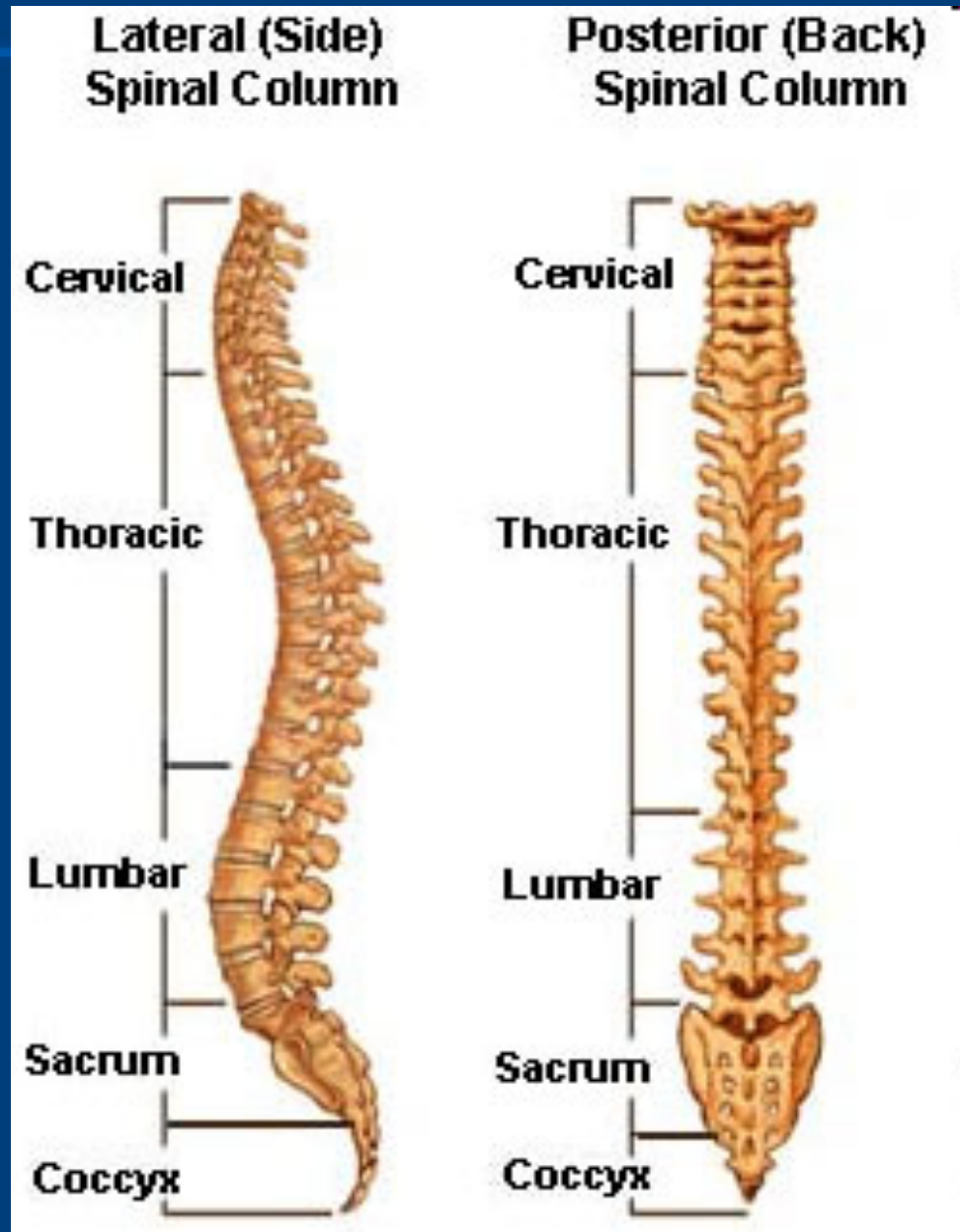


The Pediatric Spine

Mohamad Samih Yasin, FRCS

Scoliosis

Normal Spinal Curvatures





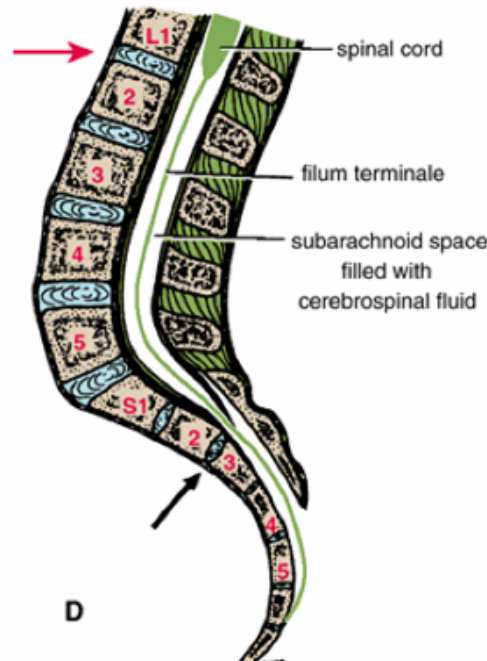
newborn infant

A



baby holds head up steadily
(3-4 months)

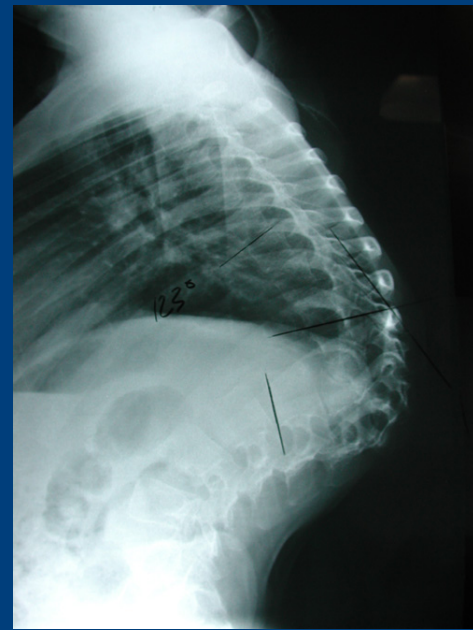
B

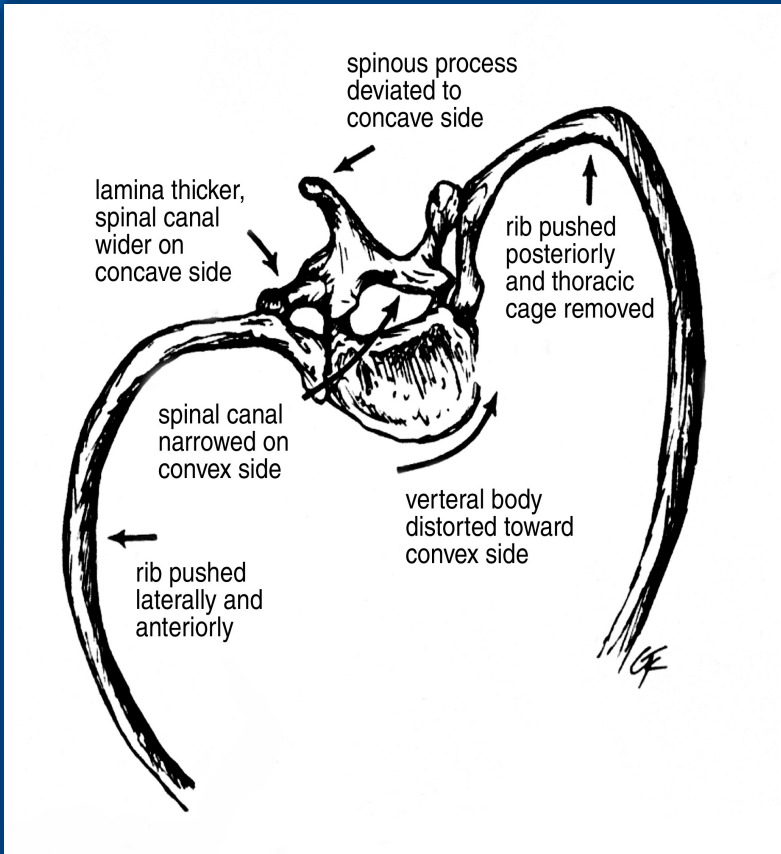


D









```
graph TD; A[Scoliosis] --> B[Postural]; A --> C[Strustructural];
```

Scoliosis

Postural

Strustructural

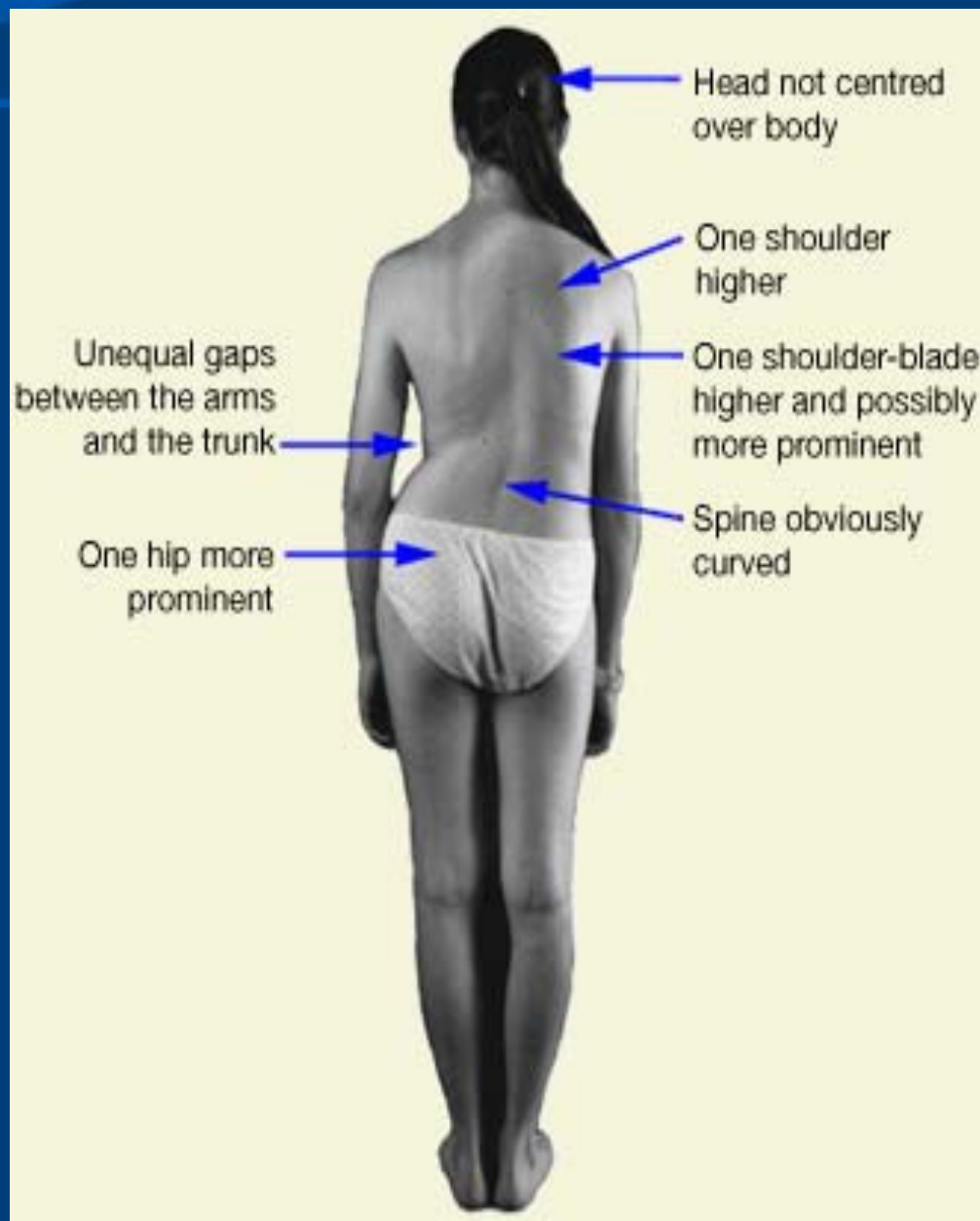
Types of Scoliosis

- **Idiopathic**
 - **Infantile**
 - **Juvenile**
 - **Adolescent**
- **Congenital**
- **Neuromuscular**

Idiopathic Scoliosis

- **Infantile**
 - < 3 years
- **Juvenile**
 - 4-10 years
- **Adolescent**
 - >10 years



