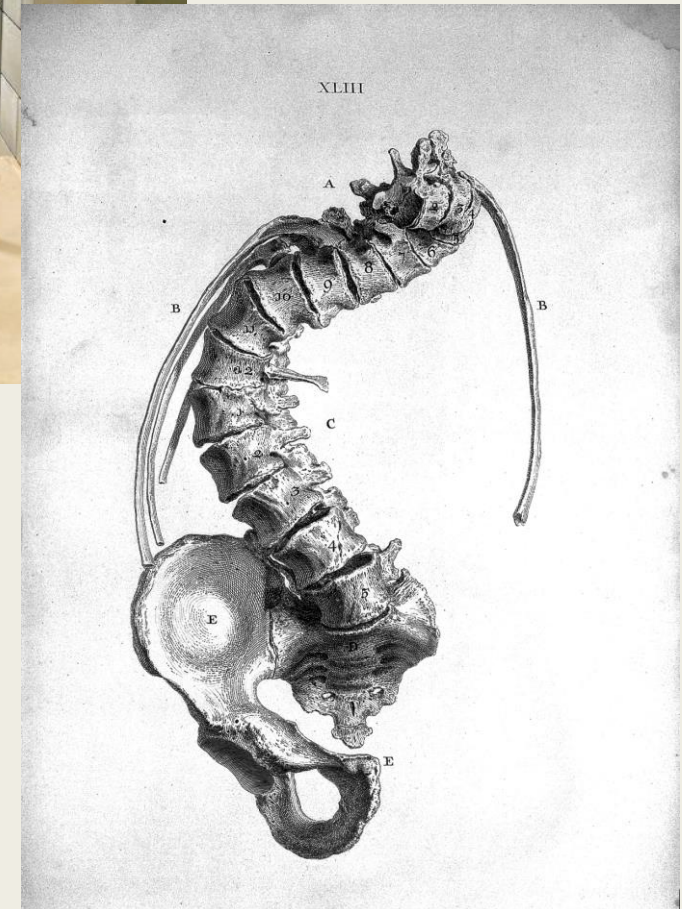


# PEDIATRIC AND ADOLESCENT IDIOPATHIC SCOLIOSIS: GOALS AND INDICATIONS FOR SURGERY

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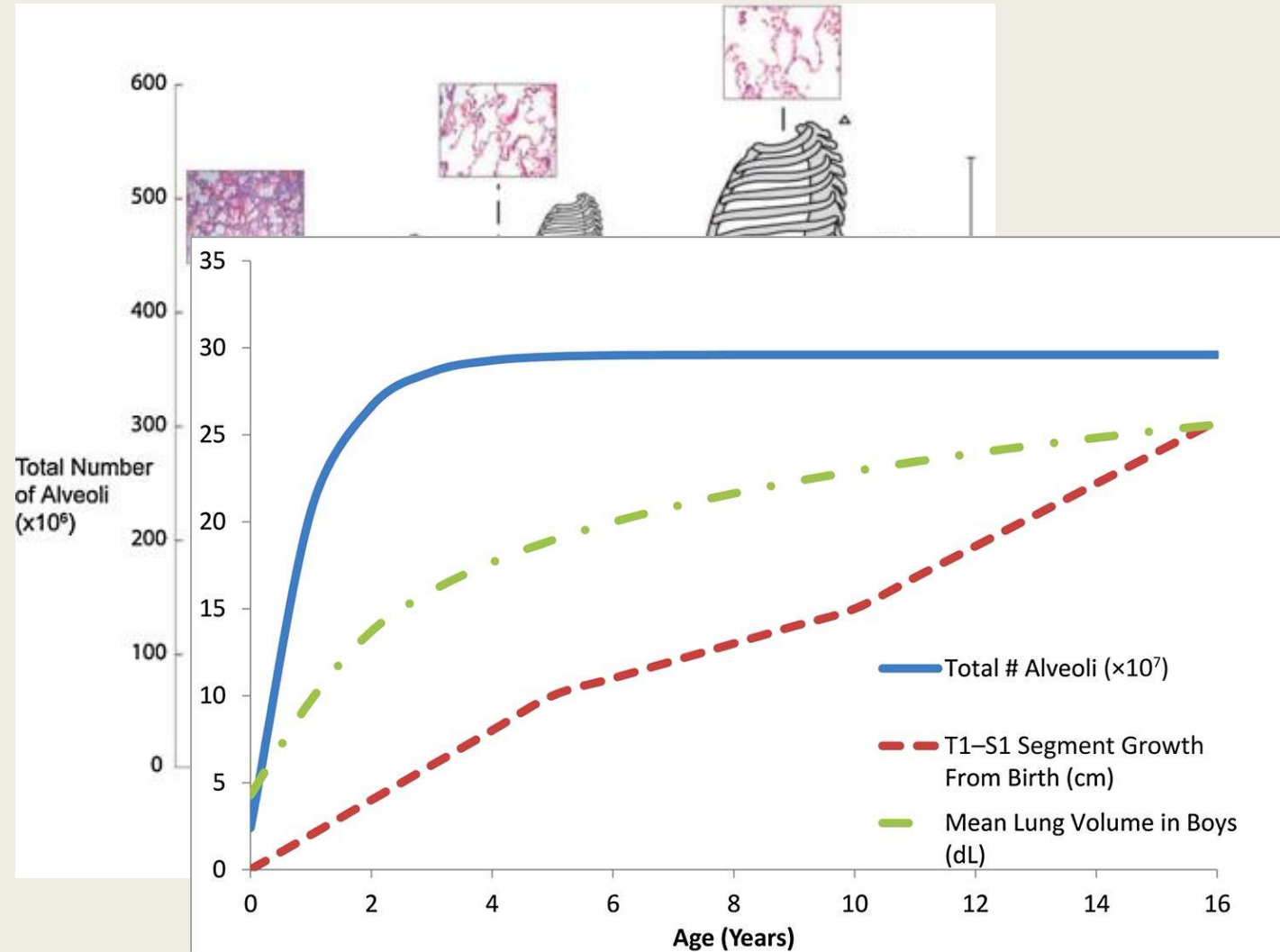
# Goals

- Understand the natural history of scoiosis
- Do better than the natural history of scoliosis
- Do no harm



# Natural History of Idiopathic Scoliosis

- Early onset (juvenile)
- Rule is progression
- Decreased vital capacity
- Pulmonary hypertension
- Cor pulmonale



# AIS: Natural History Back Pain

- Weinstein/Ponseti/Collis
  - 20-36 year
    - No correlation b/w curve size and pain/disability
  - 39 year
    - TL curves increased pain
  - 51 year
    - 61% w/chronic pain vs 35% of controls
- Cordover
  - 22 year
    - 65% back pain vs 32% of controls
- Edgar
  - 17 year
    - 79% with pain, 44% frequent pain
- Ascani
  - 33 year
    - 61% back pain





# AIS: Natural History

## Curve Progression

- Weinstein/Ponseti

- 40 year

- Curves  $<30^\circ$  no progress, except lumbar curves with “unseated” L5
    - Lumbar curves  $>30^\circ$  progressed avg  $16^\circ$
    - Thoracic curves progressed most
    - Curves b/w  $45-55^\circ$  progressed  $30^\circ$  if thoracic,  $20^\circ$  if lumbar

- Ascani

- 33 year

- Thoracic curves  $40-49^\circ$  progressed  $15^\circ$  ( $0.4^\circ/\text{year}$ )
    - Lumbar curves worsened  $17^\circ$  over 29 years
  - Other data was poor, and I chose not to consider it here

# AIS: Natural History Health

## ■ Weinstein/Ponseti

- *LARGE* curves may contribute to *pulmonary compromise*
- *Cosmetics*
  - Dissatisfied
- *Depression*: similar to controls

## ■ Ascani

- "real psychosocial disturbances" in 19%



# AIS: Natural History

How do I counsel this patient?

