Assessment of Adult Scoliosis

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Adult Scoliosis

**Adolescent Scoliosis in the Adult (ASA)**

- Pre-existing Adolescent Idiopathic Scoliosis (AIS) (mostly already known, sometimes undiagnosed)
- Age can vary, different manifestations
  - Young adults (18-30 years)
  - Middle aged adults (30-40 years)
  - Older adults (> 40 years)
- Locations
  - Occurs in Thoracic, Lumbar or Thoracolumbar spine
- Curve Severity
  - Larger Cobb angles, increased potential for progression

**Degenerative De-Novo Scoliosis (DDS)**

- Developed in adult life, as a result of degenerative instability
- Occurred in older adults, usually >50 years
- Locations
  - Exclusively Lumbar/Thoracic spine
  - Loss of lumbar lordosis
- Curve severity
  - Moderate Cobb angles, big deformities
Different Clinical Signs and Symptoms compared to AIS

• Back pain, higher incidence
  - Mainly on the convex side for ASA
  - Can be on concave side in case of rotatory subluxation/listhesis

• Radicular pain / Claudication symptoms / Neurologic deficit
  - Stenosis (central/recessal)
  - Nerve root compression

• Rigidity / reduced spinal flexibility
• Reduced lumbar lordosis
• Functional disability
• Reduced Quality of Life
Quality of life (QoL) questionnaires

<table>
<thead>
<tr>
<th>SRS-22 Patient Questionnaire</th>
<th>SF-36 QUESTIONNAIRE</th>
<th>ODI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General Health:</strong> In general, would you say your health is:</td>
<td><strong>Excellent</strong></td>
<td><strong>Fair</strong></td>
</tr>
<tr>
<td><strong>Compared to one year ago, how would you rate your health in general now?</strong></td>
<td><strong>Much better now than one year ago</strong></td>
<td><strong>About the same</strong></td>
</tr>
<tr>
<td><strong>LIMITATIONS OF ACTIVITIES:</strong> The following items are about activities you might do during a typical day. Does your health now limit you in these activities? If so, how much?</td>
<td><strong>Yes, Limited a lot</strong></td>
<td><strong>No, Not Limited at all</strong></td>
</tr>
<tr>
<td><strong>Lifting or carrying groceries</strong></td>
<td><strong>Yes, Limited a Lot</strong></td>
<td><strong>No, Not Limited at all</strong></td>
</tr>
<tr>
<td><strong>Climbing several flights of stairs</strong></td>
<td><strong>Yes, Limited a Lot</strong></td>
<td><strong>No, Not Limited at all</strong></td>
</tr>
<tr>
<td><strong>Bending, kneeling, or stooping</strong></td>
<td><strong>Yes, Limited a Lot</strong></td>
<td><strong>No, Not Limited at all</strong></td>
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</table>

- **Pain and Functional Disability** are the most important parameters
- **Cosmetics and Progression** not a major issue for older adults
Breathing function

- Vital Capacity (VC) is decreased in large thoracic curves
- Moderate restriction < 80%
- Severe restriction < 60%
- General physical condition plays a role
ASA Type 1

- 18-30 years old
- Resembles AIS
- Usually smaller and flexible curves
- Clinical appearance is the main problem.
- Pain can exist, especially in unbalanced curves
- Greater possibilities for improvement.

ASA Type 2

- 30-40 years old
- Usually larger more rigid curves
- Sometimes after pregnancy
- Pain and posture equally issues.
- Pain can be an issue even in balanced curves.
- Often early degenerative changes
- Intervention in ASA 2 could potentially stop progression to ASA 3

ASA Type 3

- >40 years and mostly >50 years old
- Usually large, rigid curves
- Pain and Disability primary problems.
- Moderate to severe degenerative changes present.
- Most commonly lumbar curves.
- No previous history of scoliosis could indicate Degenerative De Novo Scoliosis DDS.
<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
<th>Cause</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Primary degenerative scoliosis; Most commonly has curve apex L2-3 or L4</td>
<td>Disc degeneration (asymmetric); Facet joint degeneration</td>
</tr>
<tr>
<td>II</td>
<td>Idiopathic scoliosis that has progressed; Lumbar and/or thoracolumbar</td>
<td>Progression of idiopathic scoliosis (present since childhood) caused by degenerative disease and/or mechanical/bony reasons</td>
</tr>
<tr>
<td>IIIa</td>
<td>Secondary adult scoliosis; Typically thoracolumbar or lumbar-lumbosacral</td>
<td>Secondary to an adjacent curve of idiopathic, neuromuscular or congenital origin; Obliquity of pelvis caused by leg length discrepancy or hip abnormality; Lumbosacral transitional anomaly</td>
</tr>
<tr>
<td>IIIb</td>
<td>Deformity resulting from bone weakness (e.g. osteoporotic fracture)</td>
<td>Metabolic bone disease, osteoporosis</td>
</tr>
</tbody>
</table>
SRS Adult Scoliosis Classification (2006)