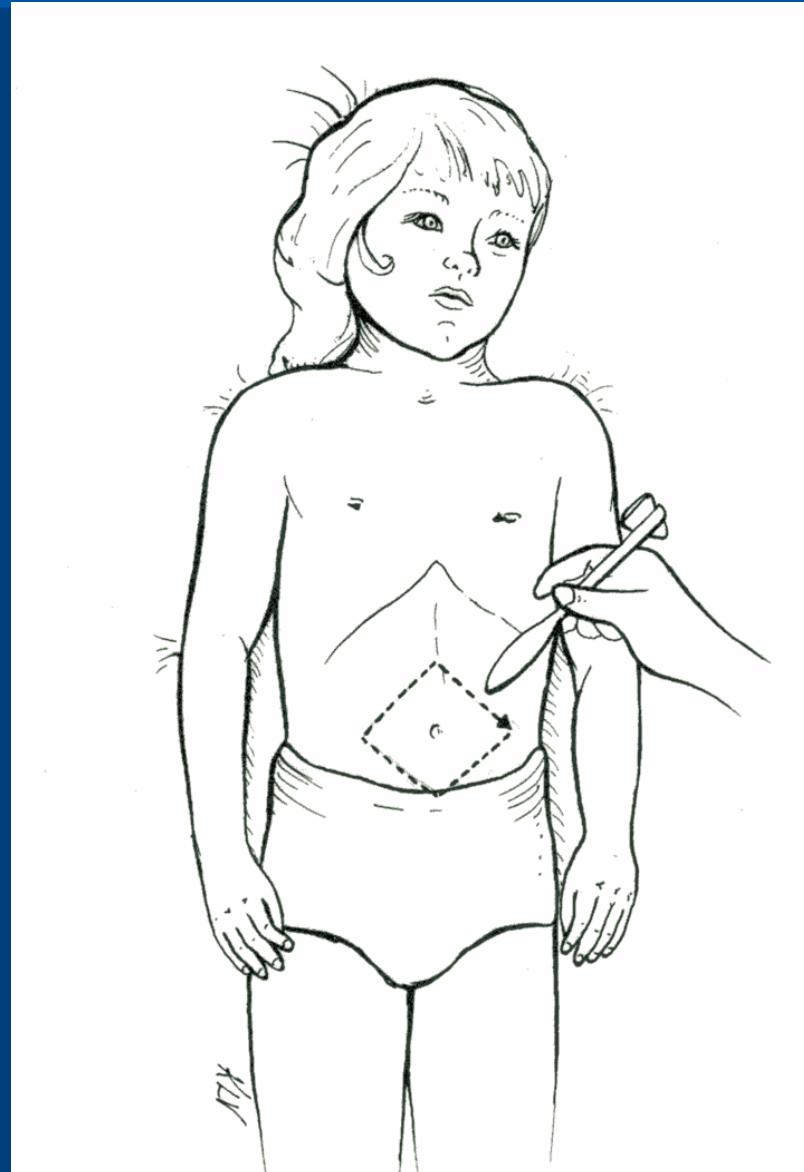


Adolescent Idiopathic Scoliosis





Adolescent Idiopathic Scoliosis



Classification (Curve Pattern)

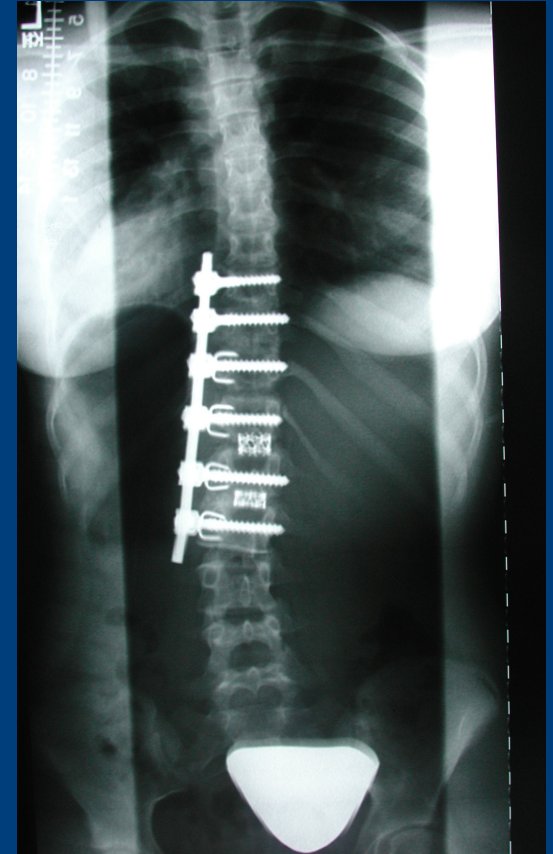
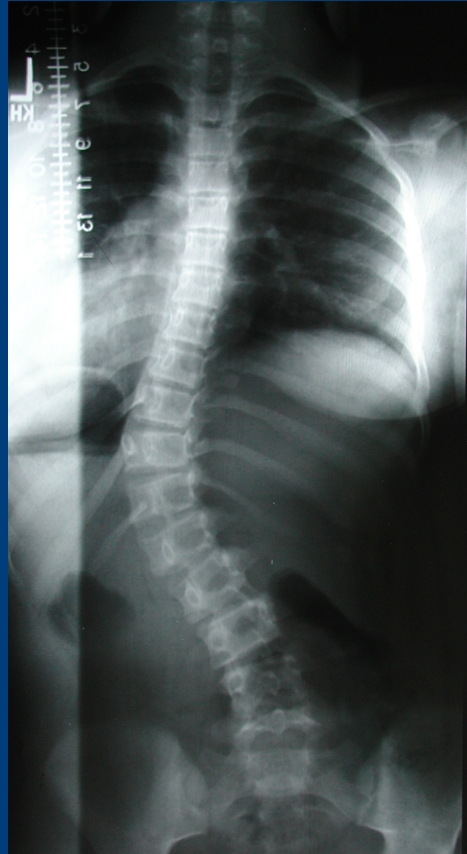
- **Thoracic** **T2 - T11/12 Disc**
- **Thorcolumbar** **T12 - L1**
- **Lumbar** **L1-2 Disc – L4**
- **Double major** **2 structural curves**



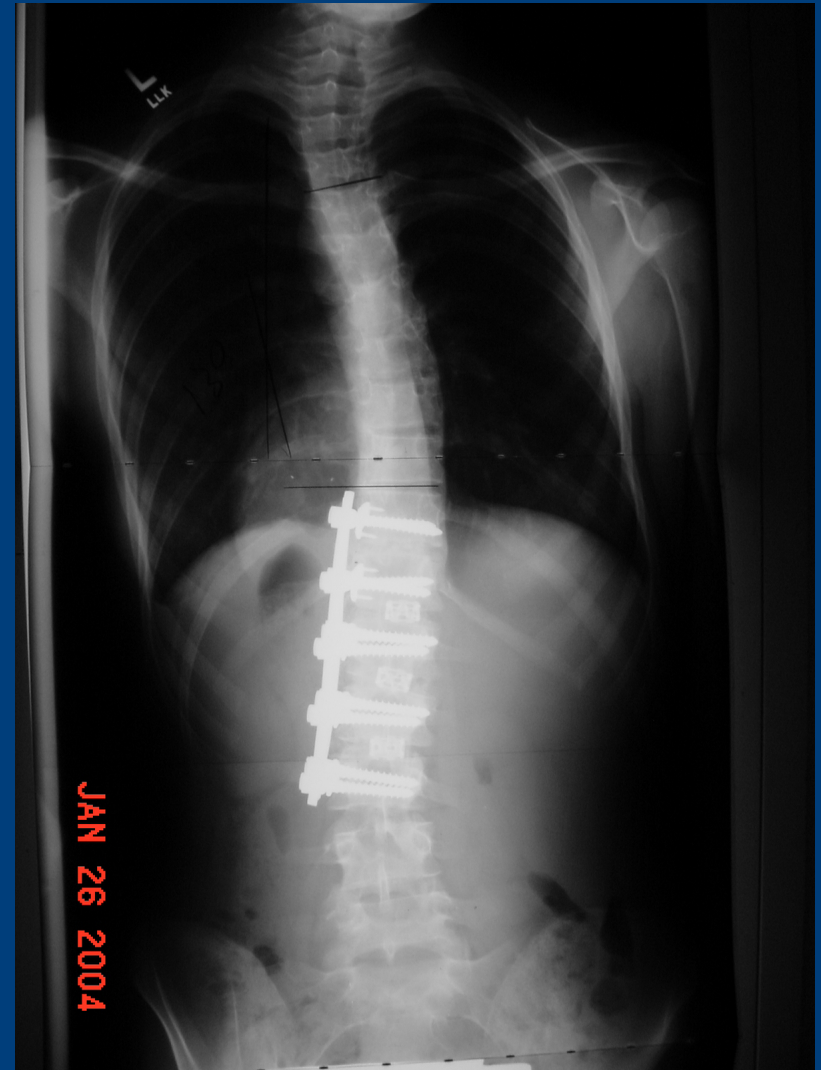
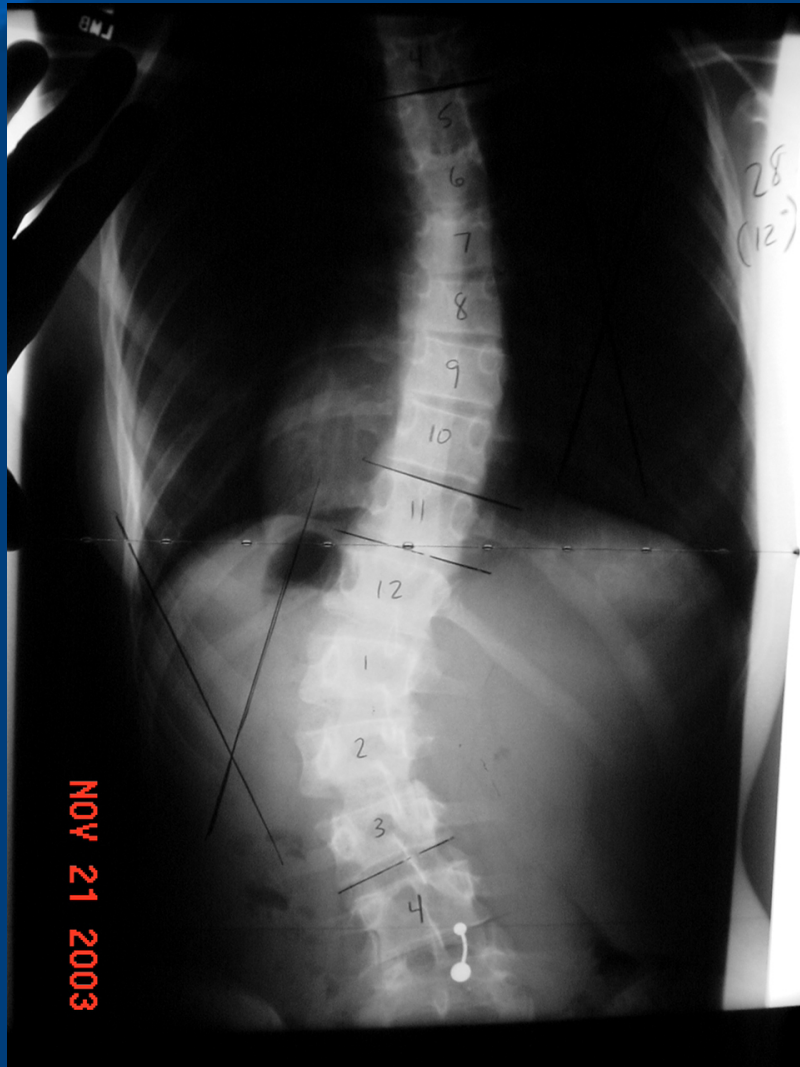
Thoracic Curve Pattern



