.28</td>
<td>0.25</td>
<td>0.43</td>
<td>0.49</td>
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<tr>
<td># of Interbody Spacers</td>
<td>0.39</td>
<td>0.16</td>
<td>0.43</td>
<td>0.96</td>
<td>0.90</td>
<td>0.69</td>
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<tr>
<td>EBL</td>
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<td>0.01</td>
<td>0.30</td>
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<tr>
<td>Operative Time</td>
<td>0.02</td>
<td>0.8</td>
<td>0.77</td>
<td>0.36</td>
<td>0.40</td>
<td>0.3</td>
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</tbody>
</table>

### Results

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<th>Surgical Complication</th>
<th>Death</th>
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</thead>
<tbody>
<tr>
<td>Revision</td>
<td>0.20</td>
<td>0.13</td>
<td>0.92</td>
<td>0.03</td>
<td>0.79</td>
<td>0.80</td>
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<tr>
<td>Staged</td>
<td>0.001</td>
<td>0.005</td>
<td>0.48</td>
<td>0.89</td>
<td>0.03</td>
<td>0.85</td>
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<tr>
<td>HTN</td>
<td>0.27</td>
<td>0.08</td>
<td>0.94</td>
<td>0.63</td>
<td>0.59</td>
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<tr>
<td>Heart Disease</td>
<td>0.26</td>
<td>0.06</td>
<td>0.21</td>
<td>0.88</td>
<td>0.57</td>
<td>0.92</td>
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<tr>
<td>Renal Disease</td>
<td>0.90</td>
<td>0.14</td>
<td>0.13</td>
<td>0.04</td>
<td>0.14</td>
<td>0.04</td>
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<tr>
<td>Pulmonary Disease</td>
<td>0.10</td>
<td>0.23</td>
<td>0.35</td>
<td>0.23</td>
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<tr>
<td>Diabetes</td>
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<td>0.71</td>
<td>0.09</td>
<td>0.23</td>
<td>0.60</td>
</tr>
</tbody>
</table>

### 5 Intervention strategies

1. Fixation /stiffness related
2. Bone healing
3. Approach related
4. Blood loss
5. Using IT

### Approaches towards an answer

*What can we do?*
Shared decision making

Use data

Risk modeling

SpineSage.com

Surgical Invasiveness Examples

1. Puncture
2. LUMA &/or percutaneous, CSM foramintomy
3. LUMA &/or percutaneous, CSM foraminotomy
4. LUMA &/or percutaneous, posterior lumbosacral fixation
5. LUMA &/or percutaneous, anterior lumbar fixation
6. Endoscopic

Lumbo-sacral fixation:
Complex constructs
Improvisational
Non-rigid

Junctional Problems:
The bottom

Iliac Screws
Screws below posterior superior iliac crest
Low profile connectors
Rostral junction lesions

Junctional Problems: The top

64 yo female
Severe osteoporosis
Teriparatide
64 yo female
Severe osteoporosis
Teriparatide

The Middle

DEGENERATIVE SCOLIOSIS
- 33% PSEUDOARTHROSIS
  • 4% IDIOPATHIC
- Correlates inversely with patient satisfaction
  • Emami et al, Spine 2002

Nonunions
Offlabel use of bone morphogenic proteins?

Eccentric PLIF for Deformity Correction
DEGENERATIVE SCOLIOSIS

Source of morbidity:

Invasiveness anterior surgery?

Can we do better?
143 scoliosis surgery patients

Retrospective study with historic matched controls
52 Staged 7 d
90 Non-staged
Staged: Age and Invasiveness higher

Blood loss

Does staging > 21 days help?
Not staged (n=29) vs Staged (n=34) patients
Anterior and posterior surgery

<table>
<thead>
<tr>
<th>Timing of Staging?</th>
<th>Not staged</th>
<th>Staged</th>
</tr>
</thead>
<tbody>
<tr>
<td>EBL</td>
<td>4.5l</td>
<td>4.0l</td>
</tr>
<tr>
<td>LOS</td>
<td>14d</td>
<td>12d</td>
</tr>
<tr>
<td>Complications</td>
<td>35%</td>
<td>18%</td>
</tr>
<tr>
<td>ODI's</td>
<td>worse</td>
<td>better</td>
</tr>
</tbody>
</table>

- Transfusions in staged
- 11/90 staged ‘failures’ (12% not completed)
- No differences in complications

Antifibrinolytics? Cell saver?

Cell saver > 4% is detrimental
Use data to drive practices

How do I even know?

All Fusions: Current Smokers

Insulin used of glucose > 200
All Fusions: Current Opioid Use

20th to 21st Century: Degenerative scoliosis

Increasing problem
No prevention
No effective nonoperative treatment
Complications underreported
Limited follow-up

Increasing the safety of surgery:
Staging
Reducing incidence of infection
Optimizing patients for surgery
Fusion
Prevention of Adjacent segment pathology

Using IT and Outcomes for ALL patients
Degen. Scoliosis: Comprehensive Solution

- Thoraco - lumbo - pelvic Instrumentation
- Lumbar decompression (L1- S1)

1. Anterior + posterior Or posterior alone (PLIF’s)
2. How high? T2 - T10
3. How low? L5 or S-1 Ala or Ilium?

78-year-old woman c/o LBP L groin pain thoracic pain

Scoliosis: Diagnostics

- Plain radiographs
  - Full length standing ap / lateral X -
  - Recumbent ap / lat L-Spine
  - Flexion / extension
- MRI
  - Screening and minor (< 20° curves)
- CT - Myelography
  - Major curves (> 20°)
  - Revisions
  - Preoperative planning

"Dynamic Instability"
Assessment of Global Balance

- Long cassette including femurs
- **Femoral axis line**
- **C7 offset** - measurement perpendicular to femoral axis line to center of C7
- Global imbalance quantified but location of deformity must be defined

Overriding presenting symptoms

Disabling low back pain and inability to stand erect

Assessment of Global Balance

- Theoretical advantages of this global assessment
  - Includes dynamic hip and knee contractures
  - Functional muscle contribution included
  - Helps with planning of single vs. multiple level procedure