Scoliosis: Spinal Disorders in Children and Adults

Considerations in Etiology, Natural History, and Operative Care

Sigurd Berven, M.D.
Professor in Residence
University of California
San Francisco
Causes of Scoliosis

- Congenital
- Neuromuscular
- Syndromic
- Idiopathic
Patient/Parent Choice

• Participation Requires Information
  – Natural history
  – Non-operative Options
  – Risk/Benefit Ratio
  – Outcome Assessment
Impact of Scoliosis on Quality of Life
Health and Function of Patients With Untreated Idiopathic Scoliosis
A 50-Year Natural History Study

- 117 pts with untreated scoliosis
  - 62 age and gender matched controls
- 50 year follow-up
- 117 untreated patients
- Mortality equal
- Curves >80 degrees associated with shortness of breath
- 66% of patients complained of chronic back pain compared with 35% of controls
What are the Future Consequences of Deformity Progression?

- What are the “future consequences”?
- Will progression bring pain, cardiopulmonary compromise, or neurologic deficits?
- What is the likelihood of progression?
- Will surgery positively affect an impaired self-image?
- What is the difference between surgery now and surgery later?
- What are accurate Pain and Functional Expectations with and without surgery?
The decision of whether or not to operate is as important as the technique and expertise with which the procedure is performed.
Patient Choice

- Accurate Understanding of Natural History
- Realistic Expectation of Treatment Results
- Clear Understanding of Risks and Benefits
- Knowledge of Alternatives
Patient Choice

Whether operative or non-operative care is chosen by the patient, information and knowledge will set the background for a successful outcome.
“Future Consequences”

- **Pulmonary Function**
  - Pulmonary symptoms (subjective dyspnea) and diminished vital capacity correlate with curve severity
  - PFT abnormalities become abnormal >60 degrees
  - Adult scoliosis may present with subjective dyspnea
  - Additive effect of smoking on PFTs
  - Unreliable improvement with curve correction
“Future Consequences”

• **Cardiac Impairment:**
  
  – Zorab- Pulmonary and cardiac compromise more common in paralytic deformity
  
  – Echocardiography with mild RV dysfunction with increased deformity
  
  – Cor pulmonale and increased mortality extremely rare in idiopathic scoliosis
CONSEQUENCES

cardiopulmonary

- more common in paralytic deformity
- pulmonary dysfunction $\propto$ curve severity
- PFT become abnormal $> 60^\circ$
- dyspnea, cor pulmonale, echocardiographic RV dysfunction $> 90-100^\circ$
- additive effect of smoking and other disease

[Pehrsson K Spine 1992]
[Nilsonne U Acta 1968]
[Bergofsky EH Medicine 1959]
“Future Consequences”

• Neurologic Deterioration:
  
  – Progressive neurologic dysfunction (paraparesis) is not a characteristic of idiopathic scoliosis
  
  – Radiculopathy and Spinal Stenosis are features of degenerative changes in the lumbar spine associated with adult scoliosis
“Future Consequences”

• Pain and Spinal Deformity
  – Etiology: Degeneration, Instability, Radiculopathy, Fatigue
  – Pain Severity Unrelated to Curve Magnitude
  – Pain is the most common presenting symptom for adults with scoliosis. However, the incidence and severity of back pain in adults with scoliosis is similar to that of unaffected controls.
Curve Progression

- Curve progression after skeletal maturity:
  - Magnitude
  - Curve Pattern
  - Etiology of Deformity
  - Apical vertebral rotation
  - Translatory Shift
  - L5/Intercrestal Line Relationship
NATURAL HISTORY

progression

• progression before maturity:
  \( \alpha \) curve magnitude
  \( 1/\alpha \) maturity
  \(~ 1^\circ/\text{month}~\)
  “race” to maturity \(< 50^\circ\)

[Duval-Beaupère G. *Acta Orthop Belg* 1972]
[Weinstein SL. *Spine* 1985]
NATURAL HISTORY

progression

- progression post maturity: thoracic scoliosis > 45°
  lumbar curve > 45° (although less often)
  ~ 1°/year

[Weinstein SL. Spine 1985]
NATURAL HISTORY

if a child with scoliosis knew that her/his curve would not change

would she or he request treatment?
NATURAL HISTORY

curve magnitude

- röntgenogramme: degree accurate

[Cobb JR. Conn State Med J 1943]
maturity

- variable
- no single reliable measure
maturity

- iliac epiphysis
  - Risser 4
  - = cessation spine growth

- Risser 4
  - progress ≤ 45%
    - [Suh PB *Spine* 1988]

- triradiate cartilage
  - closed = cessation spine growth
  - open = ?
    - [Sanders JO *JBJS-A* 1995]
    - [Hamill CL *Spine* 1997]
NATURAL HISTORY

maturity

peak growth velocity

2

10

5

Risser 4

menarche

cession spinal growth

14½

2

12

12½

yr.

cm.