ThoracoLumbar Curve Pattern



Lumbar Curve Pattern



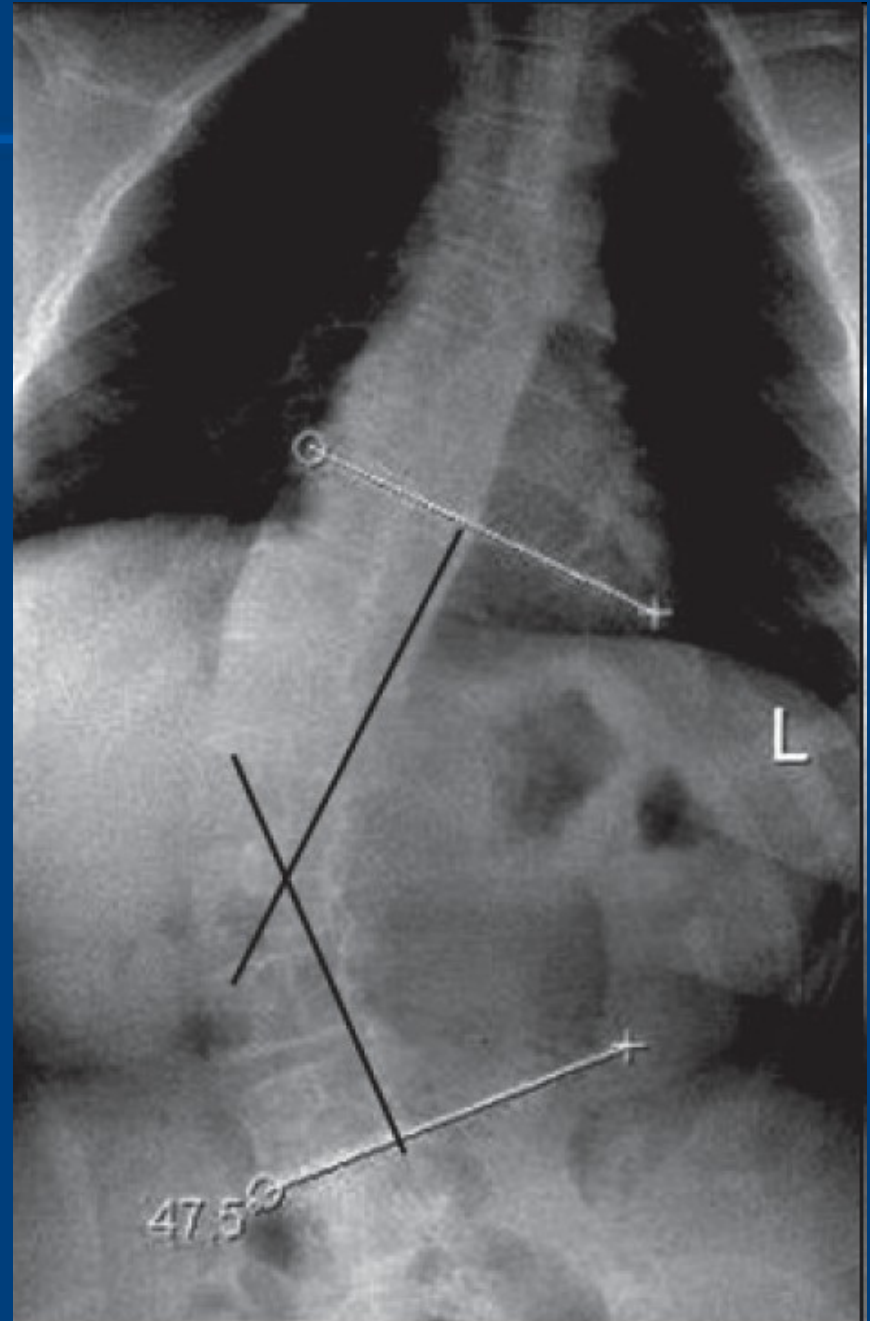
Adolescent Idiopathic Scoliosis

Cobb's Angle



Adolescent Idiopathic Scoliosis

Cobb's Angle



Why Treat Scoliosis?

- **Cosmesis**
- **Curve Progression**
- **Pulmonary Function**
- **Mortality**

Curve Progression

TABLE 2. *Probability of progression: magnitude of curve at initial detection versus age*

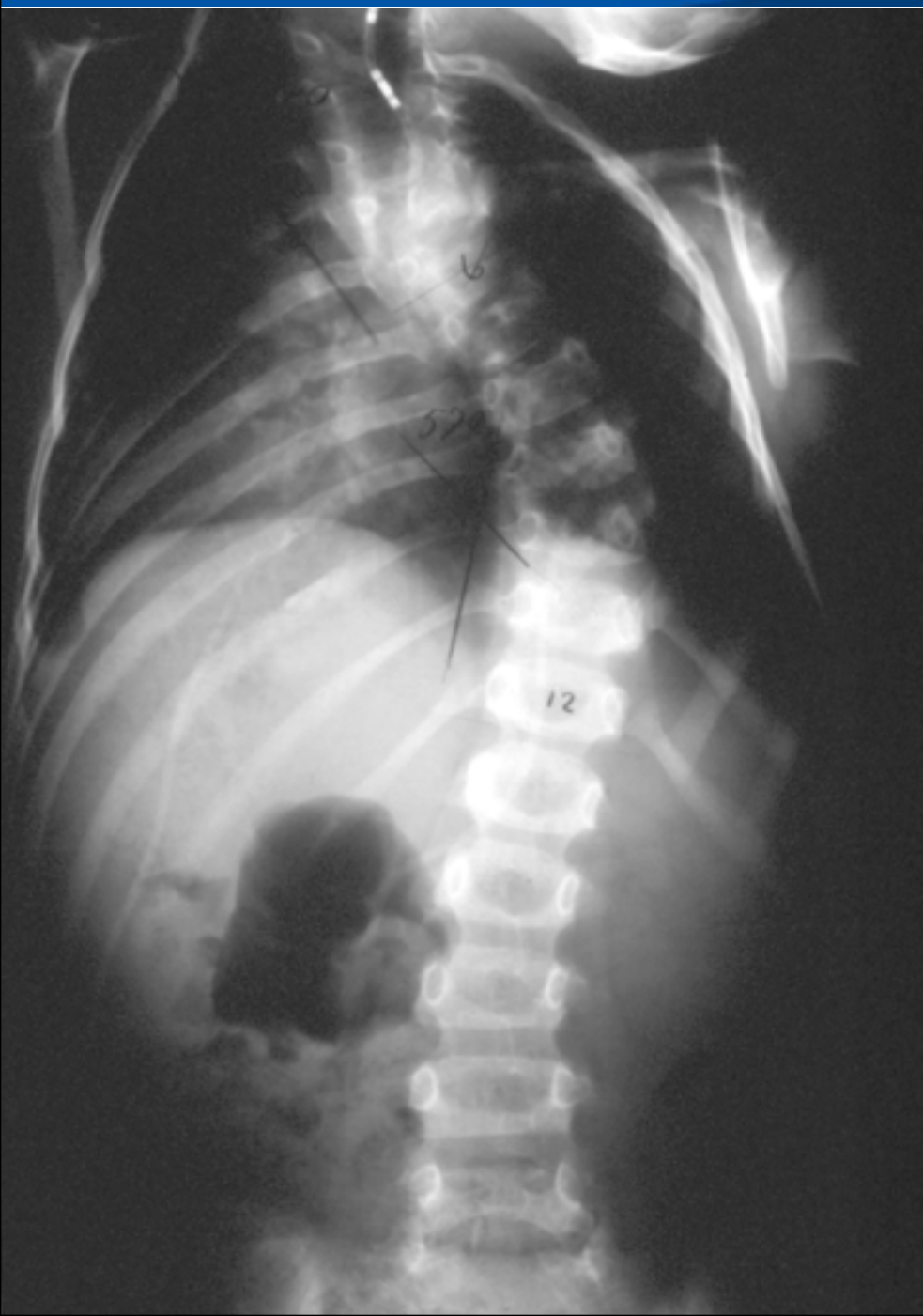
Curve magnitude at detection (degrees)	Age at detection (years)		
	10–12	13–15	16
<19	25%	10%	0%
20–29	60	40	10
30–59	90	70	30
>60	100	90	70

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Cardiopulmonary Complications

- **Early onset deformity**
- **Inability to stabilize or correct**
 - lack of thoracic growth
 - ineffective respiration
- **Underlying systemic (N-M, collagen)**
Non idiopathic





Death age 20



EOS - Overview

- **Early Onset Scoliosis**
- **Thoracic Insufficiency Syndrome**
- **Surgical Treatment**
 - **Growing Rods**
 - **VEPTR (Rib Expanders)**

Early Onset Scoliosis

- **Scoliosis of any etiology with onset less than 5 years of age**
- **Now 10 years**

Early Onset Scoliosis

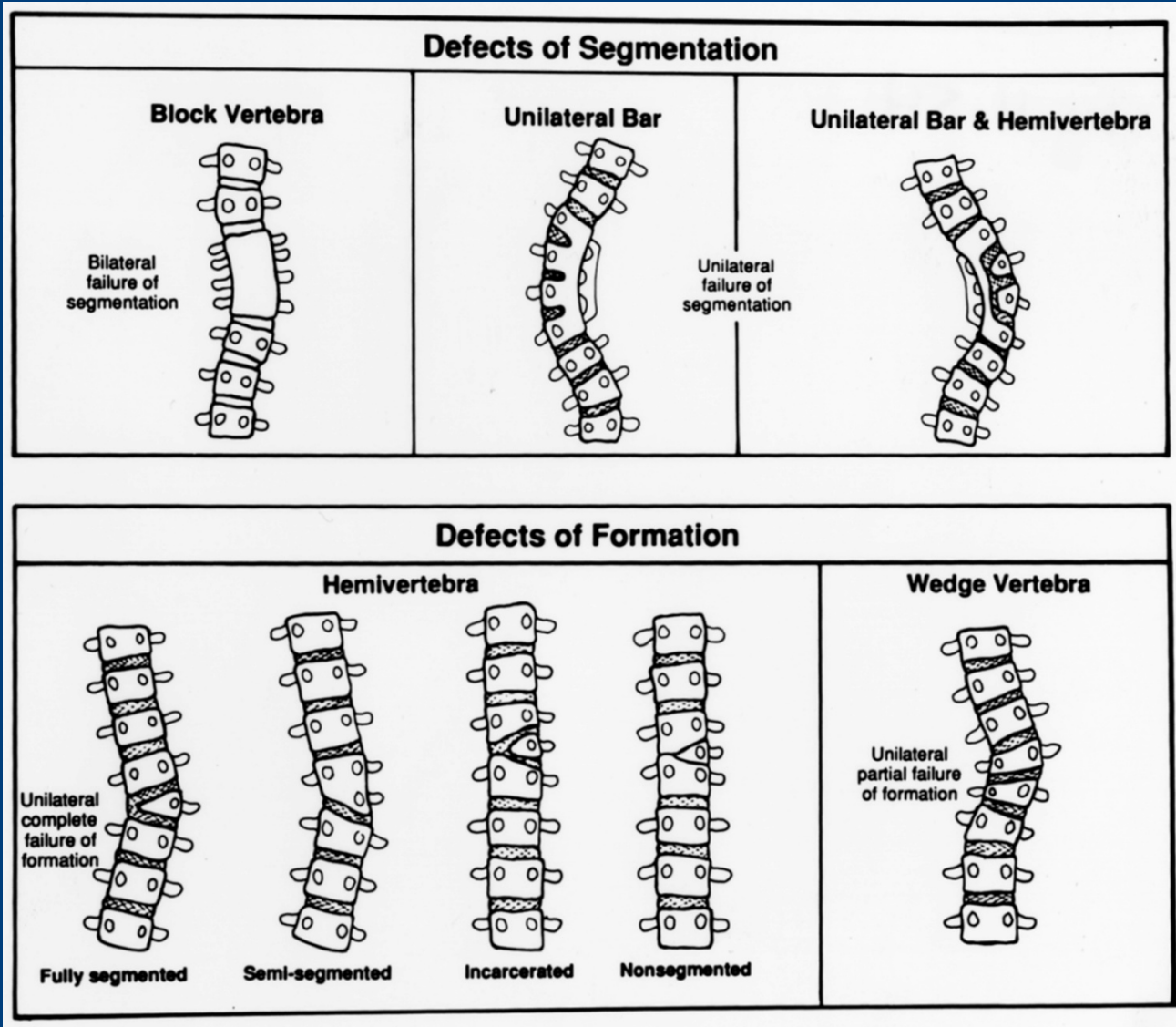
- **Infantile Idiopathic <3 yo**
- **Juvenile Idiopathic 3-10 yo**
- **Congenital Scoliosis**
 - **Failure of Segmentation**
 - **Failure of Formation**

