Idiopathic Scoliosis

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Disclosures

- None relevant to this talk

Learning Objectives

- Recognize different types of spinal deformity in children
- Understand common presentation & physical exam findings in children with spinal deformity
- Understand radiographic assessment of Scoliosis
- Recognize “atypical” presentations
- Understand the concepts behind treatment of childhood spinal deformity
- Understand the importance of early recognition of post-operative complications

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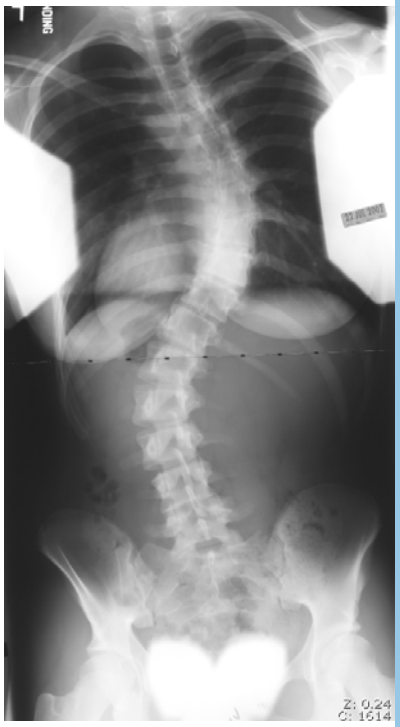
Pediatric Scoliosis

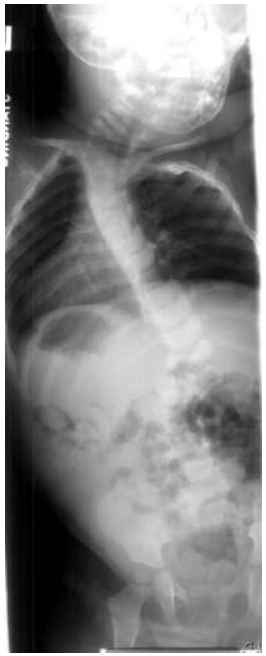
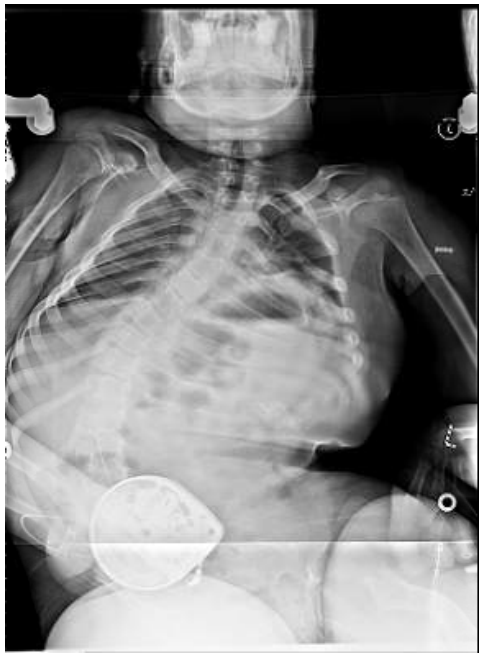
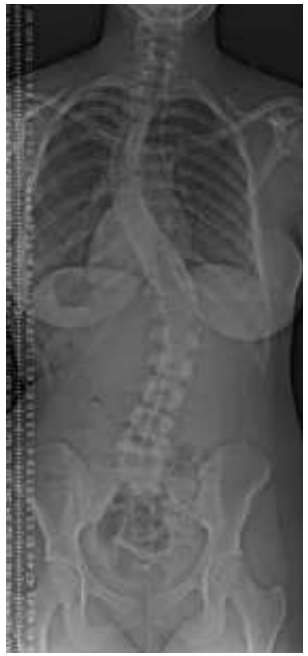
Definition:

- Structural spinal deformity characterized by decompensation of the normal vertebral alignment during rapid skeletal growth
- Deformity is 3 dimensional
  - Coronal, sagittal, as well as abnormal vertebral rotation



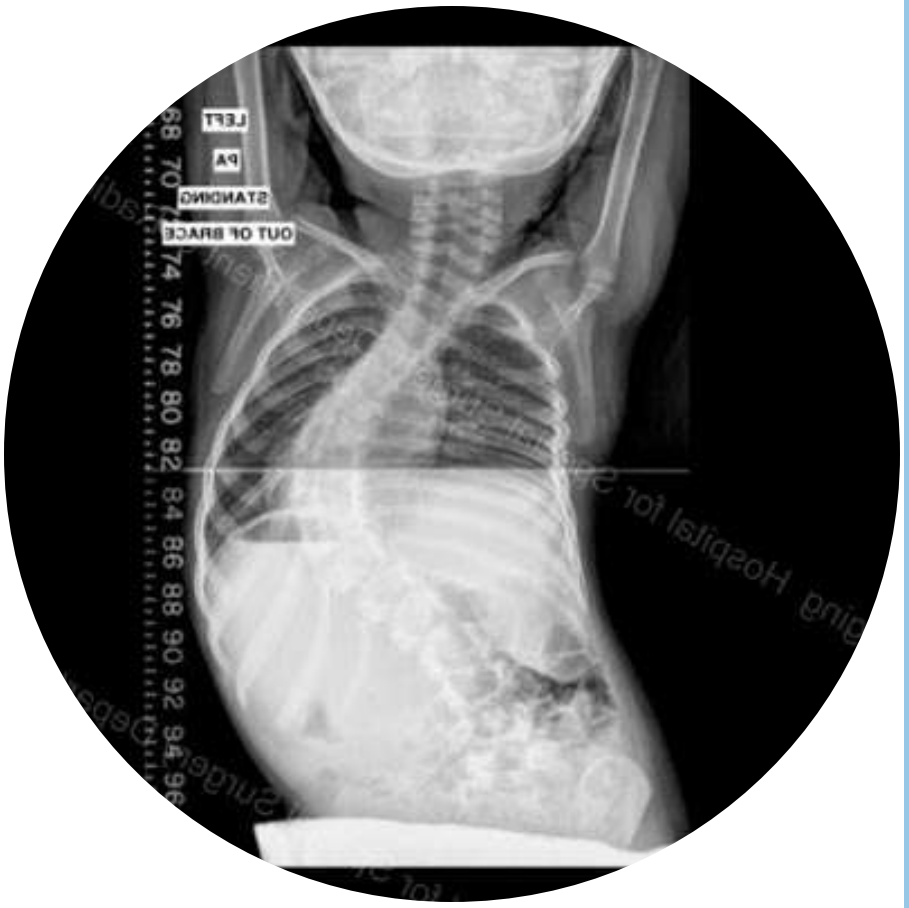
Types of Scoliosis

- **Congenital** - due to a congenital abnormality of the vertebrae or fused ribs
- **Neuromuscular** - caused by problems such as poor muscle control or muscle weakness, or paralysis due to diseases
    - Cerebral Palsy
    - Myelomeningocele
    - Muscular Dystrophy
- **Idiopathic scoliosis** - is scoliosis of unknown cause. Genetic in origin.

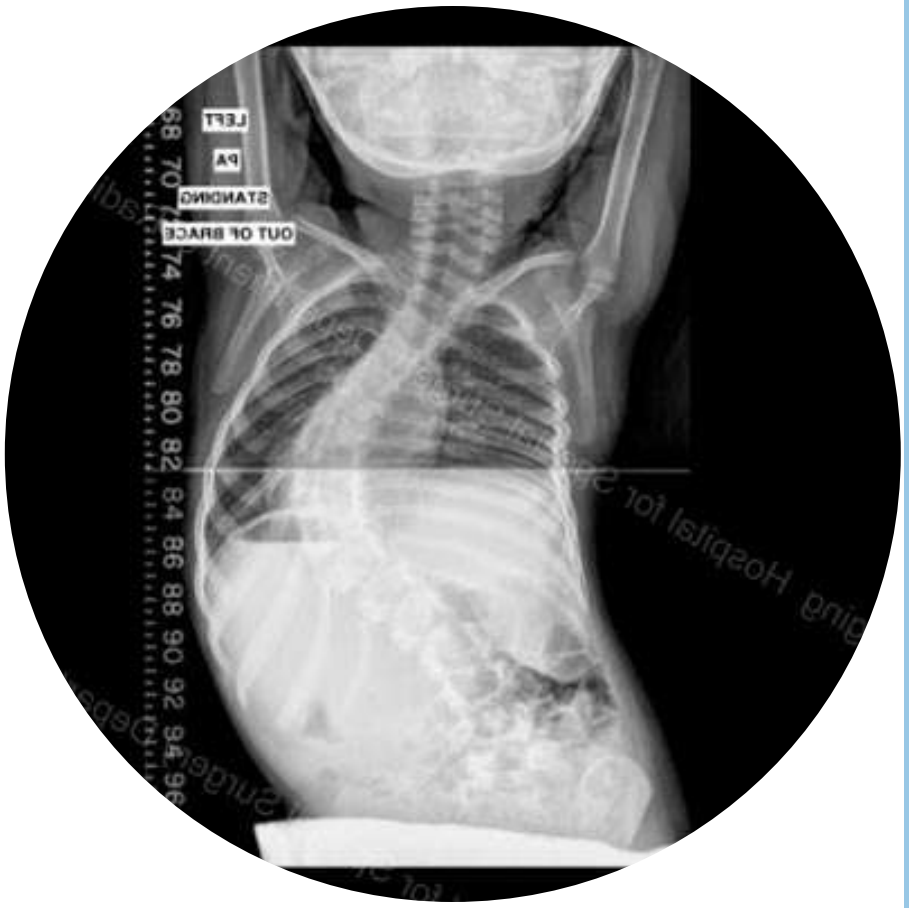
Idiopathic Scoliosis

- By far the most common type >90%
- No definite cause
- Believed to be related to asymmetric growth of vertebral bodies
- Types
  - Early-Onset
    - Infantile Scoliosis
    - Juvenile Scoliosis
  - Late-Onset
    - Adolescent Scoliosis



Infantile Idiopathic Scoliosis

- Develops before 3 years of age
- Often occurs w/ other congenital abnormalities
- 80-90% resolve w/o tx
- 90% w/ left thoracic curve



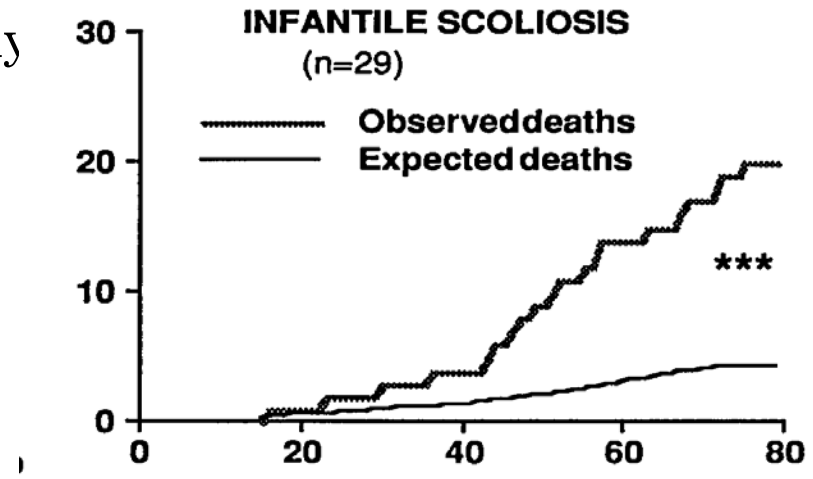
Infantile Idiopathic Scoliosis

- The good news: often resolves!