15 yof

42 degree thoracic curve, significant rib prominence

Risser 4, 2 years s/p menarche

No growth >6 months

Chronic Right scapulothoracic pain x 3 years, no improvement with PT

Cosmetic concerns, truncal shift

Pt and family want surgery



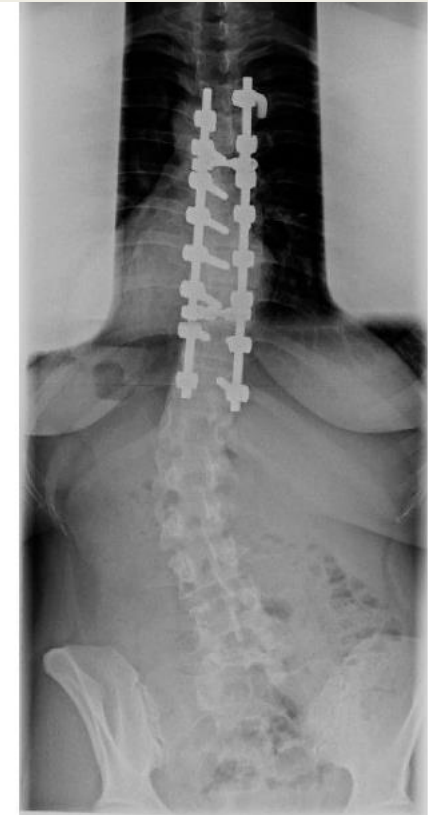
# Treatment: Long Term Outcomes

## How does it compare to natural history?

- Posterior Spinal Fusion
  - Outcome measures
    - Imaging
      - 16-20 year follow up shows good maintenance of **Coronal** correction and residual untreated curve (Takayama, Mueller, Green, Chang)
        - Coronal malalignment does not correlate well with poor outcome measures
      - Even 2 month postop **Sagittal** plane malalignment may lead to early failure/poor outcome measures (SRS-30)
      - MRI (Kelly), no correlation b/w degenerative changes and patient perceived outcome SRS-22, ODI
    - LIV and correlation to bad outcomes
      - L5 (Bridwell), study done in adults
      - Harrington rods to L4 = increased LBP (Bartie)
      - Takayama (Not Harrington rods) found no correlation b/w fusion to L4 and LBP, or radiographic degenerative changes
    - Reoperation
      - 6% (Takayama)
      - 3.9-4.6% (Kuklo)
      - 5.2% (Ahmed)
    - Pain
      - “no pain” (38.5%) or “mild pain” (30.8%) and 72.1% of participants reported a current work/school activity level of 100% normal

# Treatment: Lessons Learned

- Sagittal Malalignment
- L5 as LIV
- L4 + sagittal malalignment
- Balance b/w sparing levels and obtaining durable alignment (sagittal and coronal)



# Natural history of AIS >40 at Risser 4 vs PSF

## AIS

- Pain
  - *You will have pain, but not disabling*
- Deformity
  - *Your deformity will slowly worsen*
- Health
  - *Physiologically*
    - You'll probably be ok
  - *Psychologically*
    - You may have some psychosocial stressors, but your overall psychological health will probably be determined by other factors

## PSF

- Pain
  - *You will have pain, but not disabling*
  - *Adjacent segments will show early degeneration, it might be painful*
- Deformity
  - *Improved alignment, pretty durable*
- Health
  - *Risks of intra- and postoperative complications*

# Natural history of progressive AIS vs PSF

## AIS

- Pain
  - *You will have pain, but not disabling*
- Deformity
  - *Your deformity will slowly worsen*
- Health
  - *Physiologically*
    - You'll probably be ok
  - *Psychologically*
    - You may have some psychosocial stressors, but your overall psychological health will probably be determined by other factors

## PSF

- Pain
  - *You will have pain, but not disabling*
  - *Adjacent segments will show early degeneration, it might be painful*
- Deformity
  - *Improved alignment, pretty durable*
- Health
  - *Risks of intra- and postoperative complications*