Infantile Idiopathic Scoliosis

- Onset <3 years of age

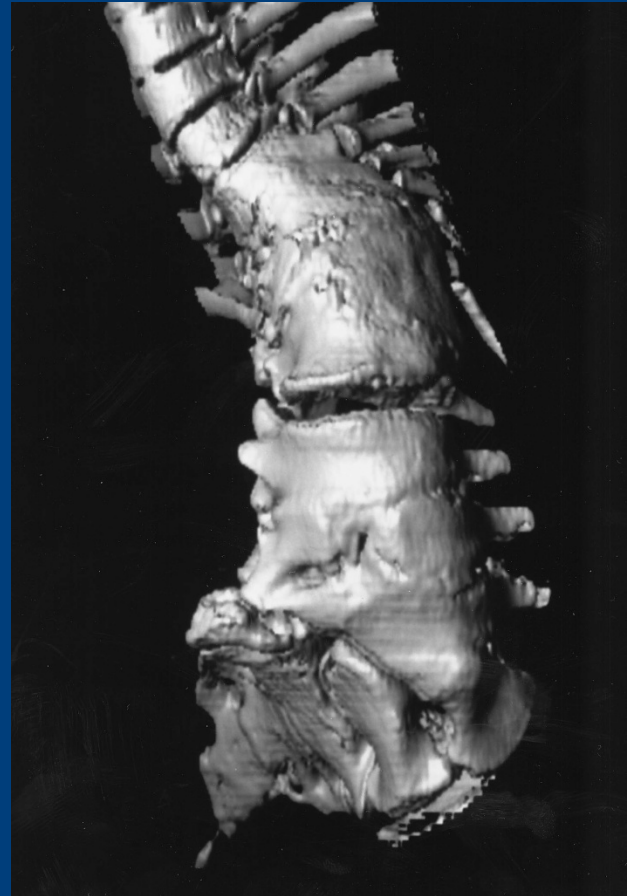
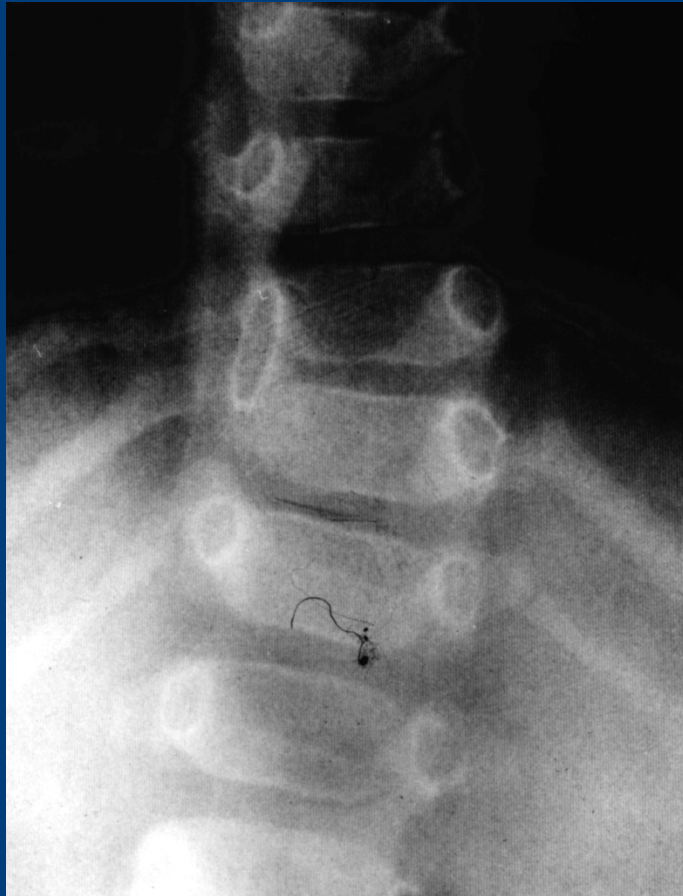


Congenital Scoliosis



Failure of Segmentation

- Bony bar between 2 or more vertebra
- Unilateral bar most common



Failure of Formation

- i.e. Hemi-vertebrae



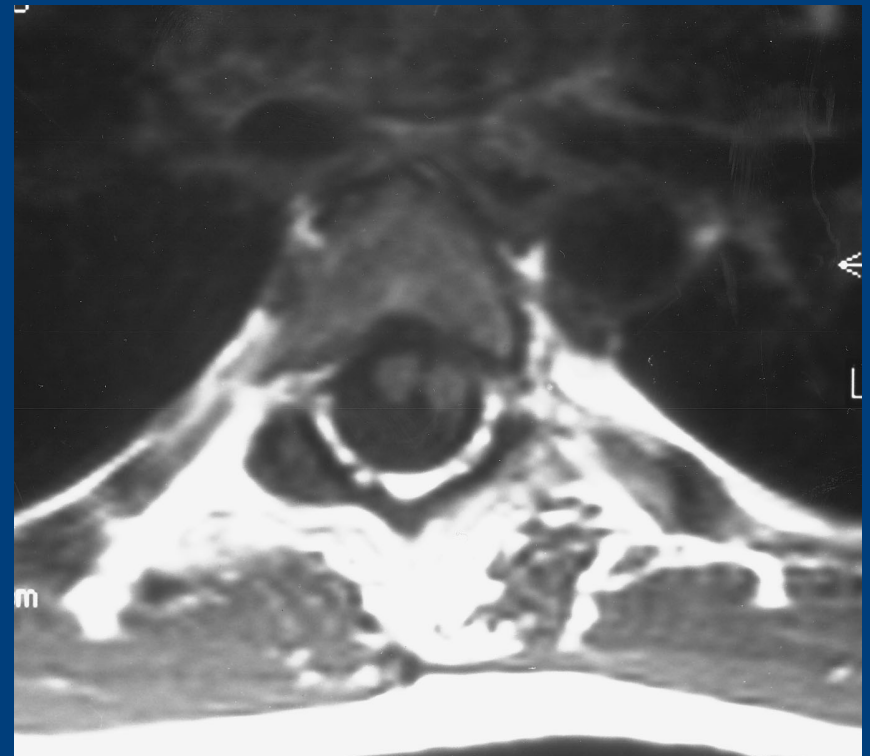
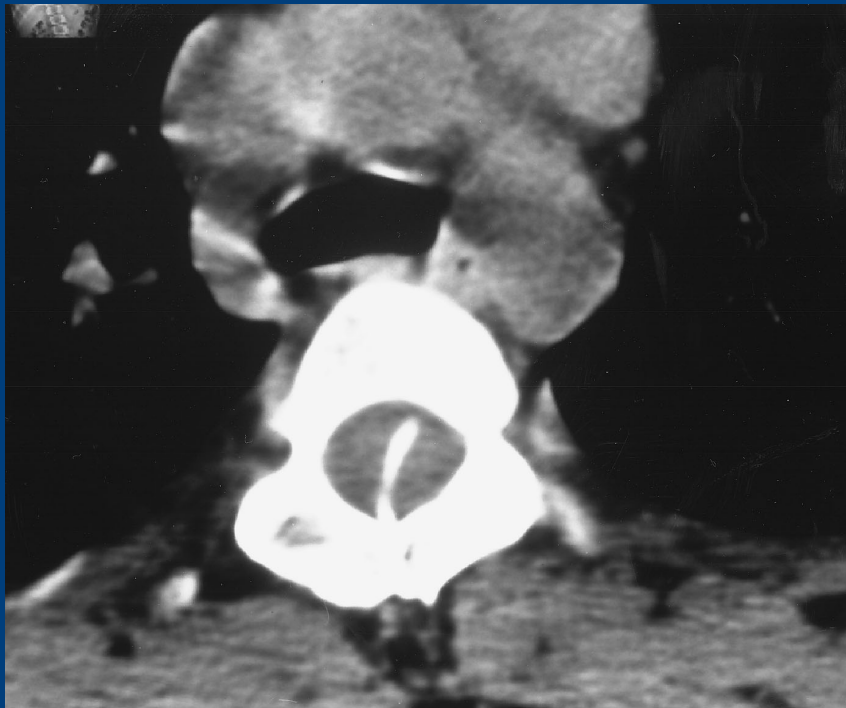
Associated Anomalies

- **60% other organ systems involved**
 - **20% GU**
 - **12% cardiac**
 - **Other possibilities: cranial nerve palsy, radial hypoplasia, TEV, DDH, Sprengel's deformity, imperforate anus**
 - **VACTERL**

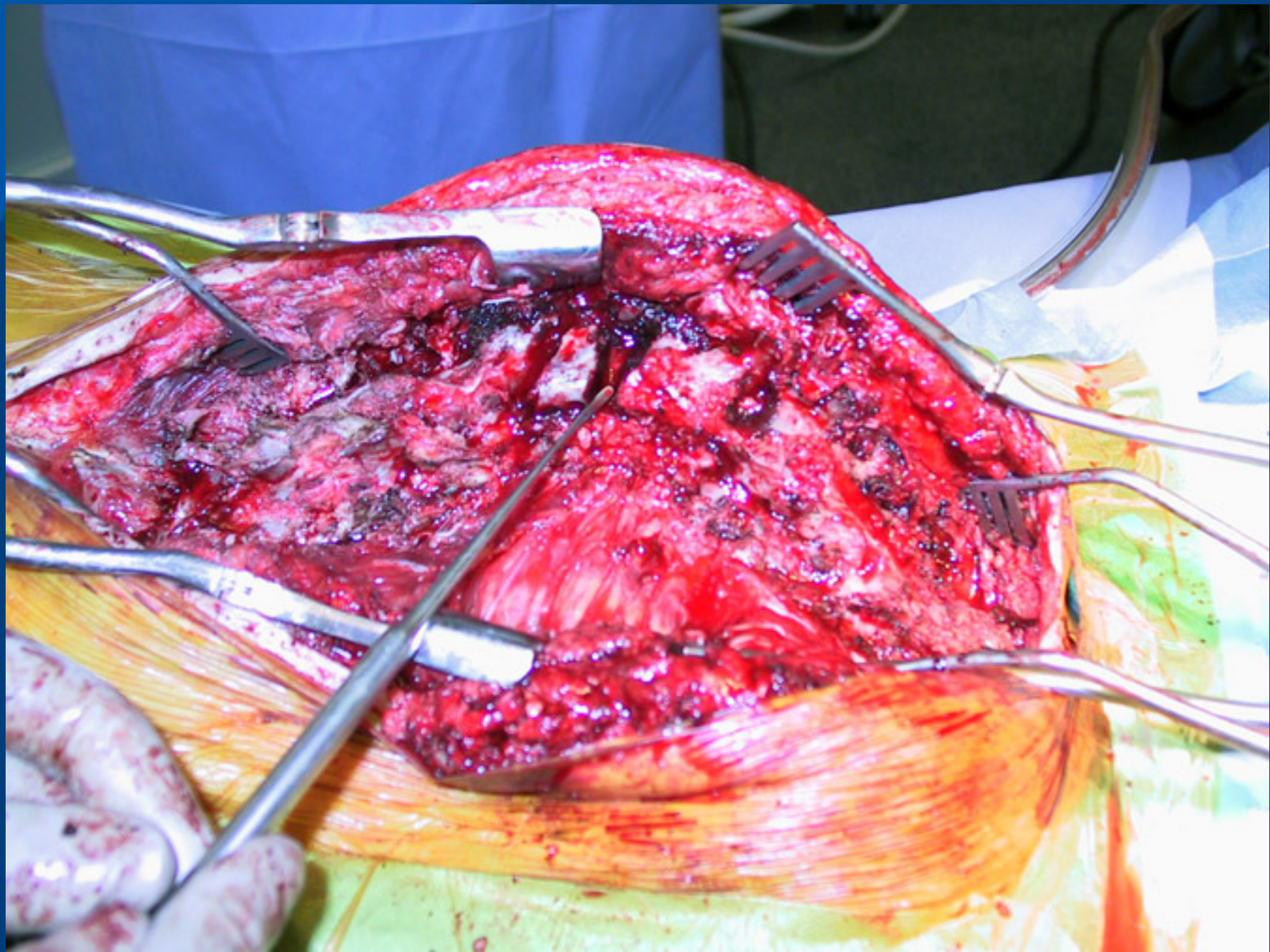
Associated Anomalies

- **Spinal dysraphism (40%)**
 - **Diastematomyelia**
 - **Syringomyelia**
 - **Arnold-Chiari malformations**
 - **Intra-spinal tumors**
- **Evaluate with MRI**
- **Neurosurgery Evaluation / Treatment**