  Up to 92% of curves reportedly resolve

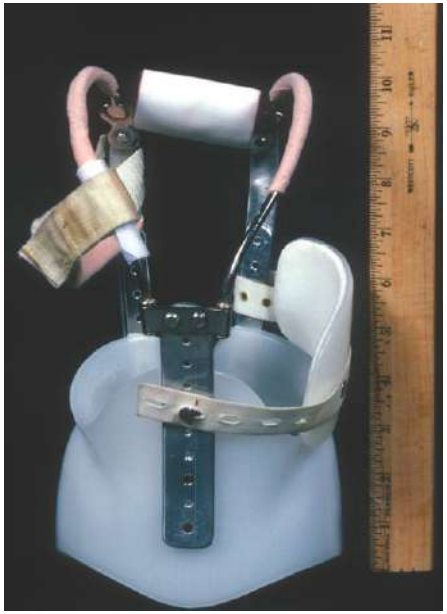
- The bad news: if it doesn't resolve

  it may kill you



Bracing in EOS

- Advantages – removable, lighter, widely accessible
- Disadvantages – removable, rib wall deformity
- Contraindications (relative)
  - children with decreased pulmonary function



Casting

- Used in progressive curves when unable to control with a brace, either due to noncompliance or increasing stiffness

- Can perform serial casting to decrease deformity for bracing

Casting - Brief History

Risser

- Introduced casting in early 1900s for AIS
- Principles elongation and derotation

Morel and Cotrel (1964)

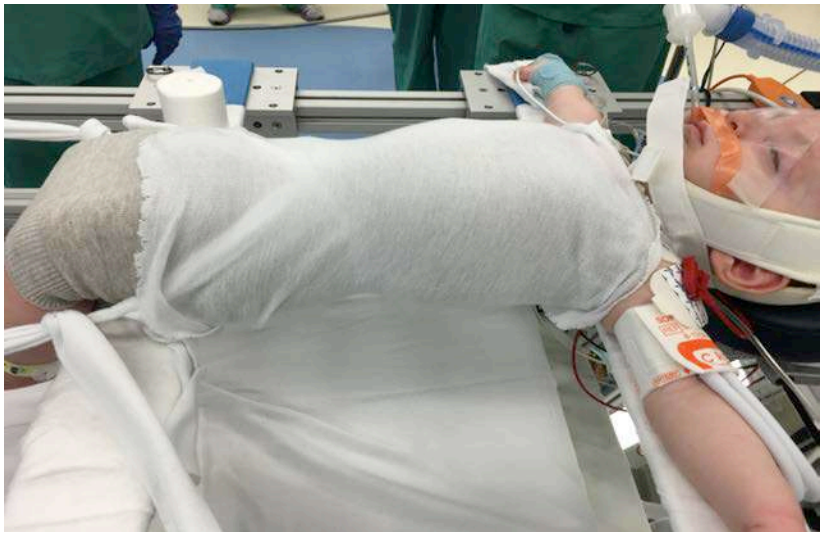
Built on Risser's principles but added

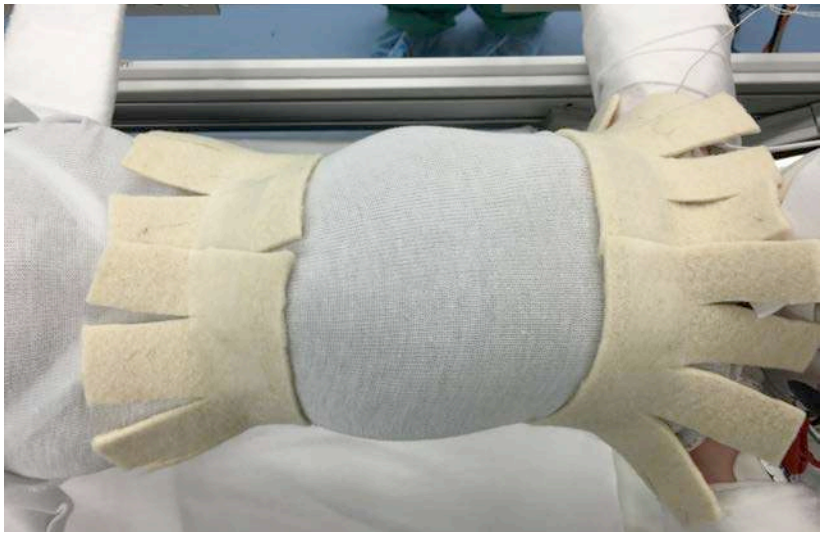
Mehta (1975-2000)

Modified technique of Morel and Cotrel

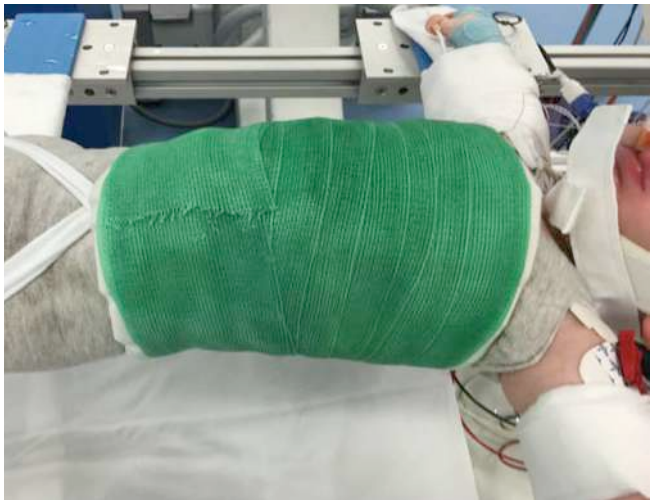
- Emphasized early intervention
- Demonstrated ability to cure EOS especially

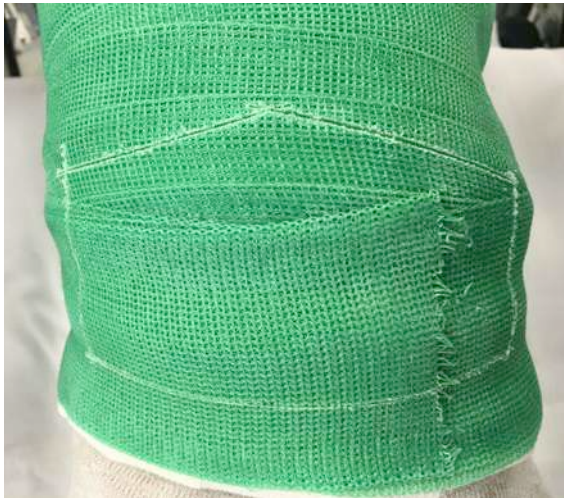
Casting Technique





Casting Technique





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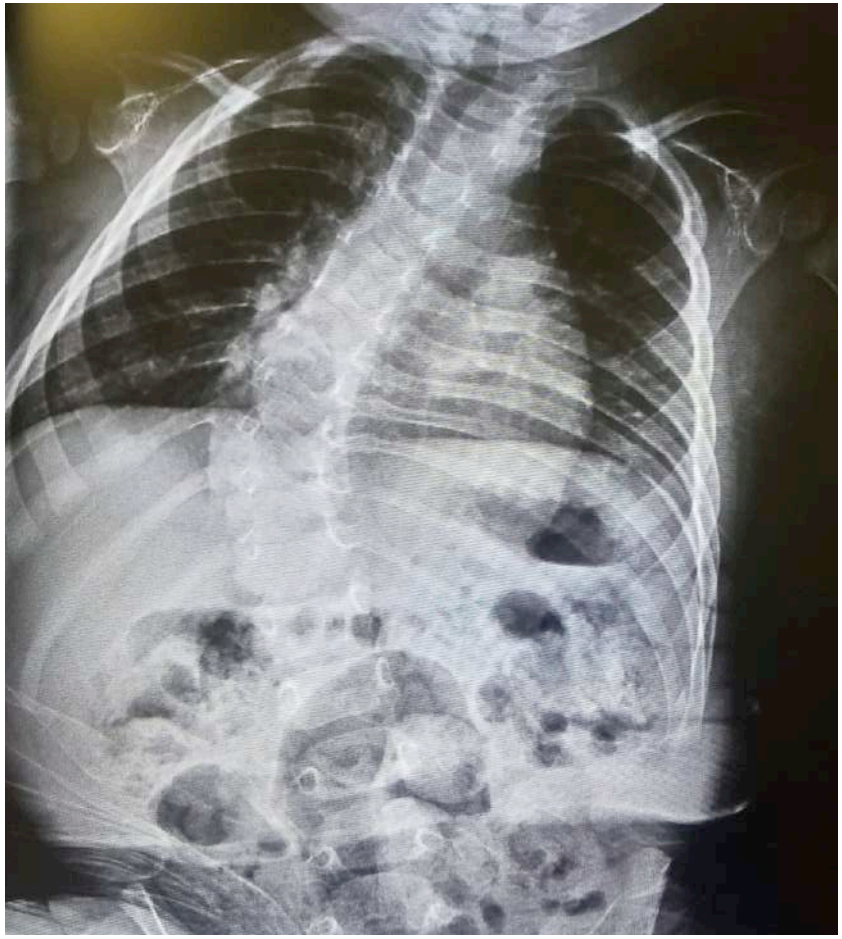
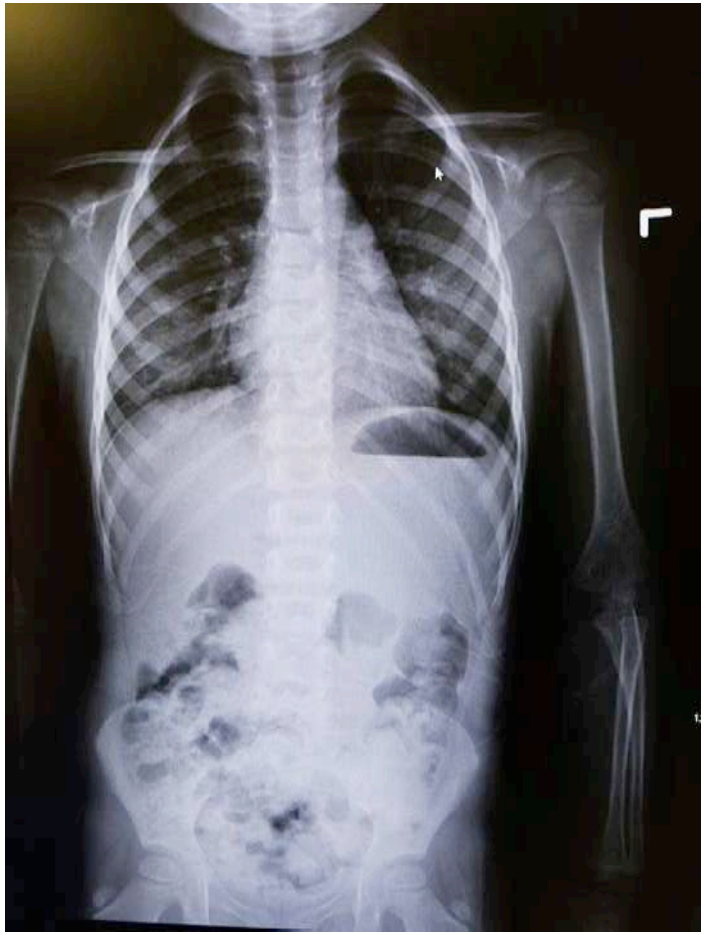
Casting as definitive treatment