Primary curve types
- Single thoracic (ST)
- Double thoracic (DT)
- Triple major (TM)
- Thoracolumbar (TL)
- Lumbar ‘de novo’/idiopathic (L)
- Primary sagittal plane deformity (SP)

Adult spinal deformity modifiers

Regional sagittal modifier (include only if outside normal range as listed)
- (PT) Proximal thoracic (T2-T5) > +20°
- (MT) Main thoracic (T5-T12) > +50°
- (TL) Thoracolumbar (T10-L2) > +20°
- (L) Lumbar (T12-S1) > -40°

Global balance modifier (include only if imbalance is present)
- (SB) sagittal C7 plumb >5cm anterior or posterior to sacral promontory
- (CB) coronal C7 plumb >3cm right or left of CSVL

SRS definition of regions
- Thoracic: apex T12-T11-T12 disc
- Thoracolumbar: apex T12-L1
- Lumbar: apex L1-L2 disc – L4

Criteria for specific major curve types
1. Thoracic curves
   - Curve > 40°
   - Apical vertebral body lateral to C7 plumbline
   - T1 rib or clavicle angle >10° upper thoracic curves
2. Thoracolumbar or lumbar curves
   - Curve > 30°
   - Apical vertebra body lateral to CSVL
3. Primary sagittal plane deformity
   - No major coronal curve
   - One or more regional sagittal measurements (PT,MT,TL,L) outside normal range
SRS Schwab Classification (2011)

Coronal curve types

T  Thoracic only with lumbar curve $<30^\circ$
L  TL/Lumbar only with thoracic curve $<30^\circ$
D  Double curve with at least one T and one TL/L both $>30^\circ$
N  No coronal curve all coronal curves $<30^\circ$

Sagittal modifiers

PI-LL mismatch
0: PI-LL $<10^\circ$
+: PI-LL $10^\circ$-$20^\circ$
++: PI-LL $>20^\circ$

C7-S1 SVA
0: SVA <4 cm
+: SVA 4 cm-9.5 cm
++: SVA >9.5 cm

Pelvic tilt
0: PT $<20^\circ$
+: PT $20^\circ$-$30^\circ$
++: PT $>30^\circ$
Prevalence of Adult Scoliosis in Back Pain

Perennou et al (1994)
671 LBP patients:
• 7.5% had evidence of scoliosis
• Prevalence of scoliosis increased with age
• 2% before 45 years (most likely ASA)
• 15% after 60 years (probably DDS)

Robin et al (1982)
554 LBP patients
• Aged 50 to 84 years
• 30% scoliosis >10°
At 5 year follow up
• 40% scoliosis >10°
• Additional 10%

“a significant number of older people have an adult scoliosis” and its “prevalence and progression is directly related to advancing age”
Radiographic parameters and pain in adult scoliosis

- ASA mean Cobb 40°
- DDS mean Cobb 25°
- Radiographic parameters correlating with pain were identical for both groups
- Common end pathway (degenerative instability and unfavorable lumbar vertebral alignment) among both groups of patients is related to symptoms.

Important radiographic parameters:

- Level of regional balance
- Instability
- Pathologic mechanical loads of the spinal elements

Radiographic parameters and pain in adult scoliosis

Highly significant radiographic parameters include:

- Lateral vertebral slippage (lateral listhesis)
- L3 and L4 endplate obliquity angles
- Decrease in lumbar lordosis
- Increased thoraco-lumbar kyphosis
- Cobb angle and age are not useful in adult scoliosis assessment
- Amount of listhesis is significantly correlated, level of listhesis not
- No correlation between VAS and number of vertebra involved in scoliotic Cobb angle

Table 2. Predictive Formulas for Self-Reported Pain in Study Group of Adult Scoliosis Patients: Visual Analog Pain Score and Radiographic Parameters

<table>
<thead>
<tr>
<th>Formula</th>
<th>Level of Significance (p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAS = 42.947 + (0.934 × L4 angle)</td>
<td>&lt;0.006</td>
</tr>
<tr>
<td>VAS = 45.96 + (0.833 × L3 angle)</td>
<td>&lt;0.002</td>
</tr>
<tr>
<td>VAS = 41.52 + (0.152 × lordosis)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>VAS = 86.353 - (0.695 × kyphosis)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>VAS = 39.612 + (1.720 × listhesis)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

Aging influences natural history of sagittal plane changes in the adult spine.