Associated Anomalies







Casting



Casting



Casting



Casting



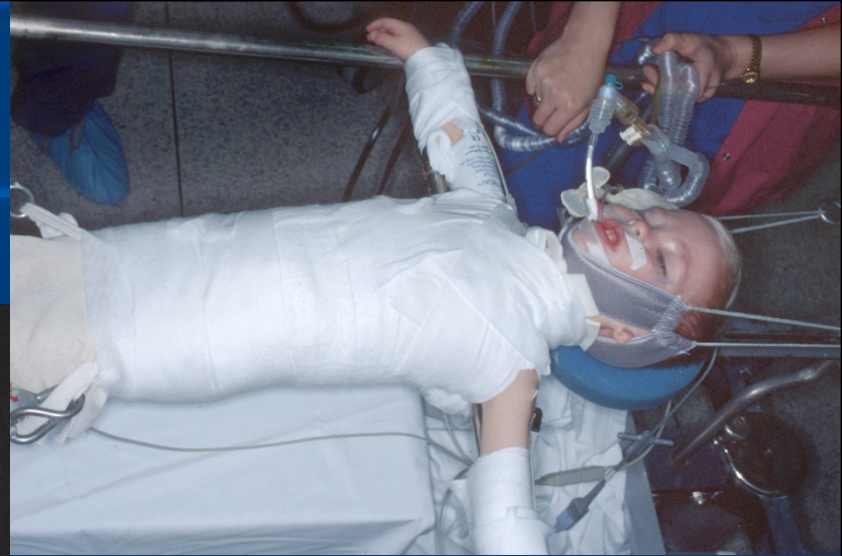
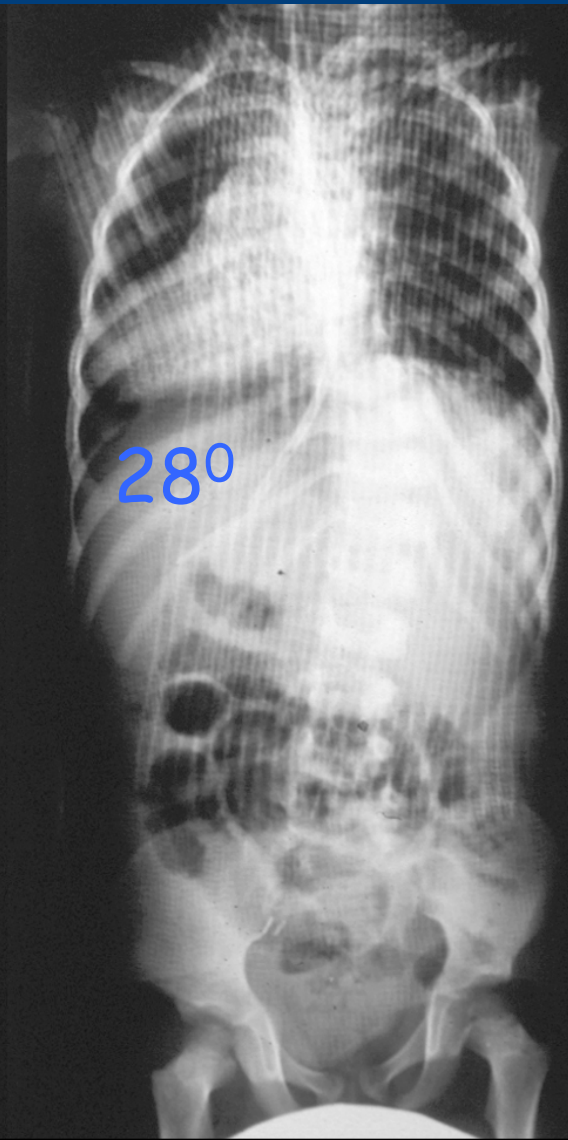
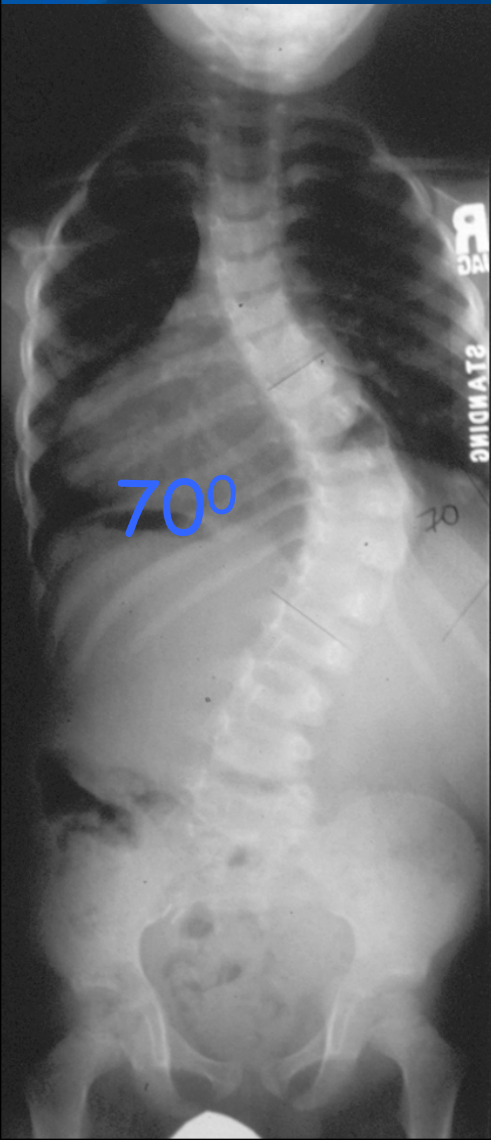
Casting



Casting



Risser Cast



Traction





Bracing

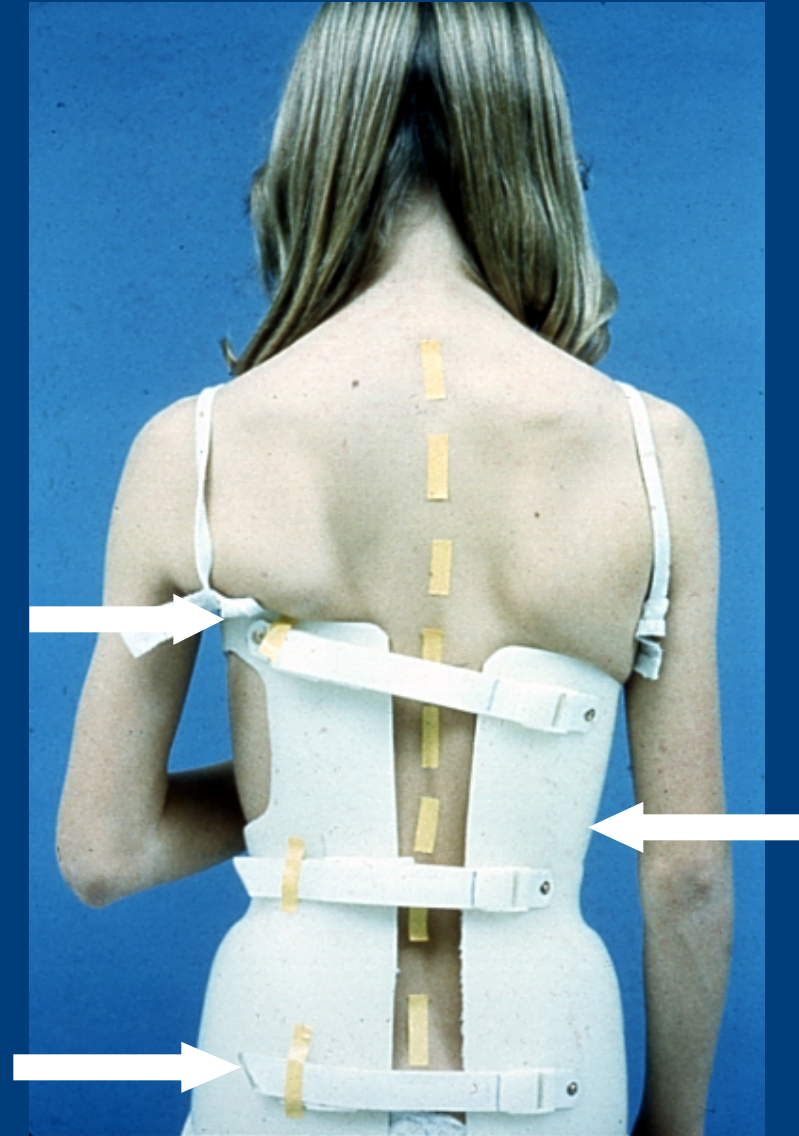
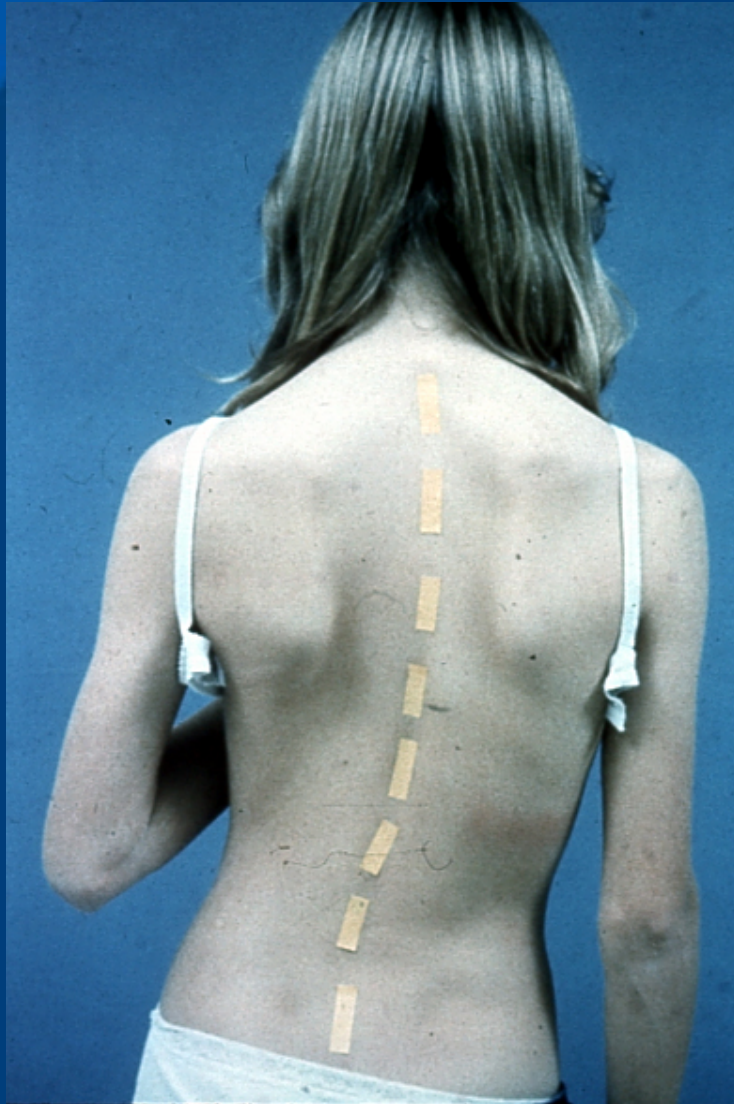
- **Types of Braces**
 - **Boston TLSO (Thoraco Lumbo Sacral Orthosis)**
 - **Milwaukee CTLSO (Cervical...)**
 - **Charleston Bending Brace**
- **Remaining Growth**