Age 12 months





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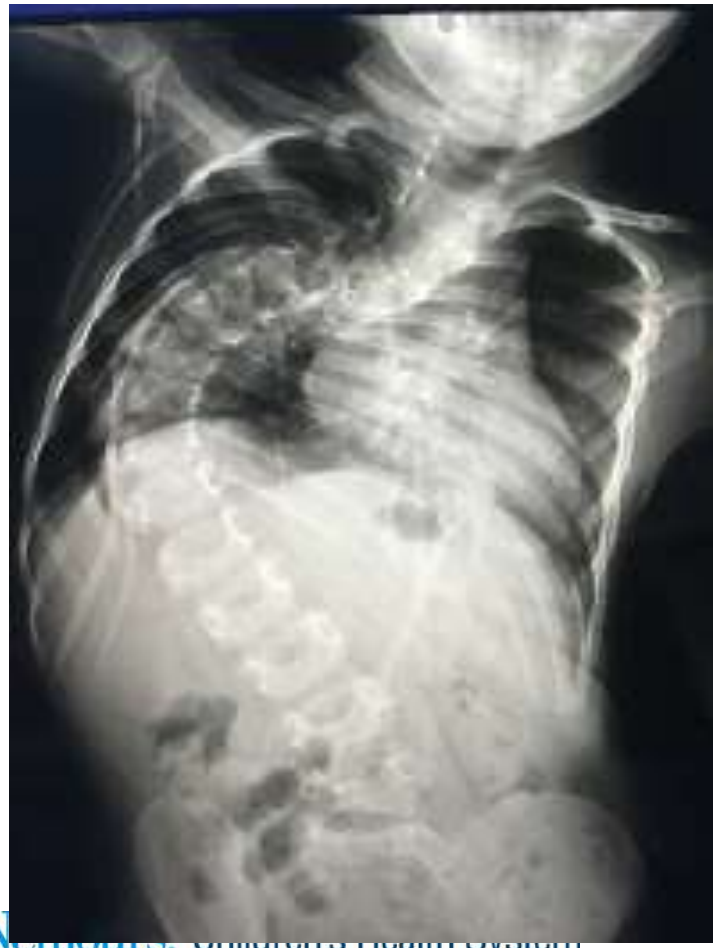
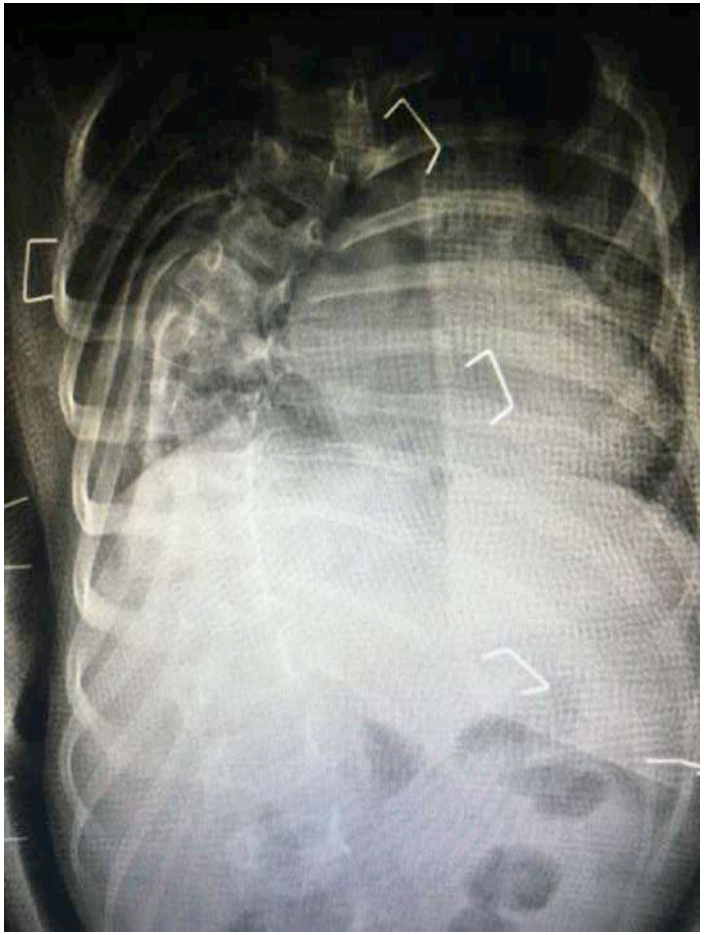
Cast to buy time

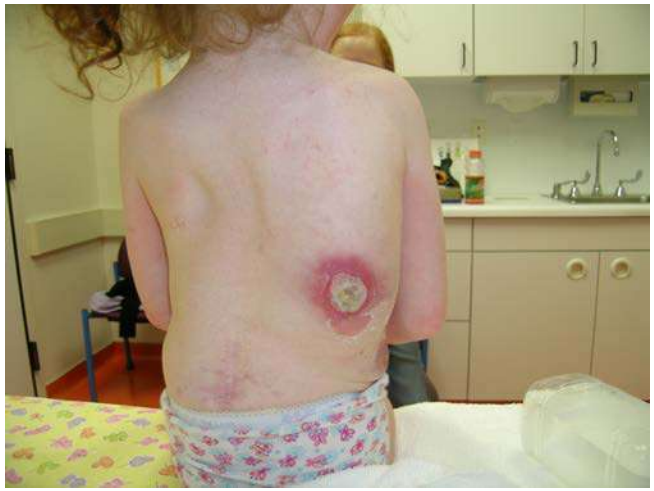


10 months later



Complications of Casting

- Chest wall deformity
- Eating intolerance
- Decreased pulmonary function (temporary)
- Cast sores
- Brachial plexus injury
- Cranial nerve palsy
- Subclavian thrombosis



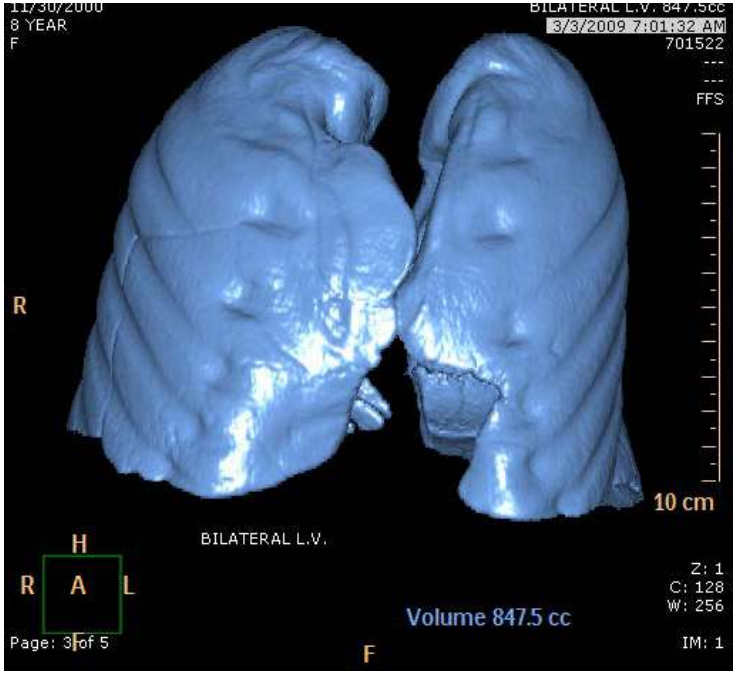
What about when casting fails? Traction

- Indicated in stiff curves with inability to brace or cast due to larger curves or proximal thoracic curves

- Goal is to increase traction as tolerated until:
  - Tiptoes if standing
  - Barely on buttocks if in wheelchair

Benefits of traction

- Coronal deformity (35%) *
- Trunk shift (65%)*
- Sagittal plane (30%)*
- Pulmonary function?
- Mobilization
- Increased surgical correction
- Decreased neurologic complications intraoperatively



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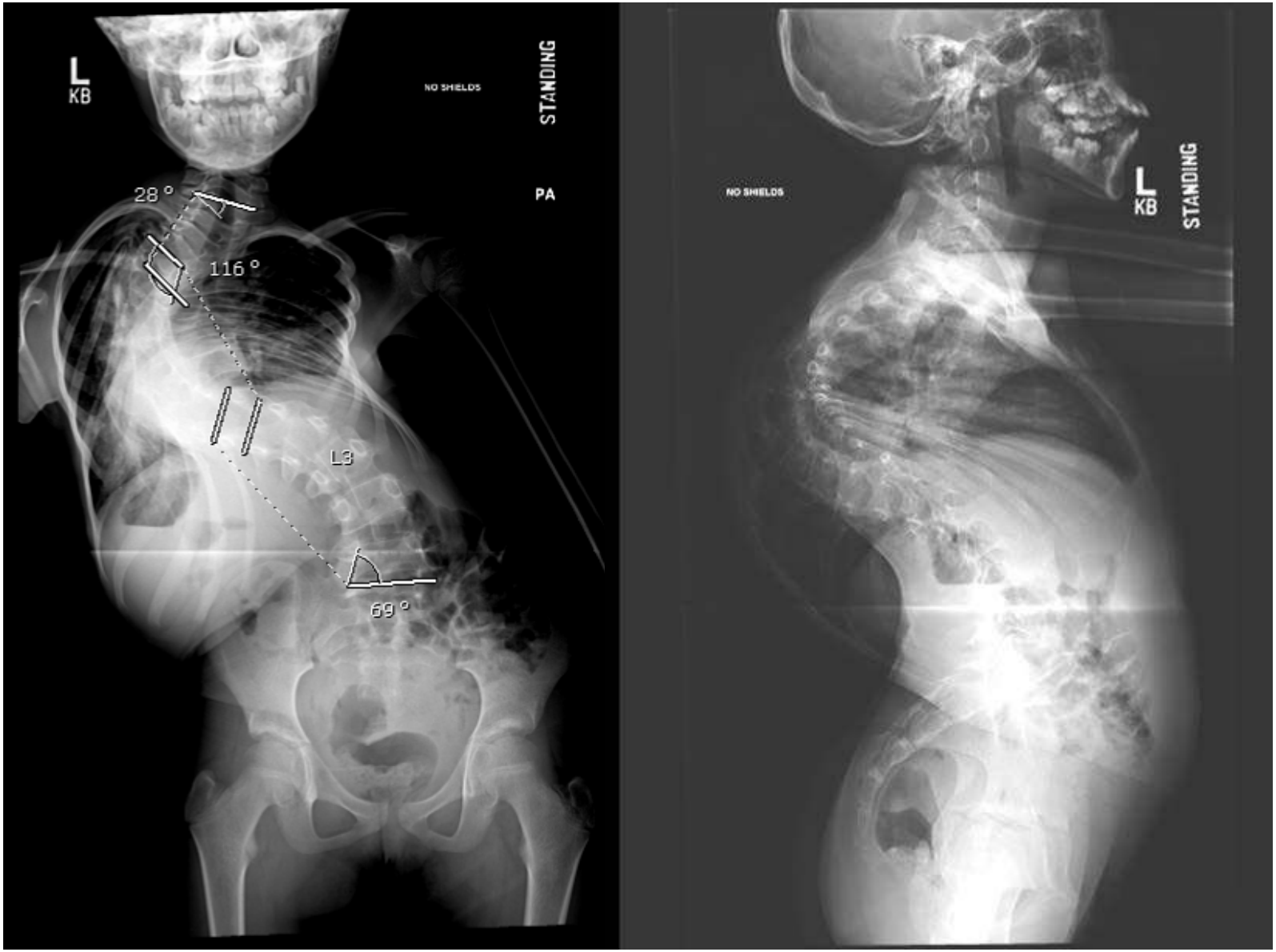