[Little DG JBJ  2000]
### NATURAL HISTORY

**progression**

<table>
<thead>
<tr>
<th>Risser</th>
<th>&lt; 20°</th>
<th>≥ 20°</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-1</td>
<td>22</td>
<td>68</td>
</tr>
<tr>
<td>2-4</td>
<td>1.6</td>
<td>23</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>age (yr.)</th>
<th>&lt; 20°</th>
<th>≥ 20°</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 10</td>
<td>45</td>
<td>100</td>
</tr>
<tr>
<td>11-12</td>
<td>23</td>
<td>61</td>
</tr>
<tr>
<td>13-14</td>
<td>8</td>
<td>37</td>
</tr>
<tr>
<td>≥ 15</td>
<td>4</td>
<td>16</td>
</tr>
</tbody>
</table>

[Lonstein JE. JBJS-A 1984]
MANAGEMENT

algorithm

“schooliosis” observe brace fusion degree

10 30 50

- 5° @ risk
BRACING

- wear full-time: > 20 hr./day
- wear until maturity
- what about the child < 10? Rarely useful in early onset deformity
- what about adolescent? development of body image
BRACING

Milwaukee

Boston
“schooliosis”

observe

brace

fusion

10

30

50

- 5° @ risk

compliance 60-75%

[Diraimondo CV JPO 1988]
[Bowen RJ SRS 2003]
BRACING

“schooliosis” observe brace fusion
degree

10 30 50

- 5° @ risk

? efficacy
no brace = surgery 28% (43/153) 1990’s
brace = surgery 23.5% 1980’s

[Goldberg CJ Spine 2001]
[Dickson RA JBJS-A 1999]
Self-Image

Spinal deformity has a significant impact on self-image for adolescents and adults.

- Weinstein- JBJS, 1981
  - No difference in marriage rates, disability, employment

- Expectation for surgical improvement in appearance

- Influence of surgical correction on self-image is variable
Surgery Now vs. Later

- Adolescent vs. Adult Deformity
- Options for Limited Fusion
- Complication Rates
- Social/Economic Factors
CURVE CLASSIFICATION 2AN-L2

PFTs 45% NL
PSF T2-L4/T10 VCR (+2)

PFTs 67% NL
Scoliosis in the Adult

• Impact of Spinal Deformity
  – Physical Function
  – Pain
  – Self-image
  – Mental Health
  – Quality of Life
Adult Scoliosis

- Impact of Spinal Deformity
  - Absolute magnitude compared with the unaffected population
  - Adults vs. Adolescents
 Discriminatory Validity

![Bar chart showing pain, function, self-image, and mental health for Adult Scoliosis and Controls.](chart.png)
Why do Adolescents Choose to Undergo Surgery for Idiopathic Scoliosis?

1) Concern Regarding **Future Consequences**
2) Cosmetic Correction
3) Reduce Present Pain
4) Limit Levels Fused
5) Return to Function
Why Do Parents Choose Surgery for Adolescents with Idiopathic Scoliosis?

1) Concern Regarding **Future Consequences**
2) Cosmetic Correction
3) Limit Levels Fused
4) Reduce Present Pain
5) Return to Function
Why do Adults Choose to Have Surgery for Scoliosis

- Pain Control
- Function Improvement
- Deformity Correction
- Concern for Future Consequences
• 36yo female, laboratory technician
• Mother of 2 girls age 3,5
• Scoliosis diagnosed age 12
• Progressive pain to lumbosacral spine with rt L5 radiculopathy
An Evidence-based Approach

- Decompression Only
- Fate of the L5-S1 intervertebral disc
- Posterior Fusion vs. Circumferential Arthrodesis
- Cephalad extent of arthrodesis
- The role of iliac fixation
- Osteoporosis
Conclusions

• Scoliosis is a common disorder of the spine that has a variable effect on health in children and adults.

• Early onset deformity, congenital scoliosis, neuromuscular scoliosis, and syndromic scoliosis may have a major impact on pulmonary function and health status.
  – Early recognition is critical.

• Scoliosis in the adult may also cause significant pain and disability. Identifying deformity that may progress and be symptomatic in the adult is useful in choosing patients who may benefit from surgery as adolescence.
UCSF Center for Outcomes Research