Bracing Indications

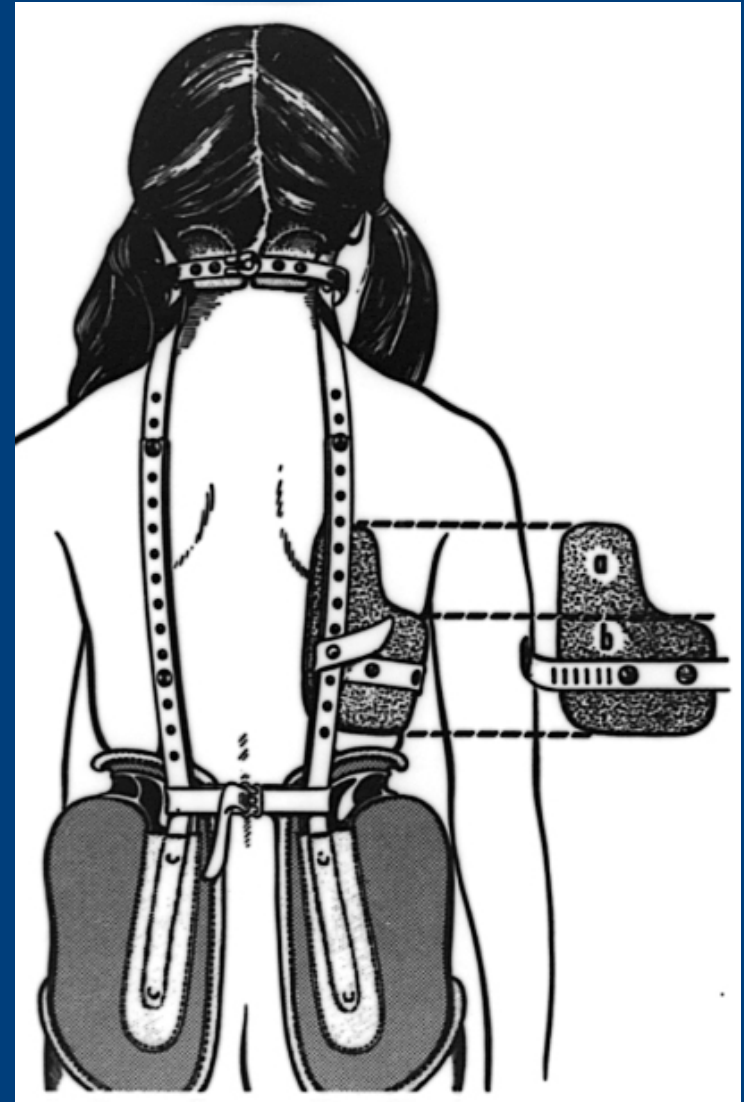
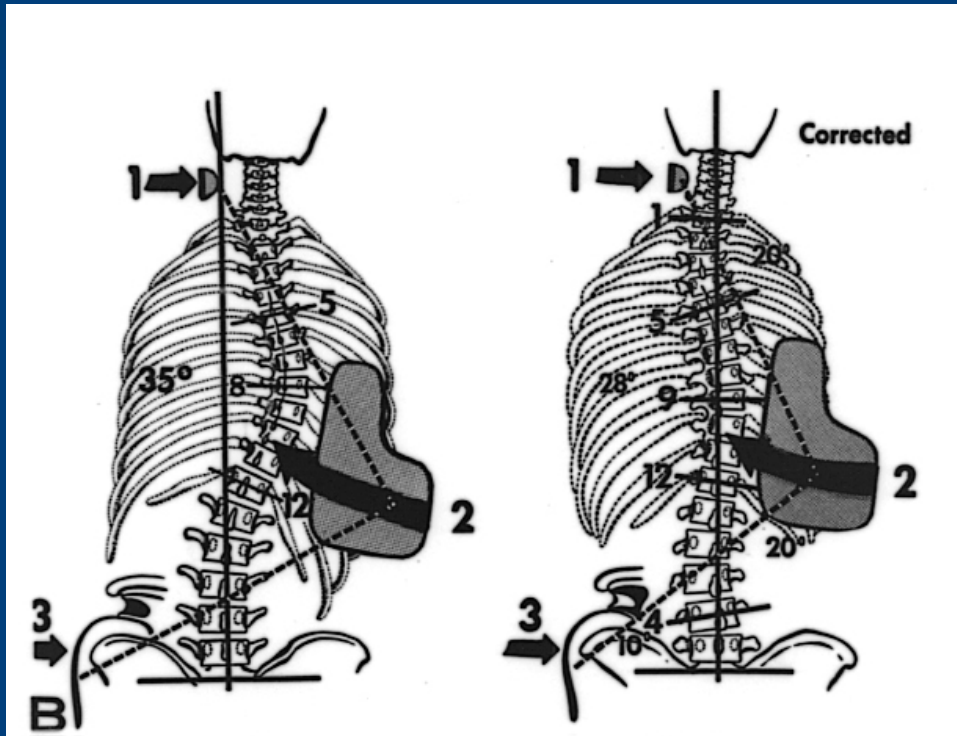
- **Greater than 25-30 degrees**
- **Less than 45 degrees**
- **Immature**
 - **Remaining spine growth**
 - **< 6 months post-menarchal**
 - **Risser 0-2**



Boston TLSO



Boston TLSO



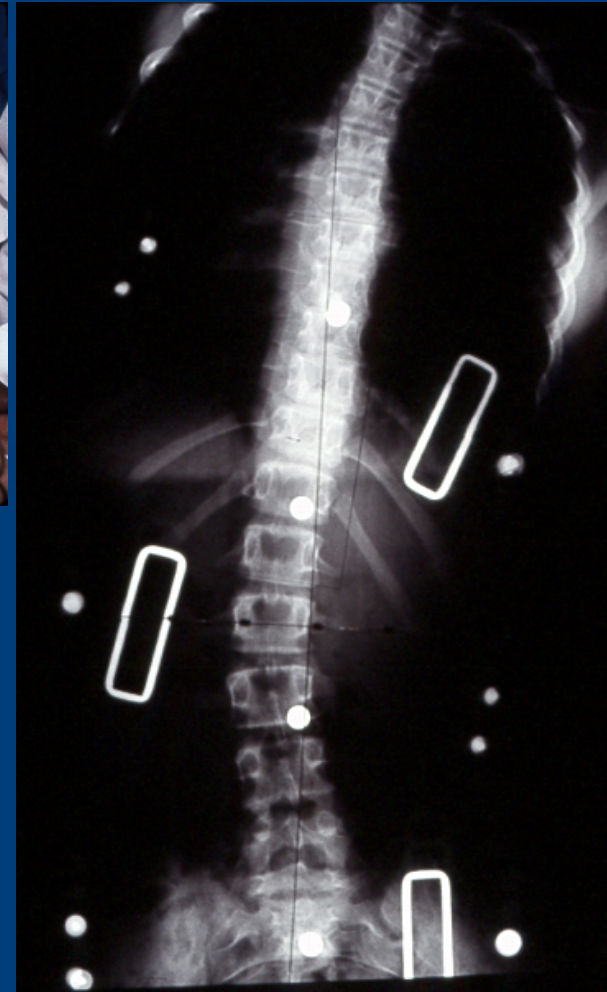
Boston TLSO



Milwaukee CTLSO



Charleston Bending Brace

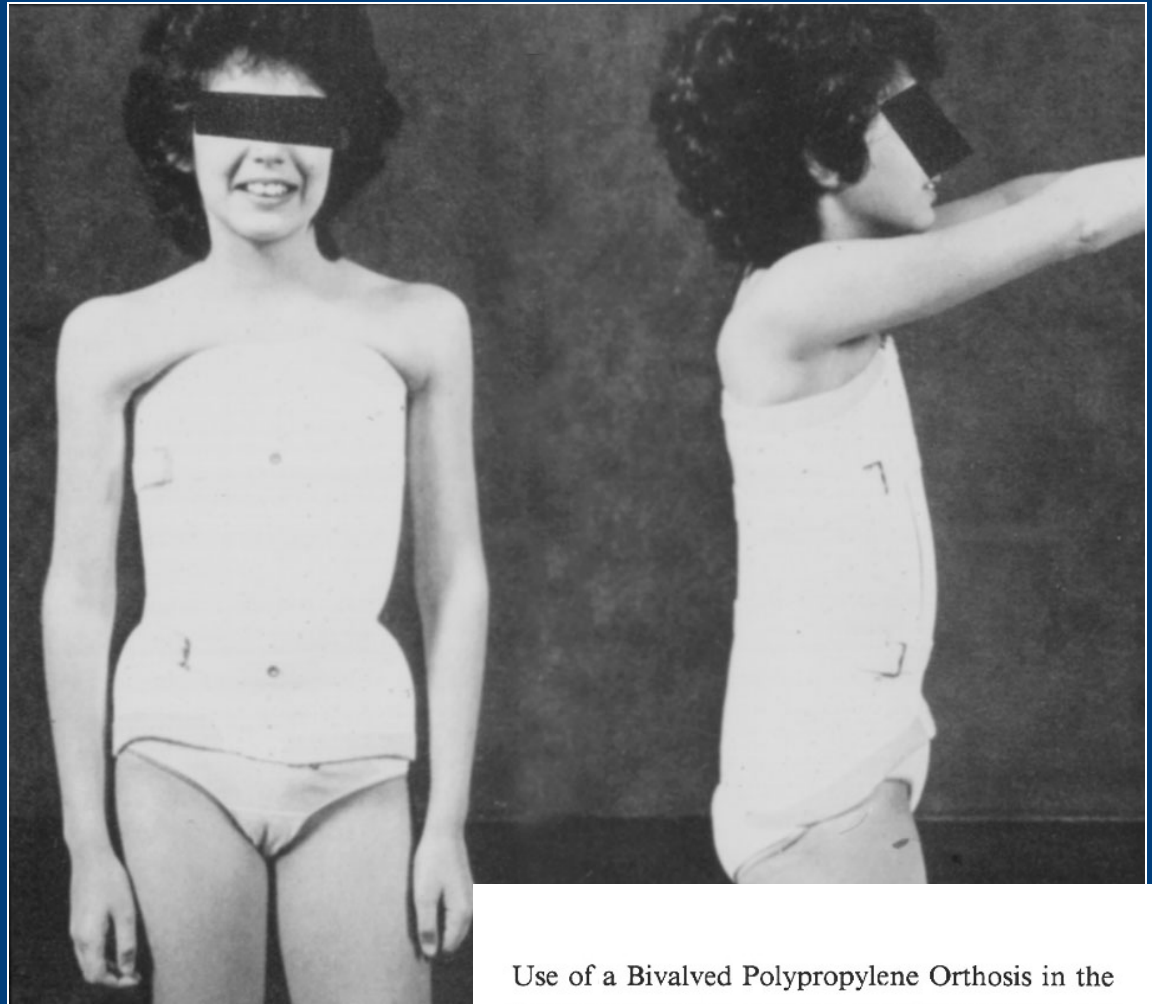
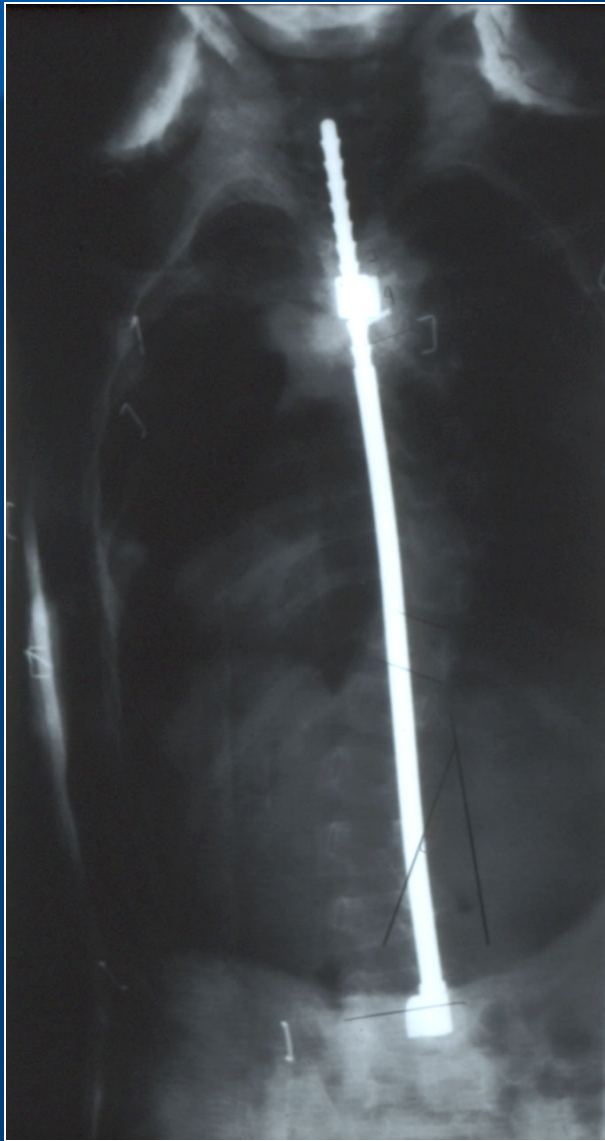


Hypercorrection
x 8-10 hrs./night

Surgery

- **Curves greater than 50 degrees**
- **Spinal Fusion and Instrumentation**
 - **Posterior**
 - **Anterior**
 - **Thoracoscopic**
 - **Combination**

Harrington Rods

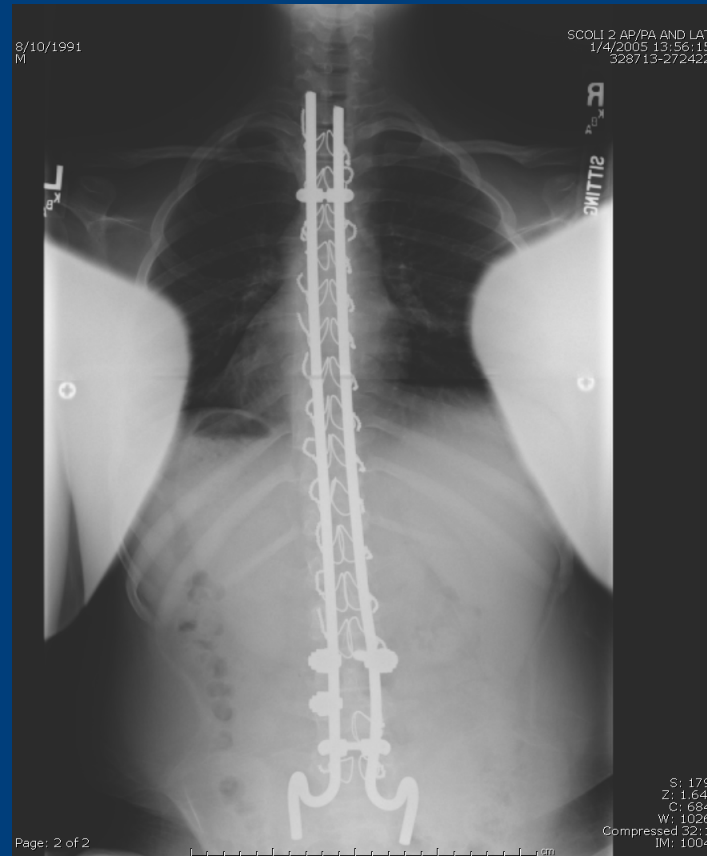


Use of a Bivalved Polypropylene Orthosis in the Postoperative Management of Idiopathic Scoliosis