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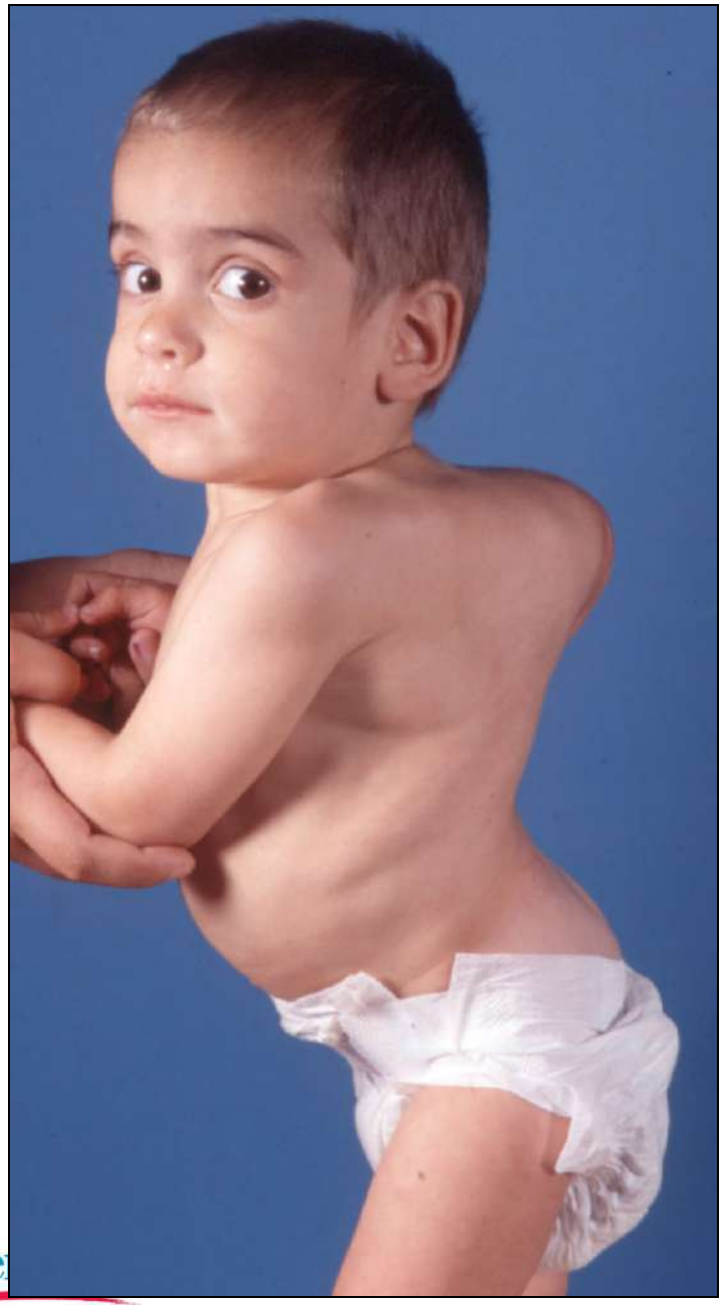

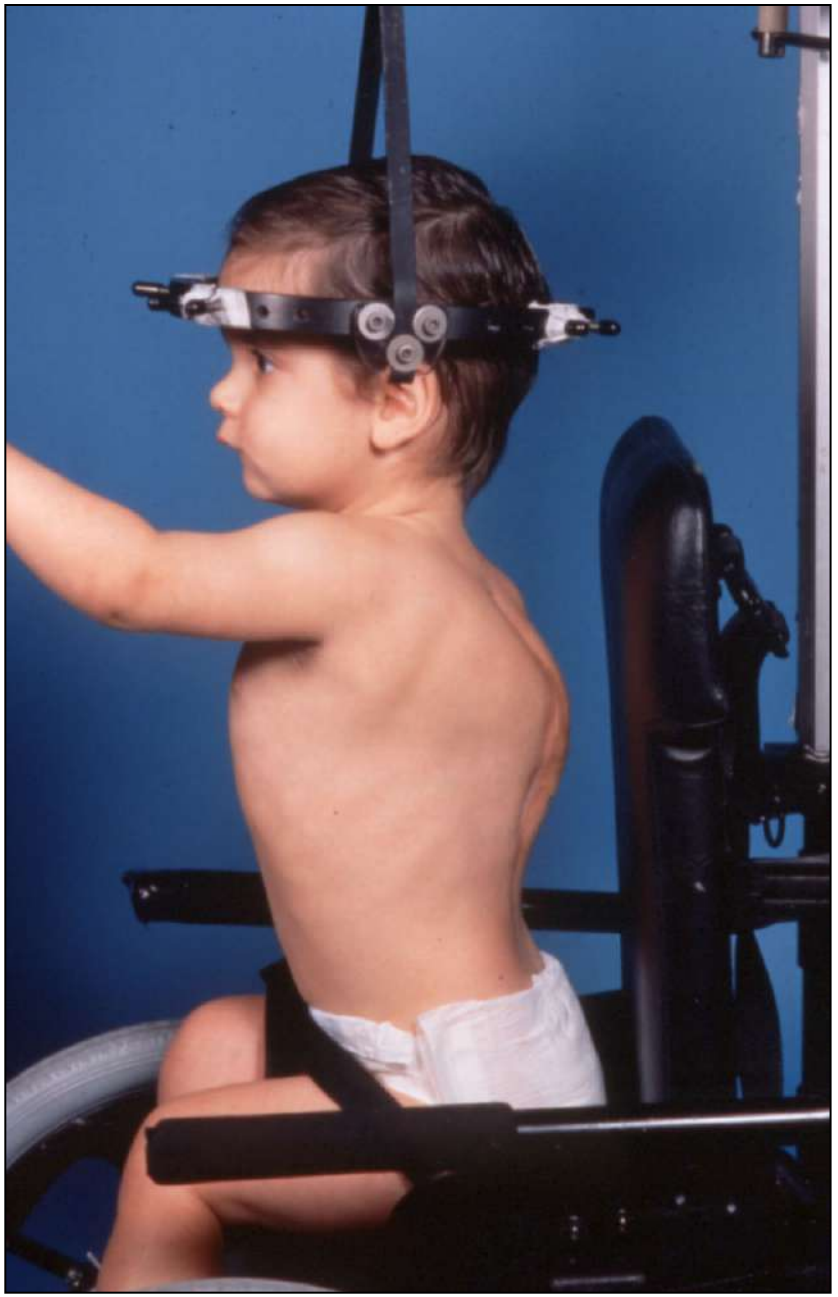

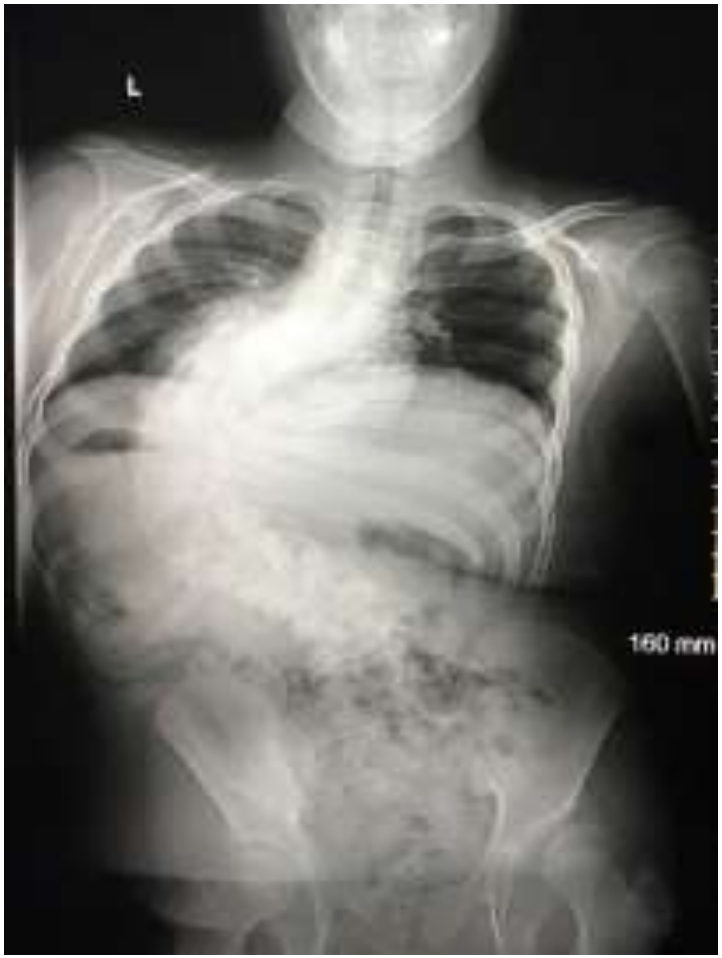
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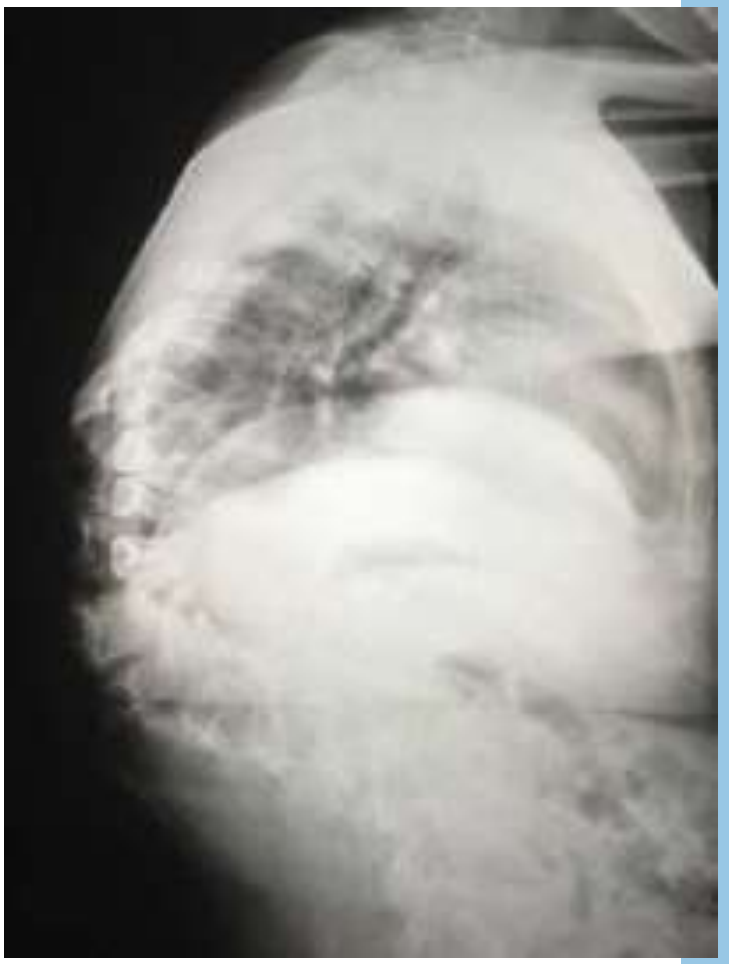