- Thoracic kyphosis increases with age
- Lumbar lordosis decreases with age

Thoracic kyphosis increases with age

Lumbar lordosis decreases with age

Positive sagittal balance predicts clinical symptoms in adult spinal deformity

Thoracolumbar and lumbar curves generate less favorable scores than thoracic curves

Significant coronal imbalance was associated with pain and dysfunction in unoperated patients only.
Radiographic parameters and clinical symptoms in adult scoliosis

- Positive (anterior) Sagittal Balance
  - Increased pain
  - Diminished physical function
  - Reduced self image
  - Impaired social function

- Coronal shift > 4 cm
  - Decreased function
  - Increased pain

Progression of Adult Curves

• Generally unpredictable (rate of progression 0.5° -1° / year)
  ➢ Cobb angle < 30° less likelihood to progress
  ➢ Cobb angle > 50° significantly more likelihood to progress

• Progression in ASA 1&2 not a major concern, curves <50°
• 36% of AIS patients had progressed by more than 10° after 22 years.  
  Danielson and Nachemson (2003)
• 68% of scoliosis cases progress, (min difference of 5°), particularly curves > 30°.  

• ASA 3 and DDS can become moderate to severely progressive due to degenerative instability and/or hormonal influence.
• The most progressive DDS cases often have osteoporosis as a co-morbidity

Asymmetric Degeneration  Asymmetric Loading

Asymmetric Degeneration

Adult Degenerative Scoliosis

Asymmetric Deformity
Two main types were identified:

1) **Type A**
   - Adolescent scoliosis
   - Progression after skeletal maturity

2) **Type B**
   - Progression late in adulthood
     *(Pre-existing stable adult scoliosis with late progression)*
   - *De novo* late-onset scoliosis.

Linear rate of progression for both types

No correlation between initial Cobb angle and slope of progression

*Figure 9. Graph of all the curves type A and B.*

_Natural History of Progressive Adult Scoliosis_ Marty-Poumarat et.al. _Spine_ 2007
<table>
<thead>
<tr>
<th></th>
<th>Type A</th>
<th>Type B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Loss of height</td>
<td>5 cm (0.18 cm/y)</td>
<td>10 cm (0.46 cm/y)</td>
</tr>
<tr>
<td>Lumbar/Thoracolumbar slope</td>
<td>0.82°/y (0.34 – 1.65)</td>
<td>1.64°/y (0.77 – 3.82)</td>
</tr>
<tr>
<td>(rate of progression)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean age at the time of the</td>
<td>24 years</td>
<td>46 years</td>
</tr>
<tr>
<td>first radiograph</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean Lumbar and</td>
<td>37° (range 22° to 52°)</td>
<td>20° (range 3° to 35°)</td>
</tr>
<tr>
<td>thoracolumbar Cobb angle of</td>
<td></td>
<td></td>
</tr>
<tr>
<td>first radiograph</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean age of first rotatory</td>
<td>42 years</td>
<td>56 years</td>
</tr>
<tr>
<td>subluxation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean Cobb angle of first</td>
<td>52°</td>
<td>29°</td>
</tr>
<tr>
<td>rotatory subluxation</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Natural History of Progressive Adult Scoliosis Marty-Poumarat et.al. Spine 2007
Role of menopause

- In 8 women with type A scoliosis with a long progression comprising menopause, no change of slope was observed at menopause.
- Patients with type B scoliosis were all women and exclusively presented a lumbar or thoracolumbar single curve.
- In type B, 11 out of 20 (>50%) of these patients progressed at the time of menopause.
AIS in Adult patients (ASA)

1992 (17 years old)  
36°

2018 (43 years old)  
68°
01-2006
51° – 37°

11-2017
58° – 38°
2005 (39 years old)  
26°  
Stable from adolescence

2007 (41 years old)  
26°

2018 (52 years old)  
47°
De-novo Adult Scoliosis (DDS)
Cobb angle > 100°
Conclusions

- Adult scoliosis is complicated and unpredictable
- 2 basic types: ASA and DDS
- Young adults: Aesthetics main concern
- Older adults: Pain and Disability main concerns

➢ How should we treat them?

➢ Standardisation for decision-making??

- Pain management / medications / acupuncture / injections
- Scoliosis Specific Exercises / Generic Exercises / Physiotherapy / Other types
- Brace (Type, Duration)
- Surgery
Thank you for your attention!!!

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