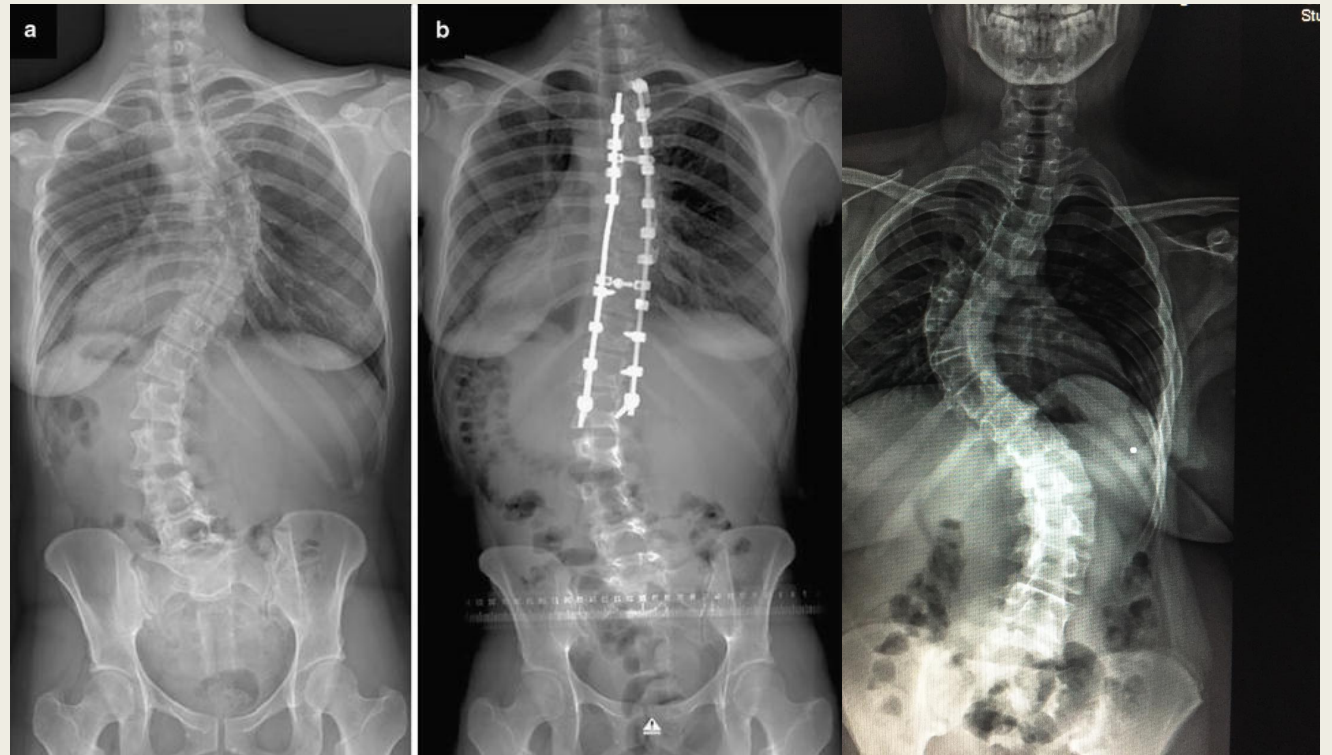
# Goals

- Intervention should lead to a better outcome than natural history
  - *Minimize deformity*
  - *Preserve abilities*
  - *Reduce pain?*
- Intervention should introduce the least morbidity possible
- Maximize non operative treatment efficacy
- Bracing
- Casting



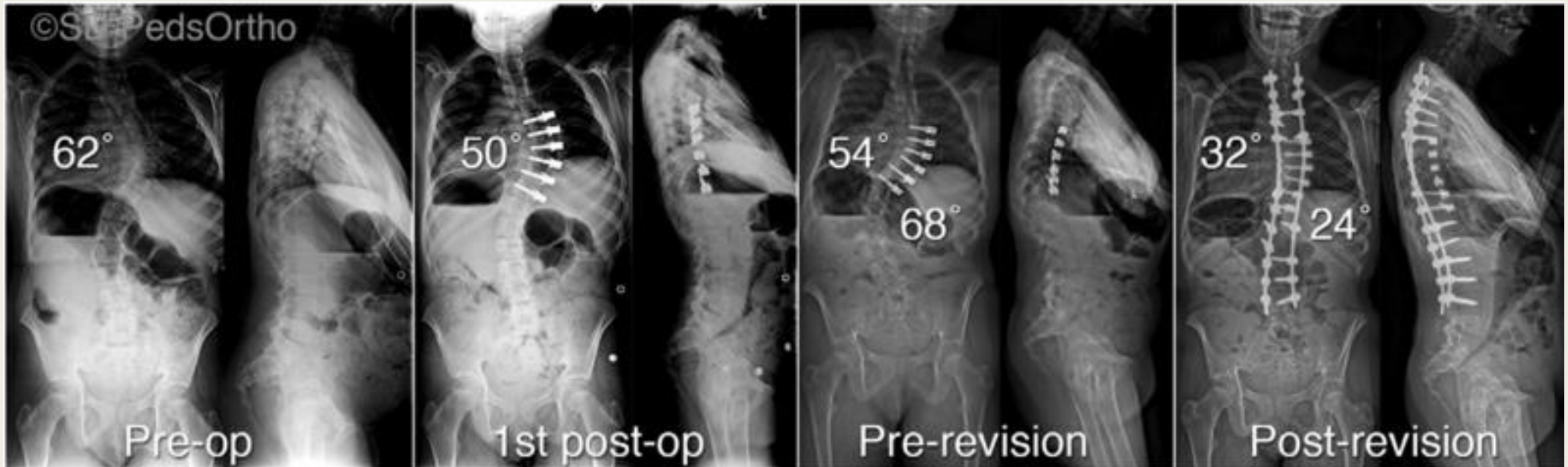
# Goals of treatment: Do No Harm, Reduce Morbidity