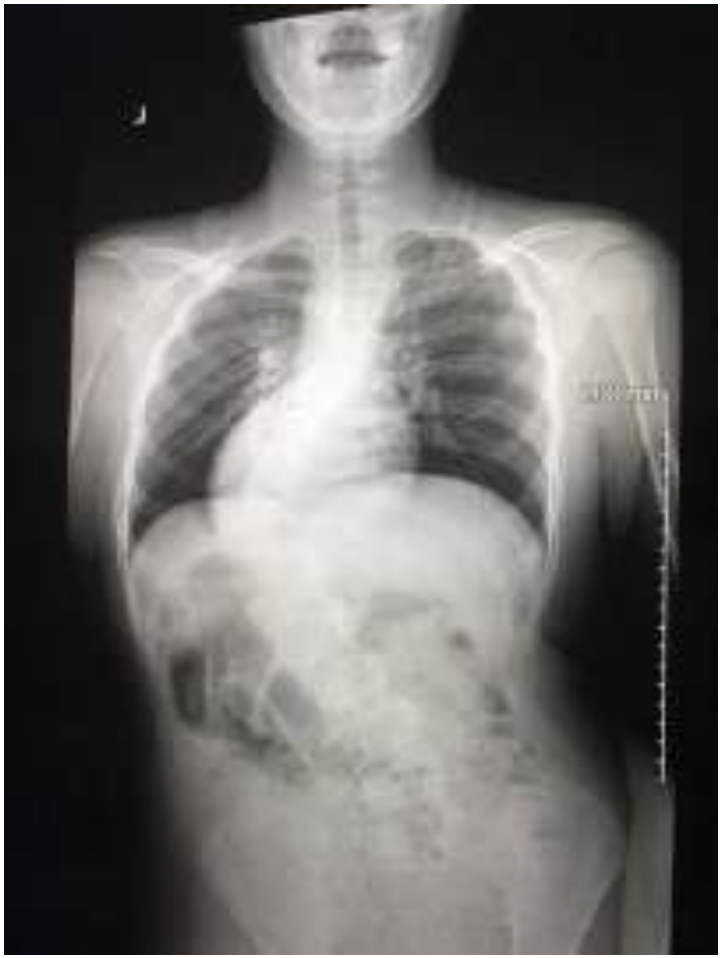

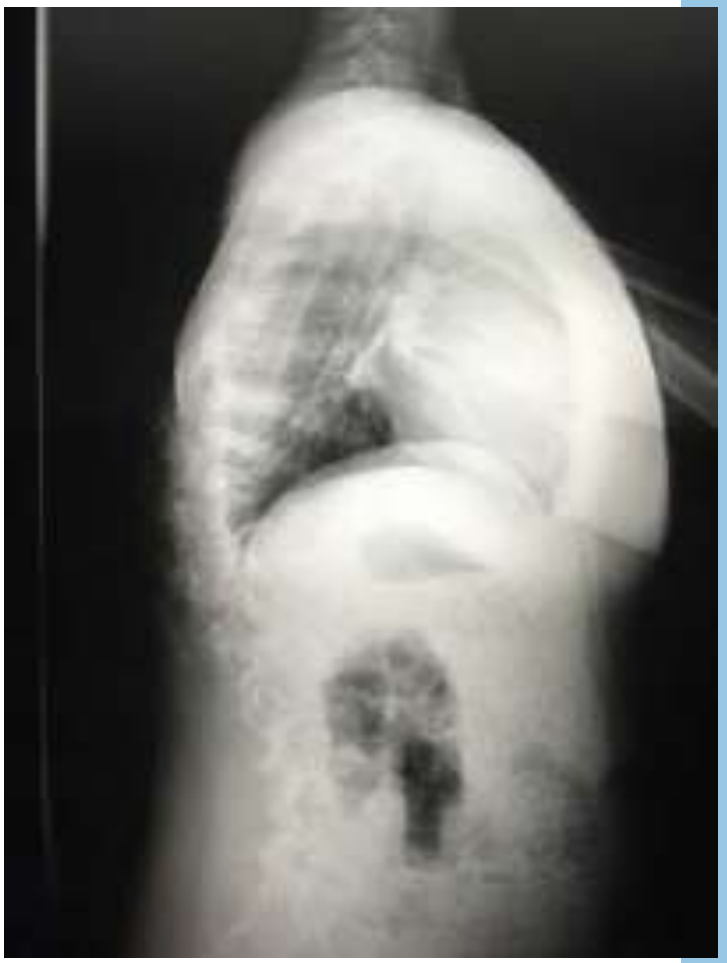

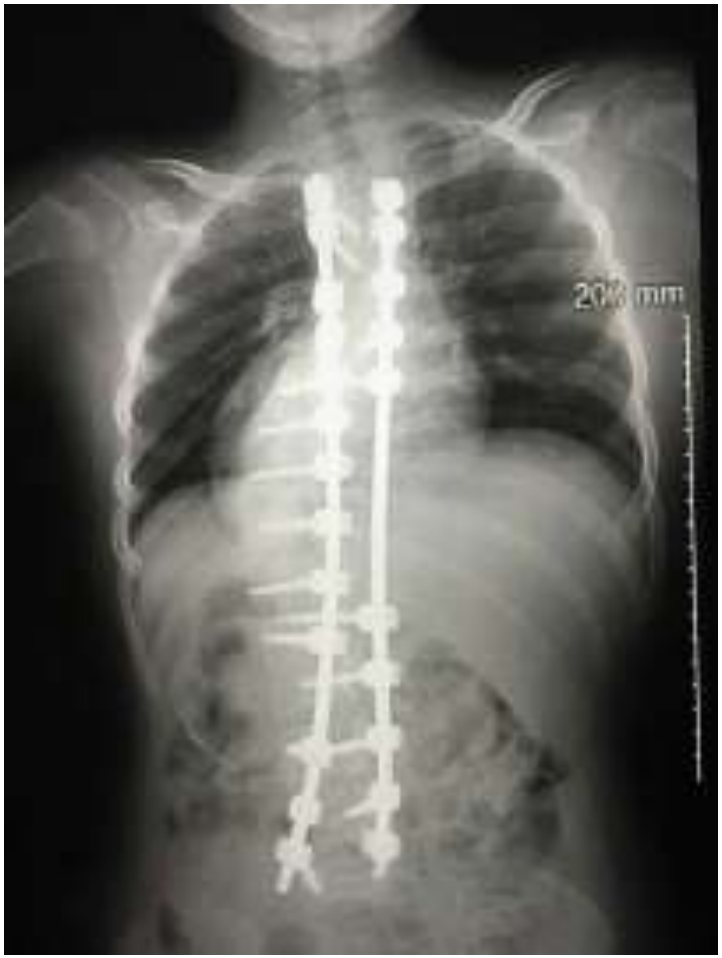

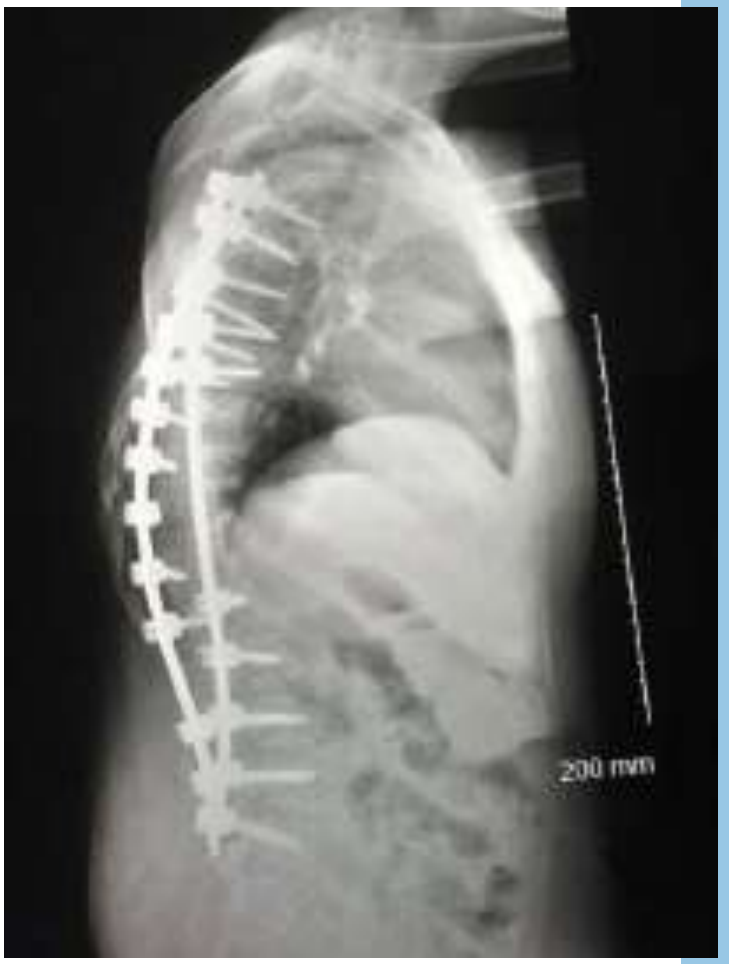

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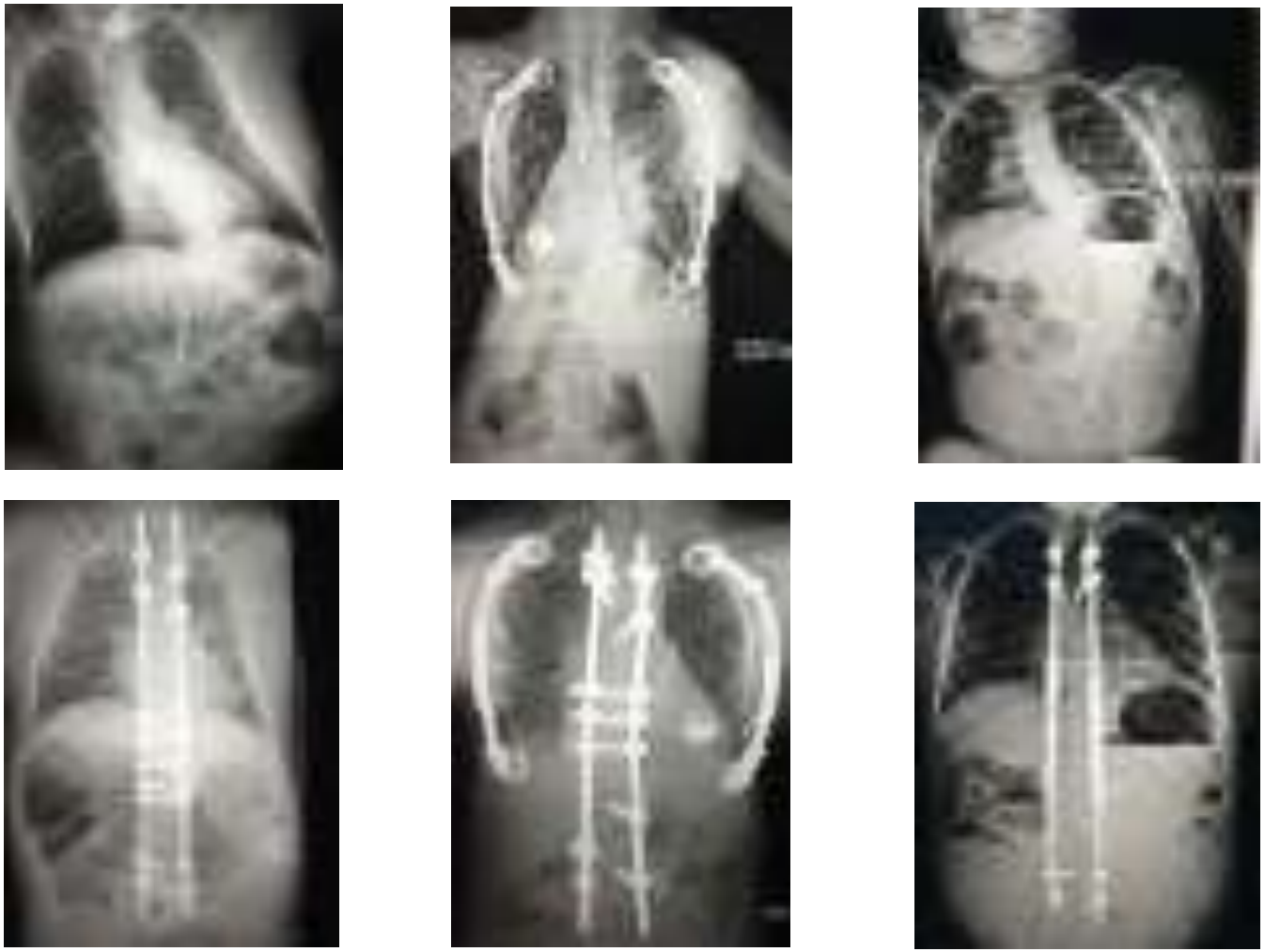
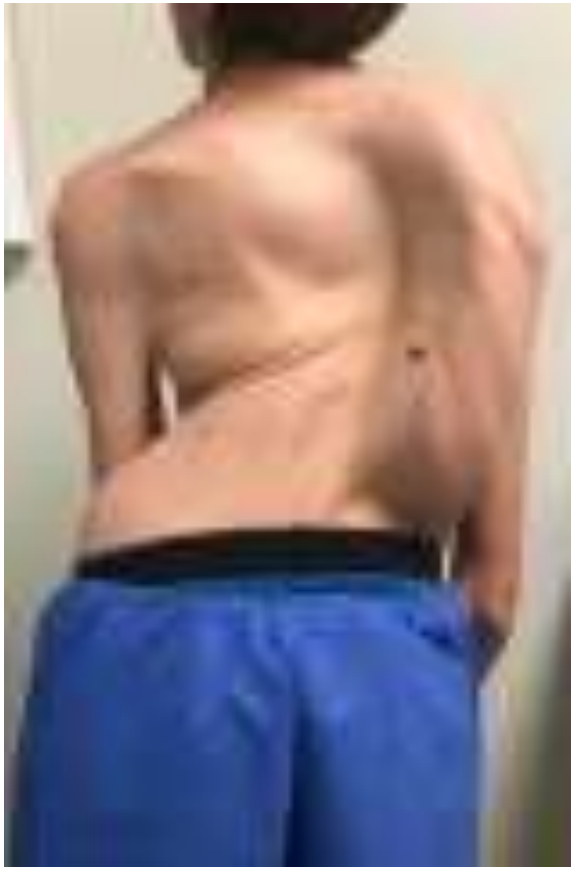
Multiple Surgical Options