ROBERT S. ROBERTS, M.D.,* CHARLES T. PRICE, M.D.,** AND MAX F. RIDDICK, M.D.†

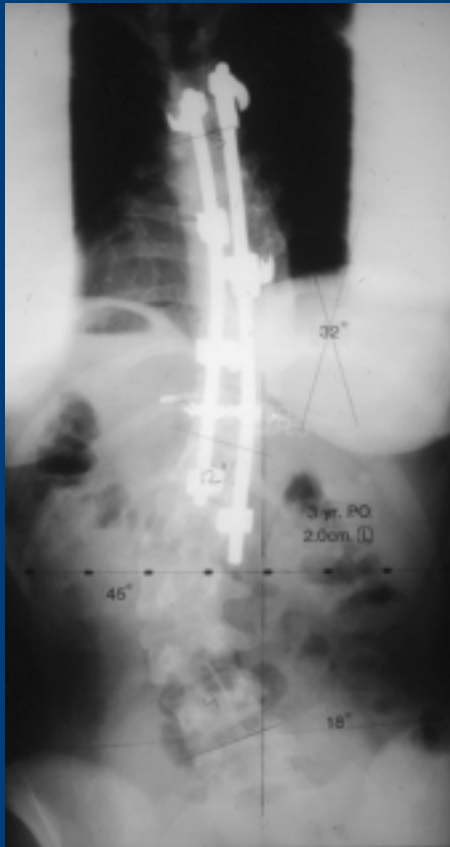
Lucque Technique

- Sub-laminar wires
- Neurological risk



Thoracic Pedicle Screws

- Suk 1995 - South Korea
- Lenke - St. Louis



• g



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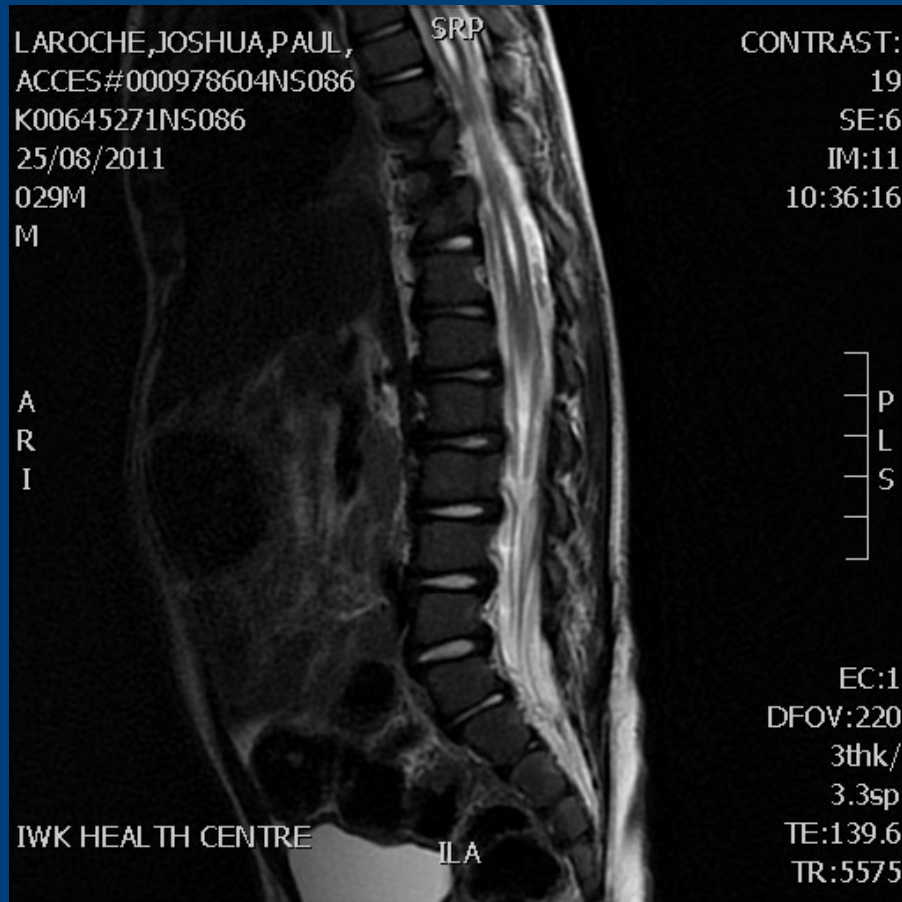






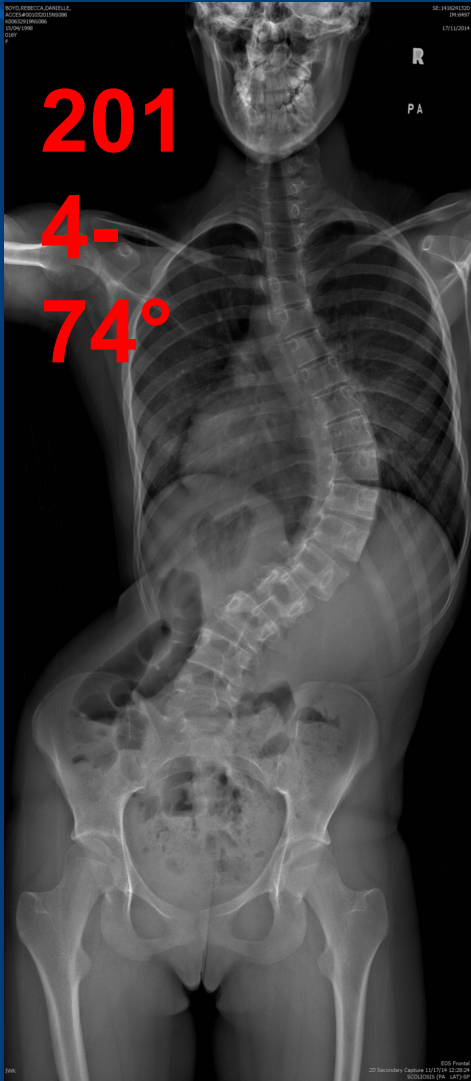
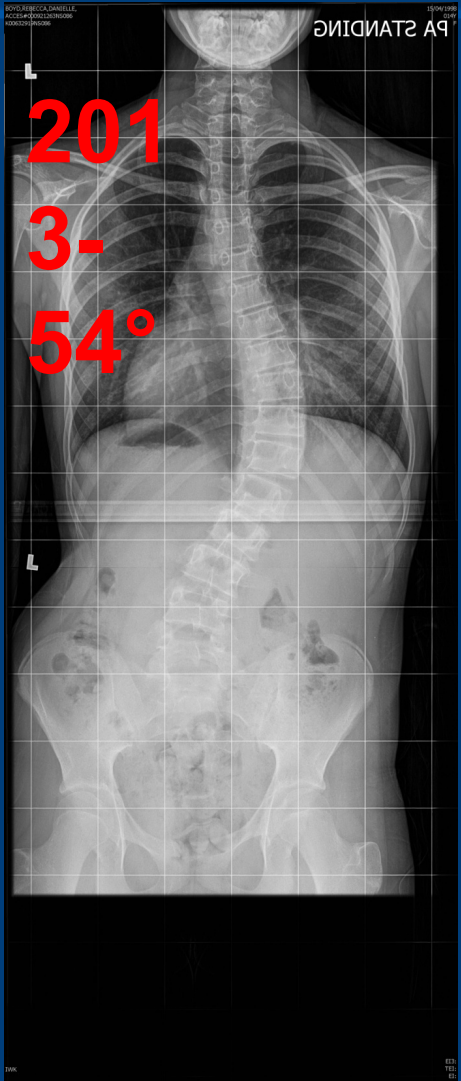
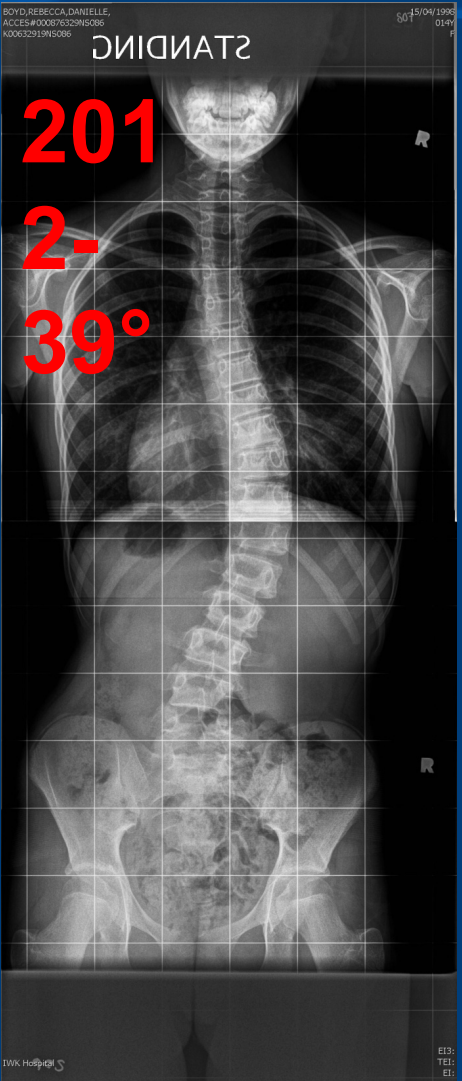


**MRI 2012: No
tethering – Tight
Filum Terminale**



**Syrinx T6-12 with prominence
at T7-8, T10-11**

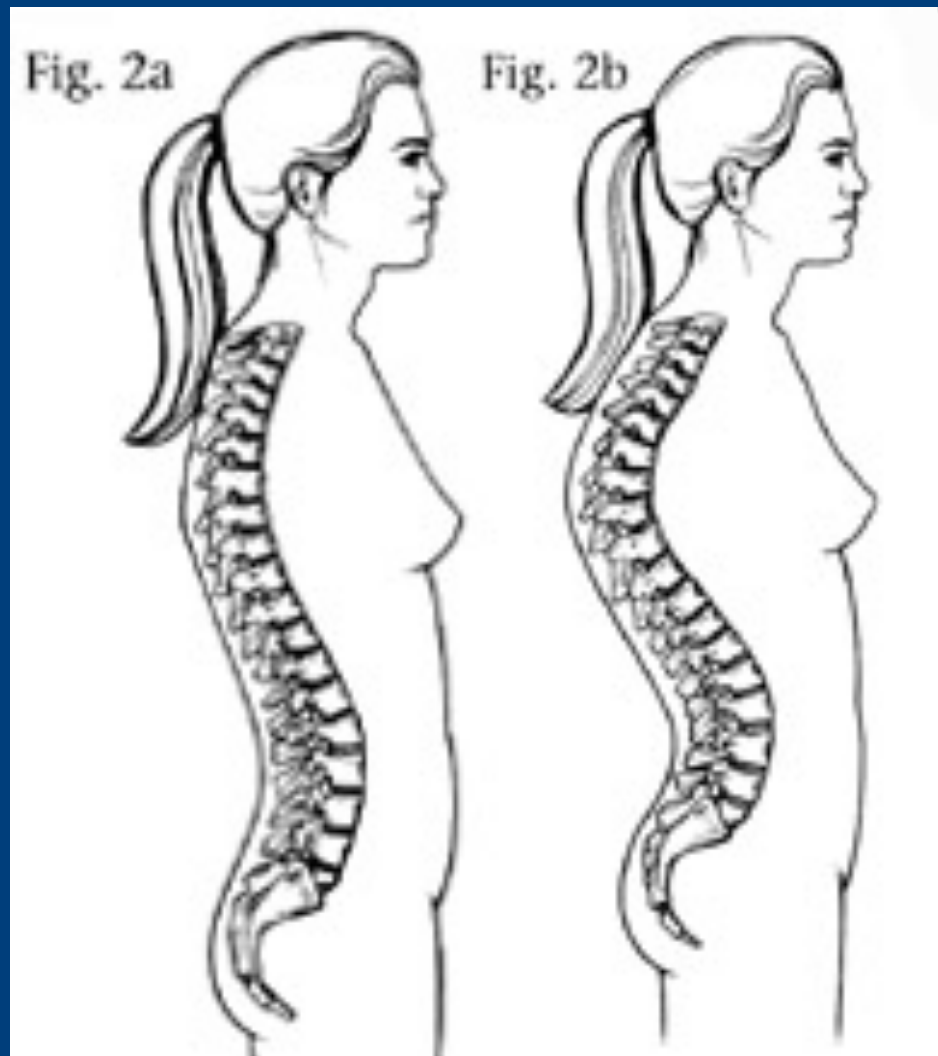




Kyphosis

- **Terminology**
 - Kyphosis, Hyperkyphosis, Kyphos (gibbus)
- **Postural Kyphosis**
 - ‘Round back’, ‘drooping shoulders’
 - May be associated with other postural defects such as flat-feet.
- **Structural Kyphosis**
 - Osteoporosis of the spine
 - Ankylosing spondylitis
 - Scheuermann’s Disease
- **Kyphos**
 - A sharp post. Angulation due to localized collapse or wedging of one or more vertebrae.
 - Causes:
 1. Congenital defect
 2. Fracture
 3. Spinal TB

Kyphosis



Gibbus Deformity (Kyphos)



Gibbus at L3-L4 in a 12 year old boy

- Collapse of the vertebral body may result in short segment kyphotic deformity, or Gibbus deformity. Note also the paravertebral abscess.