- PSF
  - *Adjacent segment degeneration*
  - *Symptomatic ASD?*
  - *Adding-on*
  - *Pseudarthrosis*
  - *Infection*
  - *Metal sensitivity*
- How much morbidity is a result of **fusion**, not just **surgery**?
- How much residual lumbar curve is acceptable?
- Sagittal malalignment is not acceptable



# Goals: Minimize Morbidity

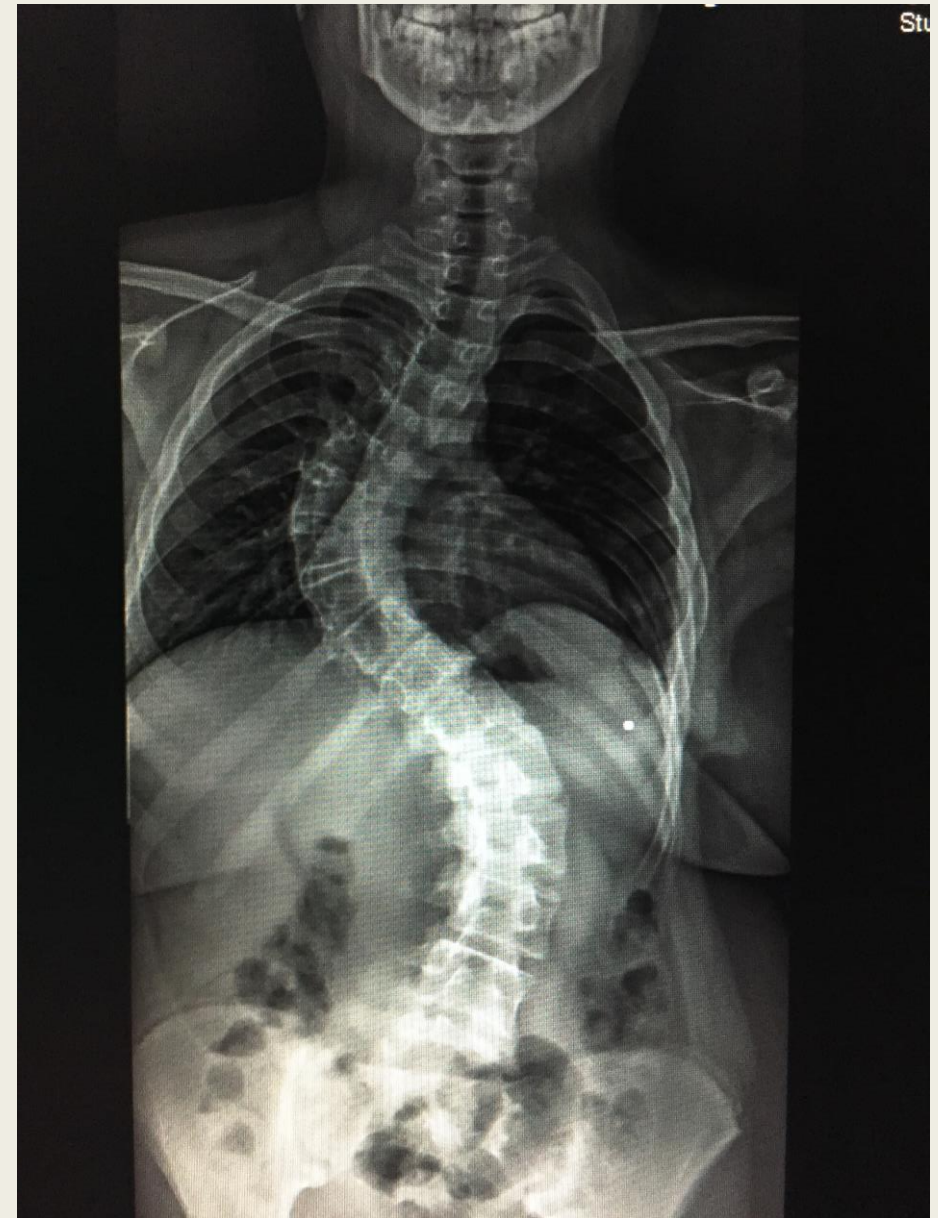
- Brace, cast
- Non fusion surgery
  - *Vertebral body tethering (2 year follow up)*
  - **Samdani** (n=11)
    - 2 returned to OR for loosening of tether (overcorrection)
    - Good curve correction in coronal, sagittal and axial planes
  - **Newton** (n=17)
    - 41% revision rate
    - Complications
      - *Tether breakage*
      - *Overcorrection*
      - *Curve progression*