- Stay tuned – we are still figuring this out

Juvenile Idiopathic Scoliosis

- 3-10 years of age
- Curves are often progressive
  - Potential for
    - severe truncal deformity
    - cardiopulmonary complications
    - Significant impact on lung maturation
  - 90% will need surgery due to magnitude of deformity and progression potential



Adolescent Idiopathic Scoliosis

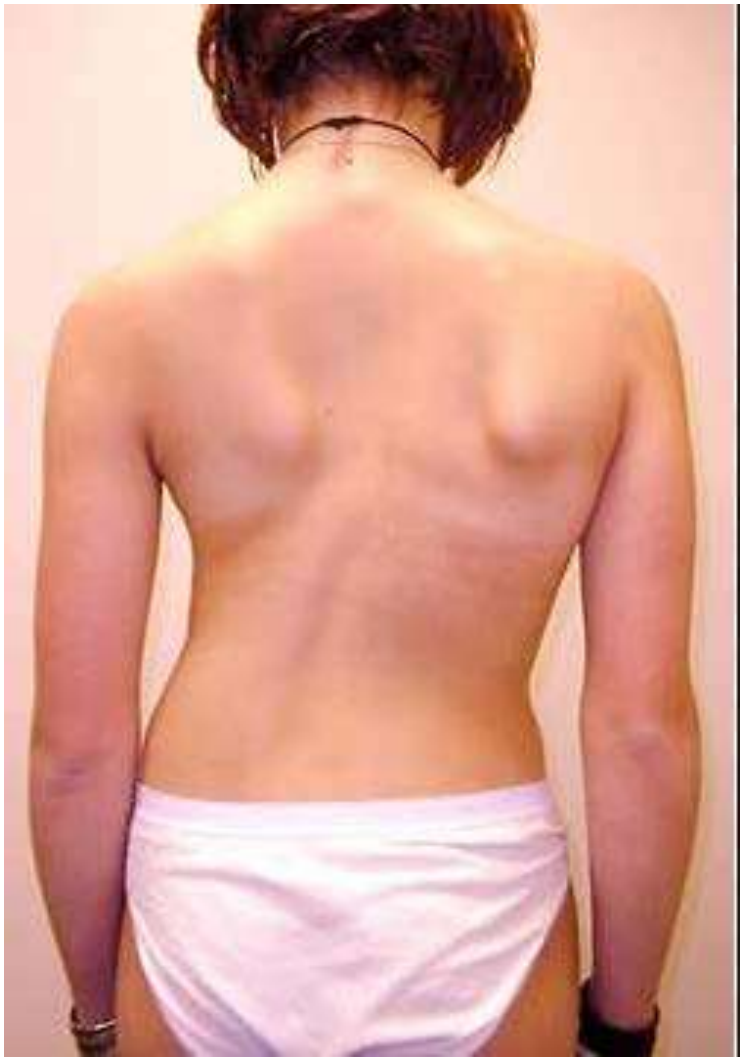
- 11-18 years of age
- Approximately 90% of childhood spinal deformity
  - Prevalence 1-3%
  - Female-male ratio
    - 6:1 non-operative
    - 7:1 operative
- > 90% w/ right thoracic curve
- Majority asymptomatic
  - Back pain is common
- Patient/Family perception of body asymmetry

Risk Factors

- Family History
  - 30% incidence in daughters of women with AIS
  - 73-92% monozygotic twin condordance;36-63% dizygotic
- Peak adolescent growth spurt

Physical Examination

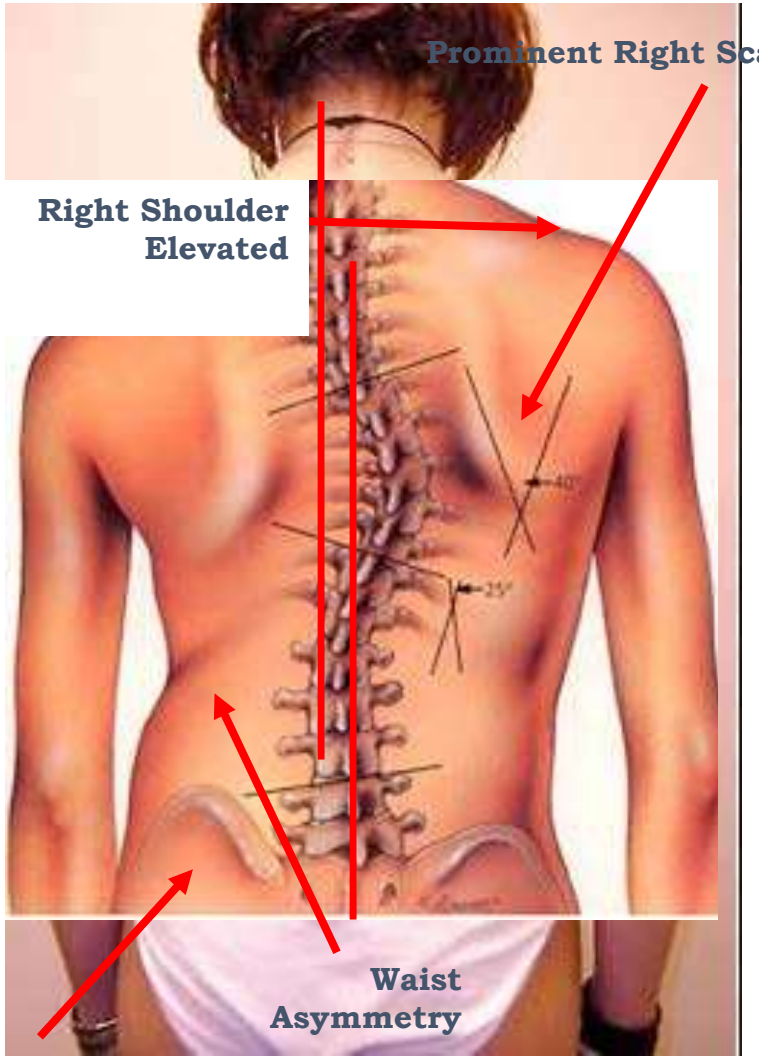
- Skin
  - Look for birthmarks, dimpling, hairy patches
- Strength
- Gait
  - Heel/Toe Walk
    - Can be used to elicit subtle motor weakness
- Neurologic Exam
  - Strength, sensation, deep tendon reflexes
    - Upper Extremities
    - Lower Extremities
    - Abdominal reflexes
    - Gag reflex
    - Supine straight leg raise
- Sensation



Physical Examination

Back Evaluation

- Anterior, posterior, lateral view
- Truncal asymmetry
  - Thorax, ribs, breasts
- Shoulder height
- Waist asymmetry
- Leg-length inequality

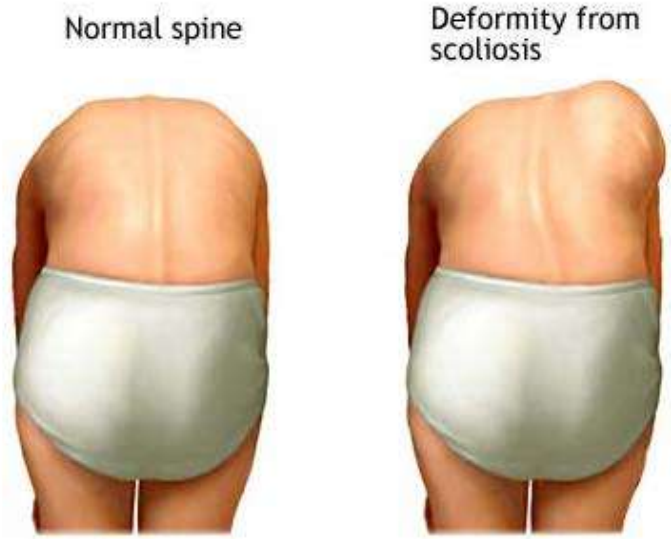


Physical Examination

Adam's Forward Bend Test

- Forward bend at waist
- Identify paraspinal prominences
- Result of abnormal vertebral rotation and coronal

- **Scoliometer**
  - Used to quantify paraspinal prominences
  - Positive result is > 7 degrees



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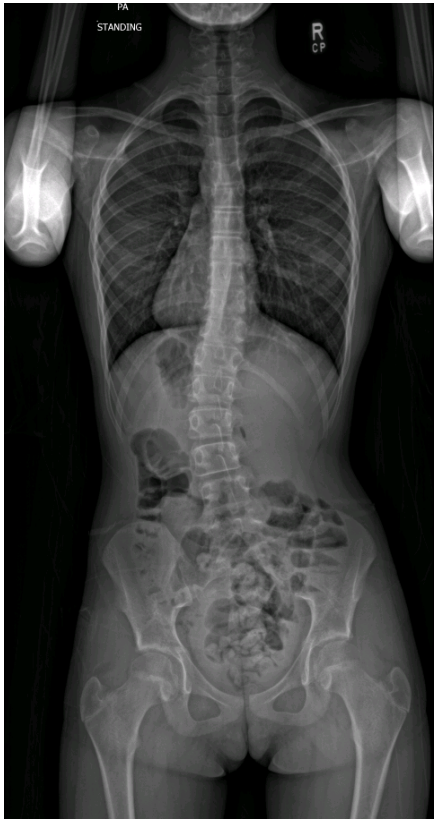
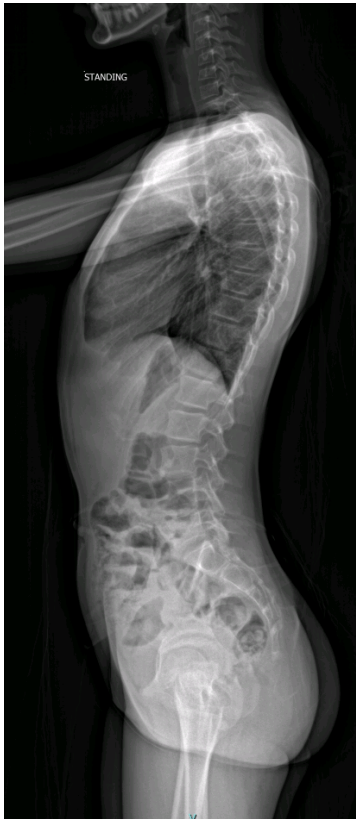
Radiographs