Gibbus Deformity (Kyphos)

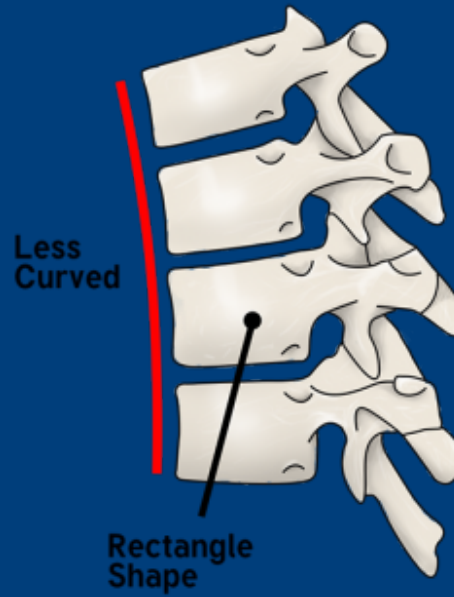


Scheuermann's Disease (Adolescent Kyphosis)

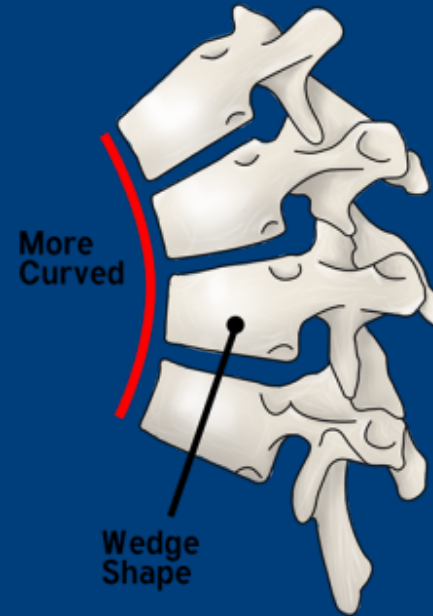
- A developmental disorder of the growing spine.
 - Irregular ossification
 - Some fragmentation
 - Osteochondrosis.
- Pathology
 - Irregularity of vertebral end-plates
 - **Schmorls' Nodes** ; small central herniation of disc material into the vertebral body.
 - Wedging
 - Thoracic vs. Lumbar response



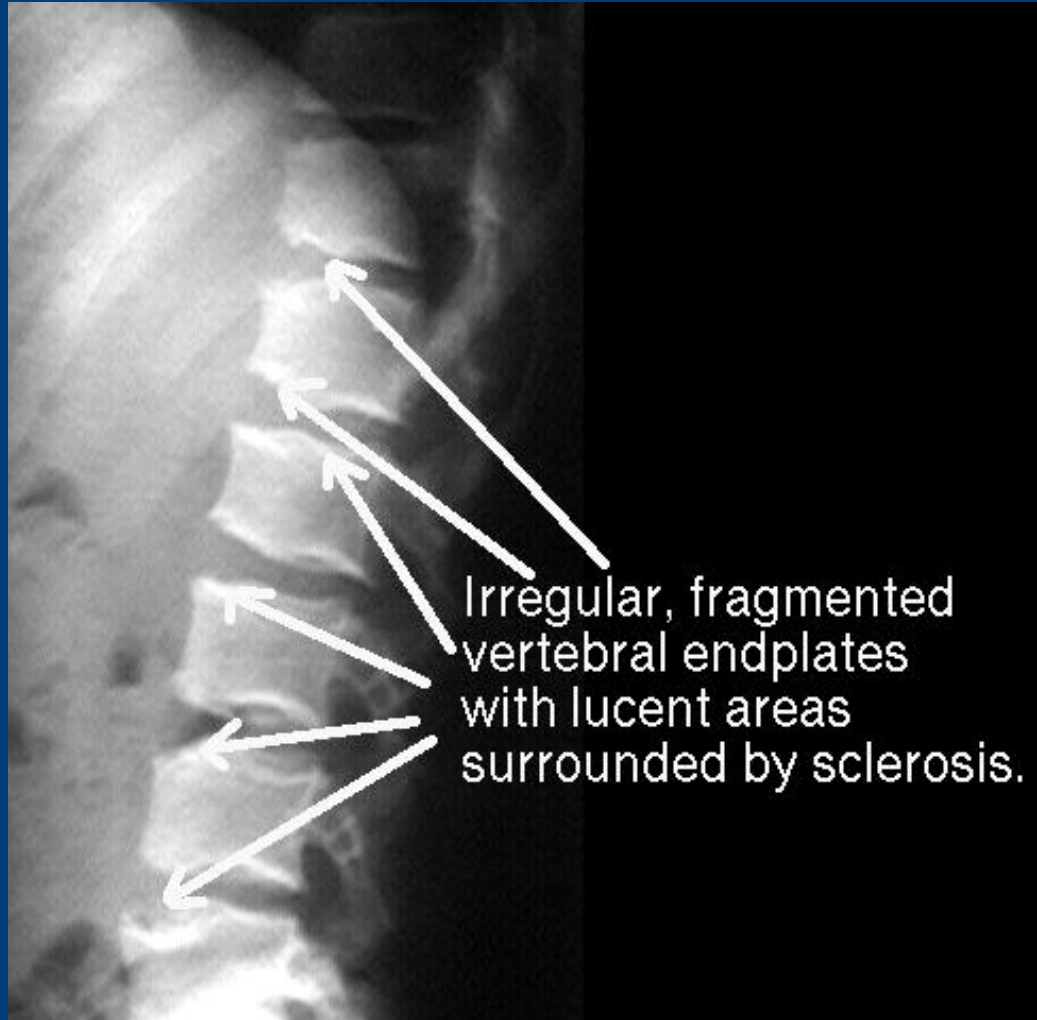
Normal
Vertebrae



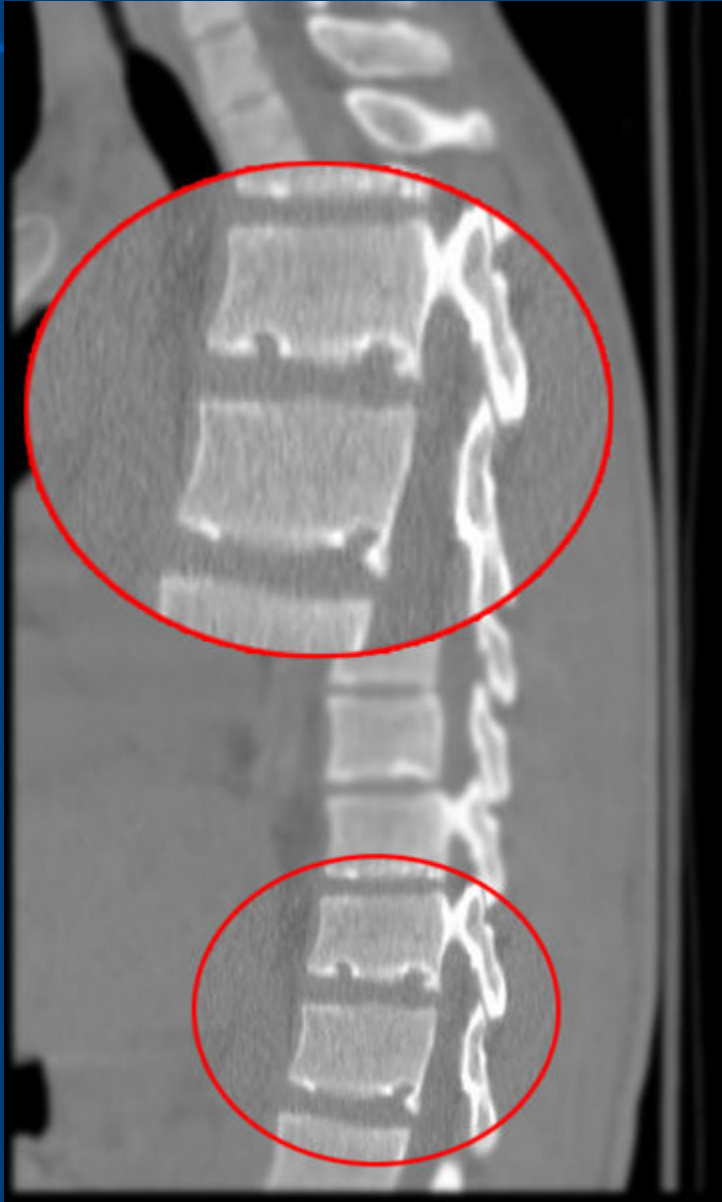
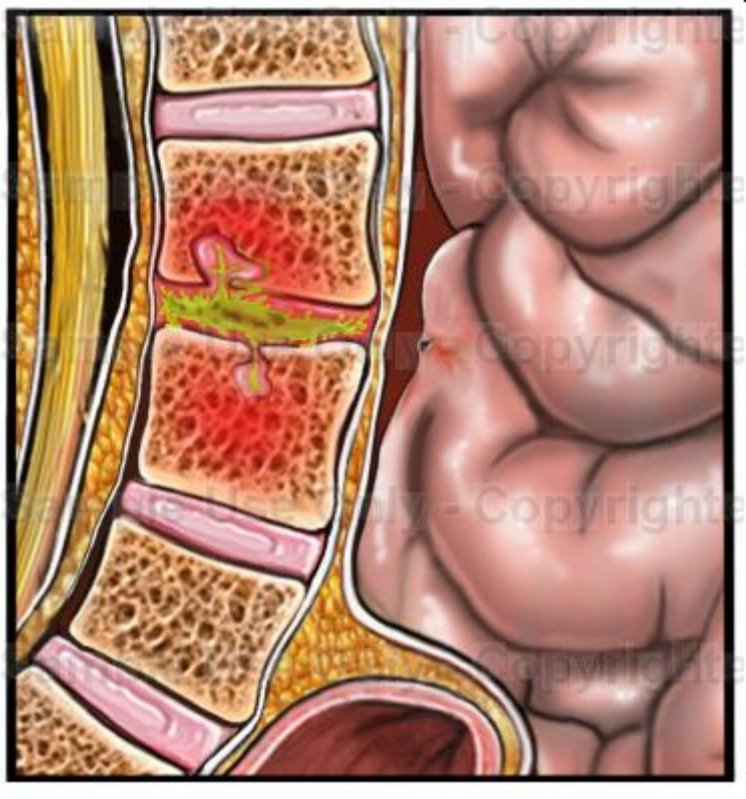
Vertebrae with
Scheuermann's
disease



Scheuermann's Disease



Schmorls' Nodes



Scheuermann's Disease

- Lateral thoracic radiograph showing typical appearances of type I Scheuermann's disease with
 - end-plate abnormalities
 - and anterior wedging resulting in a kyphotic deformity



Scheuermann's Disease

Thoracic Form

- The typical form
 - Appear in the mid thoracic vertebrae
 - Starts at or shortly after puberty
- Males >> Females
- Clinical Presentation:
 - History
 - Rounded shoulder
 - Backache
 - fatigue
 - Physical Examination
 - X-rays
 - Lateral views : patchiness or irregularity of the vertebral end plates
 - Schmorls nodes at several intervertebral levels.,,,, wedge of ver.

Scheuermann's Disease

Thoracic Form

Treatment

- **Depends on the severity**
- **Conservative**
 - **Extension brace for a yr or 18 mon**
- **Surgical**
 - **Correction & Fusion**

Scheuermann's Disease

Thoracolumbar Form

- **May appear together with thoracic kyphosis or may occur on their own.**
- **Cf. Thoracic Scheuermann's Disease :**
 - **Prevalence.**
 - **Age of Presentation**
 - **Type of Presentation**
 - **Local deformity**
 - **X-ray changes**
- **Treatment**
 - **Usually conservative**
 - **No need for operative management**