# Indications

- 13 yof, Risser 3
- CLEAR method
- Schroth
- 85° thoracic, 66° lumbar
- Lumbar curve bends to 30°
- Large rotational component



# Indications and Goals

- PSF
  - *Cobb >50, Risser 1 or greater*
- Indications for thoracoscopic anterior release
  - *None in my practice*
- Indications for growing rods
  - *None in the adolescent age group in my practice*
- Indications for VBT
  - *In development*
  - *AIS*
    - *Risser 0-2, curve 45-65*
- *Cobb >X and pain?*



# Indications



- 12 yof
- Risser 0, open triradiate cartilage, premenarchal
- 64° thoracic curve

**Table 2. Logistic Projection of the Probability of Lenke Type 1 and Type 3 Curves Progressing to Surgery Assuming a > 50° Threshold**

Curve	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6	Stage 7, 8
10°	2% (0% to 40%)	0% (0% to 15%)	0% (0% to 0%)	0% (0% to 0%)	0% (0% to 0%)	0% (0% to 0%)	0% (0% to 1%)
15°	23% (4% to 69%)	11% (1% to 58%)	0% (0% to 2%)	0% (0% to 0%)	0% (0% to 0%)	0% (0% to 0%)	0% (0% to 7%)
20°	84% (40% to 98%)	92% (56% to 99%)	0% (0% to 14%)	0% (0% to 1%)	0% (0% to 1%)	0% (0% to 1%)	0% (0% to 26%)
25°	99% (68% to 100%)	100% (92% to 100%)	29% (3% to 84%)	0% (0% to 5%)	0% (0% to 5%)	0% (0% to 2%)	0% (0% to 64%)
30°	100% (83% to 100%)	100% (98% to 100%)	100% (47% to 100%)	0% (0% to 27%)	0% (0% to 22%)	0% (0% to 11%)	0% (0% to 91%)
35°	100% (91% to 100%)	100% (100% to 100%)	100% (89% to 100%)	0% (0% to 79%)	0% (0% to 65%)	0% (0% to 41%)	0% (0% to 98%)
40°	100% (95% to 100%)	100% (100% to 100%)	100% (98% to 100%)	15% (0% to 99%)	0% (0% to 94%)	0% (0% to 83%)	0% (0% to 100%)
45°	100% (98% to 100%)	100% (100% to 100%)	100% (100% to 100%)	88% (2% to 100%)	1% (0% to 99%)	0% (0% to 98%)	0% (0% to 100%)

# Bottom Line

- If the goal is to be better than natural history, PSF is the best we have, but has too many morbidities for which we don't have sufficient long term follow up
- We need safe, durable, motion sparing solutions
- This may mean expanding our surgical indications in the future, rather than contracting