- PA and Lat of the entire spine
- EOS





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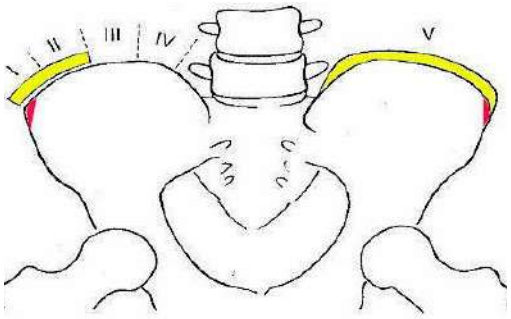
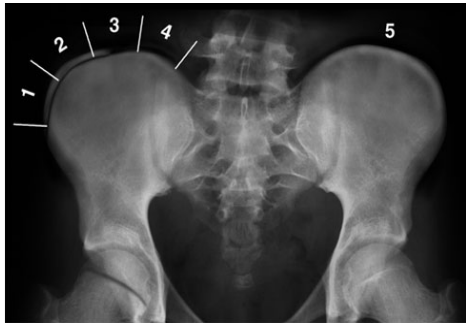
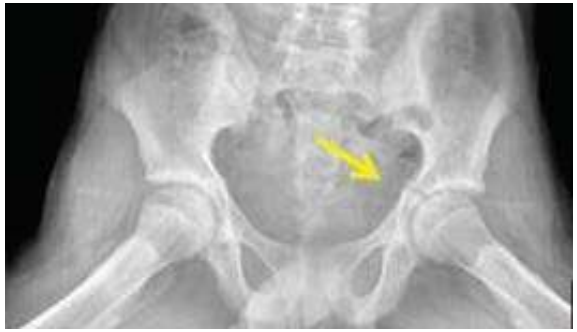
Radiographs

- Risser Sign:
  - Iliac apophysis develops from lateral to medial on AP view of pelvis
  - Risk of progression in Risser 1 or less as high as 70%
  - Risser of 3 has risk of progression ~ 10%
- Triradiate Cartilage
  - Closure coincides w/ the end of peak adolescent growth spurt

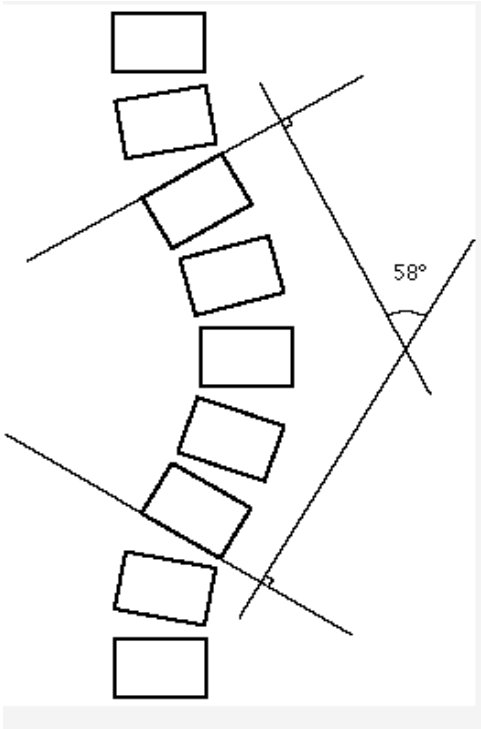






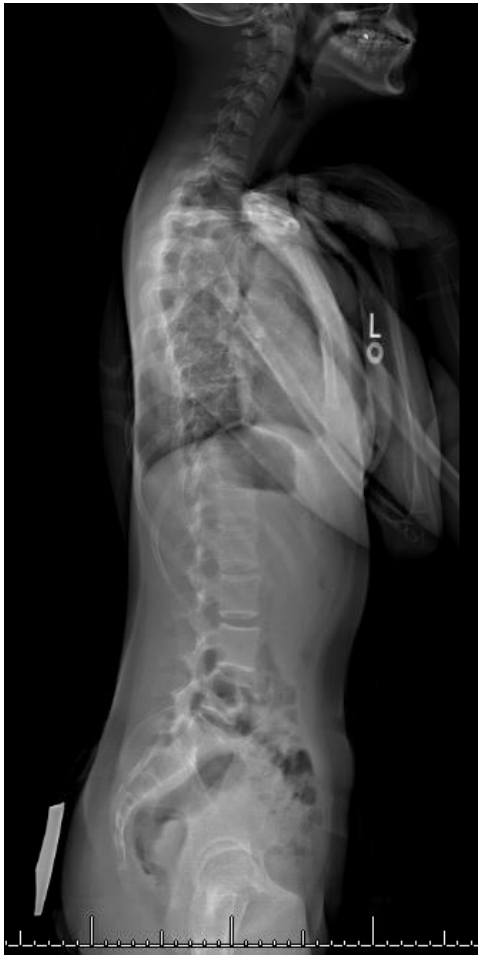
Radiographic Examination

- **Cobb Angle:**
  - Should be measured for all curvatures present
  - > 10 degrees establishes a diagnosis of scoliosis



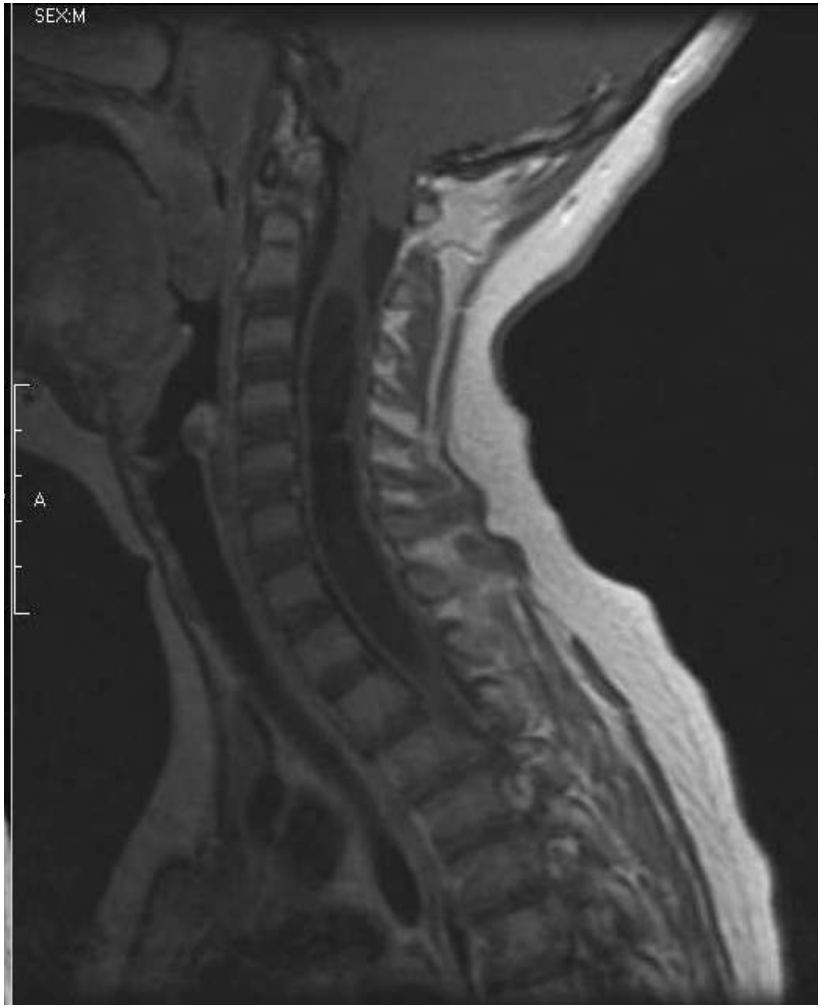
Radiographic Examination

- **Kyphosis:**
  - Assessment of sagittal thoracic contour
  - Patients w/ AIS are usually hypo-kyphotic, but convex rib prominence may give appearance of increased kyphosis



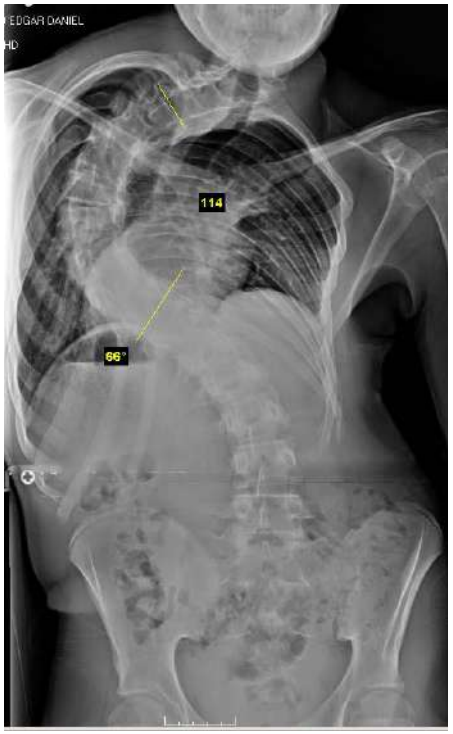
Radiographic Examination

- **MRI:**
  - Used to evaluate patients with “atypical” presentation
  - Should include brain (posterior fossa) and entire spine (C,T,LS)
  - Include Gadolinium contrast
  - Neural axis lesions
    - Syringomyelia
    - Chiari malformation
    - Tethered cord
    - Tumors



Atypical Presentation

- Signs/symptoms that may suggest non-idiopathic deformity
  - Rapid progression
  - Large curve at dx
  - Left sided T curve
  - Pain that limits activity
  - ANY neurologic symptom/finding
  - Early onset



Natural History?

- Progression with growth
- Risk of curve progression is related to patient's maturity (Risser sign, menarchal status) and to the size of the curve
- Larger curves with more growth more likely to progress

Lonstein (1984) ***Progression >5º in curves:***

	Less than 20º	*20º-29º*
Risser 0 or 1	***22%***	***68%***
Risser 2-4	***2%***	***23%***

Risk of Scoliosis Progression			
Degree of Curve (Cobb Angle)	Age 10-12	Age 13-15	Age over 16
<20°	25%	10%	0%
20°-30°	60%	40%	10%
30° -60°	90%	70%	30%
>60°	100%	90%	70%

The above data has been obtained from the Scoliosis Research Society.

Treatment

- Based on initial deformity and risk of curve progression
  - Overall assessment of growth potential
- Goal is to prevent progression until skeletal maturity
  - Risk of curve progression decreases

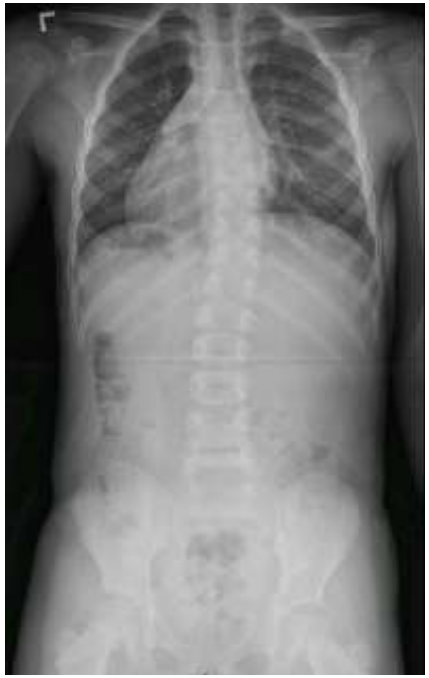
Degree of Curve	**Treatment**
10º to 25º	Close observation – PA spine Q4-5months
25º to 45º	TLSO bracing
>45º-50º	Posterior Spinal Fusion

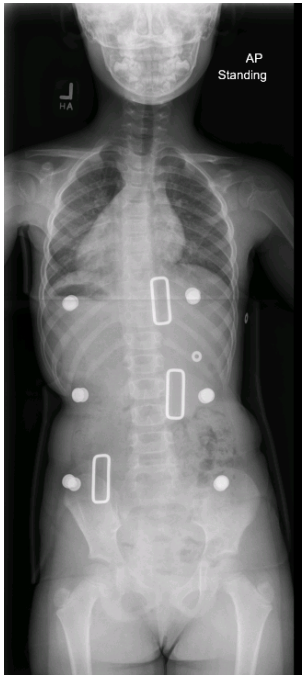
Therapy

- **Observational Monitoring**
  - Follow-up standing PA and lateral scoliosis x-rays at 4-12 month intervals depending on growth potential
- **Core strengthening & conditioning exercises**
  - Recommended for all patients, especially those with pain
    - Physical Therapy techniques
    - Yoga/Pilates

Bracing

- Braist study (NEJM 2013 Weinstein et al.)
  - Study stopped short because of success
  - Brace wear positively associated with decreasing rate of progression to surgical grade curve
  - More brace wear associated with greater success with greatest success seen in those wearing the brace >12.9 hours daily
- Cobb angle between 25 & 45 degrees who are at increased risk of progression
  - Premenarchal
  - Risser < 2





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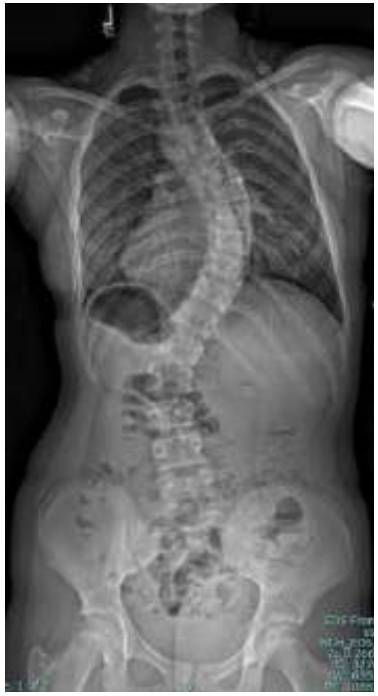
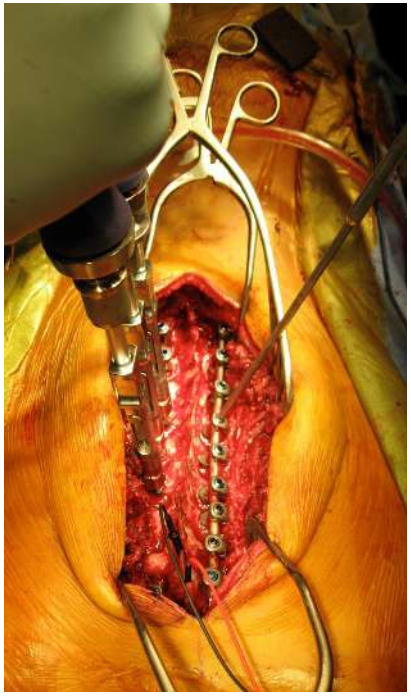
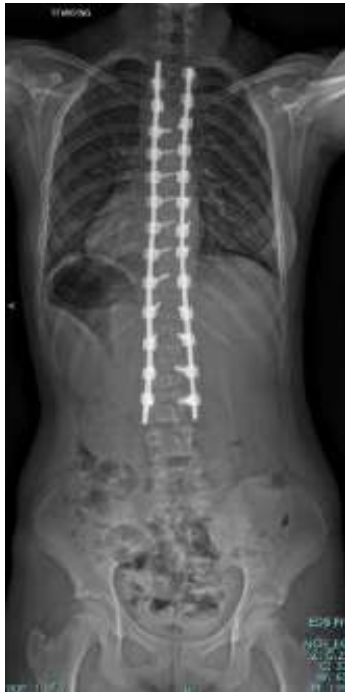
Surgical Treatment

- Cobb angle > 45 degrees w/ risk of progression
- Spinal arthrodesis w/ instrumentation

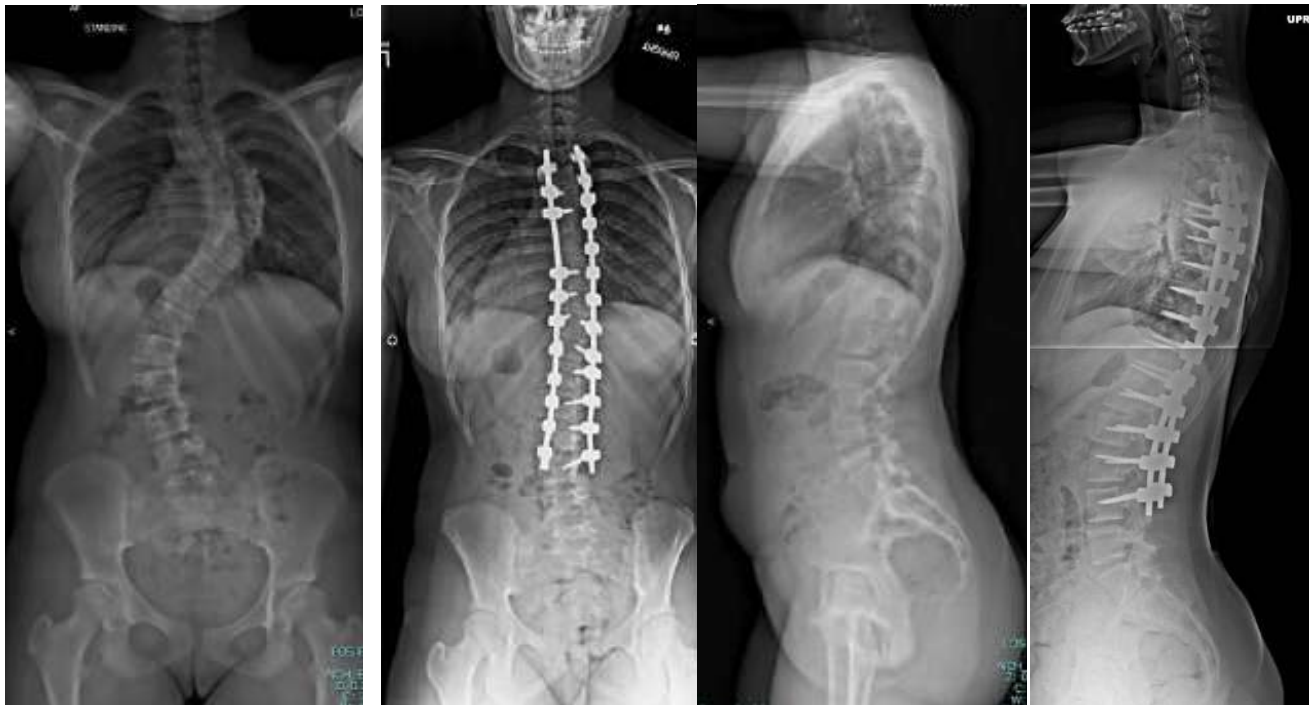






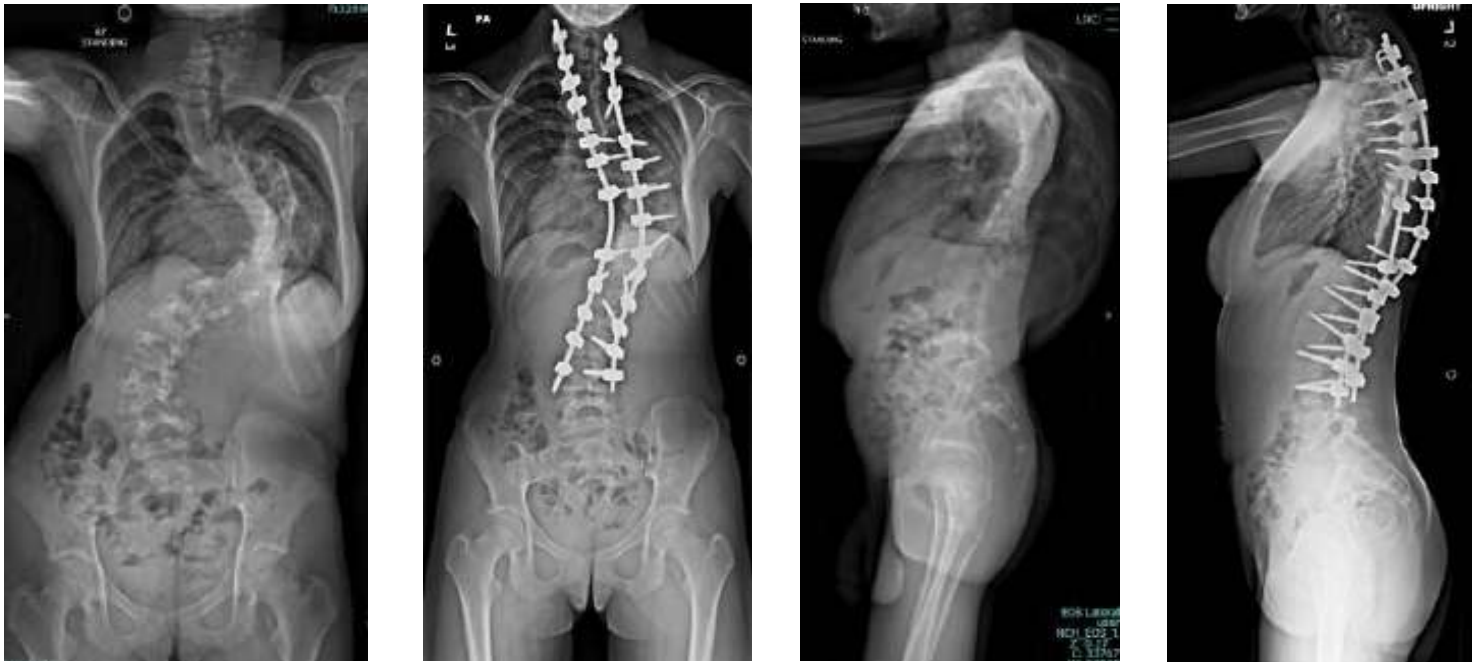
Goals of Surgical Treatment

- Stop curve progression
- Achieve maximal deformity correction
- Improve appearance w/ trunk balance
- Reduce short- and long-term complications



Surgical Treatment Technique

- Choice of surgical approach and technique is dependent on deformity, flexibility, and surgeon preference
  - Most treated by posterior approach
  - Some by anterior approach
  - Occasionally combined approach



Post-operative Care

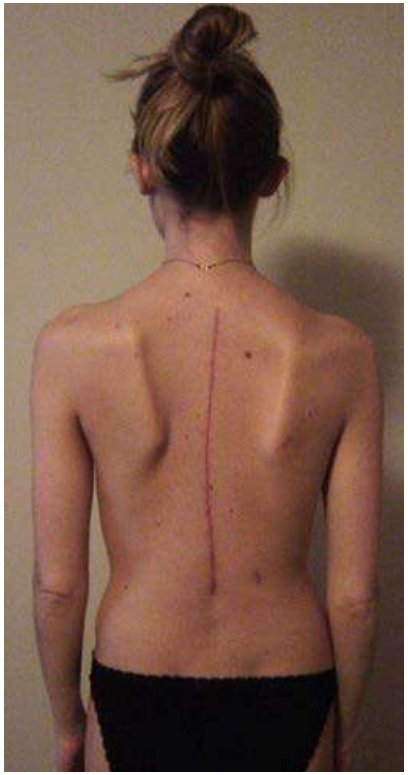
- Typical hospital stay of 3 days
- No post-operative brace
- Return to school in 3-6 weeks
- Activity restrictions for at least 6 months

Nemours. Children's Health System

Complication Risks with Surgical Treatment

	National	NCH
• Blood loss (transfusion rate)	~ 50%	0 since 2014
• Infection	.9-3-%	<.01%
• Neurologic injury	1-2 per 1000	NR*
• SMA Syndrome	1-4%	NR*

*NR- non-reported



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Take Home Points

- Who
  - Spinal deformity in children is relatively common
  - Can develop at any age
  - Predominately effects girls

- Diagnosis
  - Clinical exam
  - Full length PA and Lat scoliosis films
  - Recognize “atypical” presentations
  - In all age groups larger curves are associated with greater risk of progression
  - Significant effects on thoracic and pulmonary growth and ultimately mortality in patients <8yrs old especially in IIS

- Treatment
  - Varies based on age and severity of curve

Thank You

From the Nemours Children's Hospital Orthopaedic Team