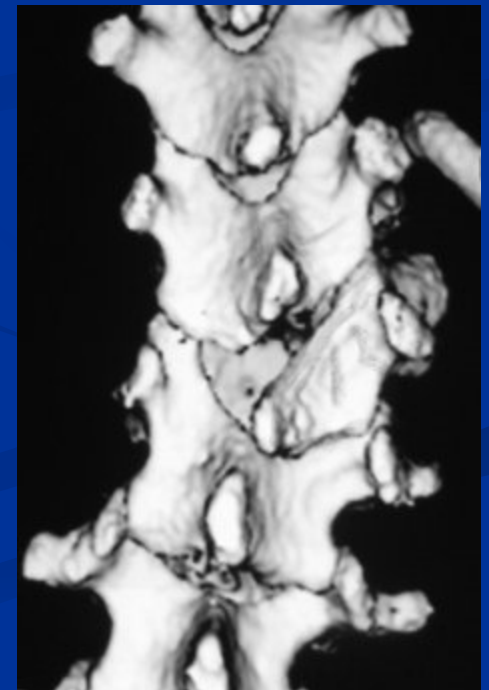


Hemivertebralrectomy: Posterior Approach Only

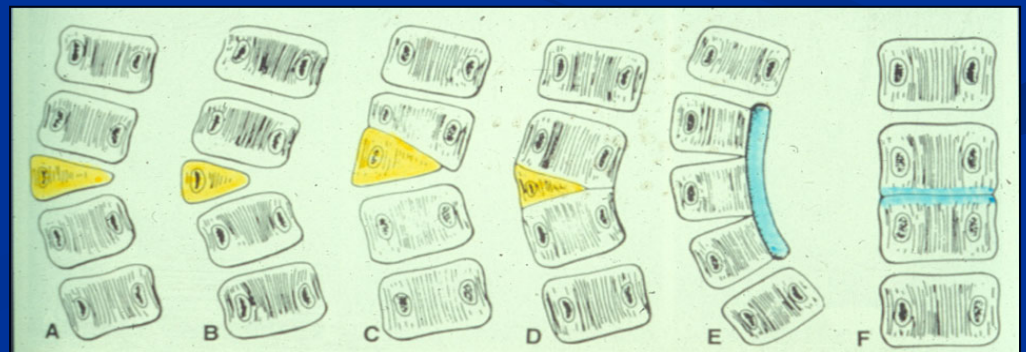
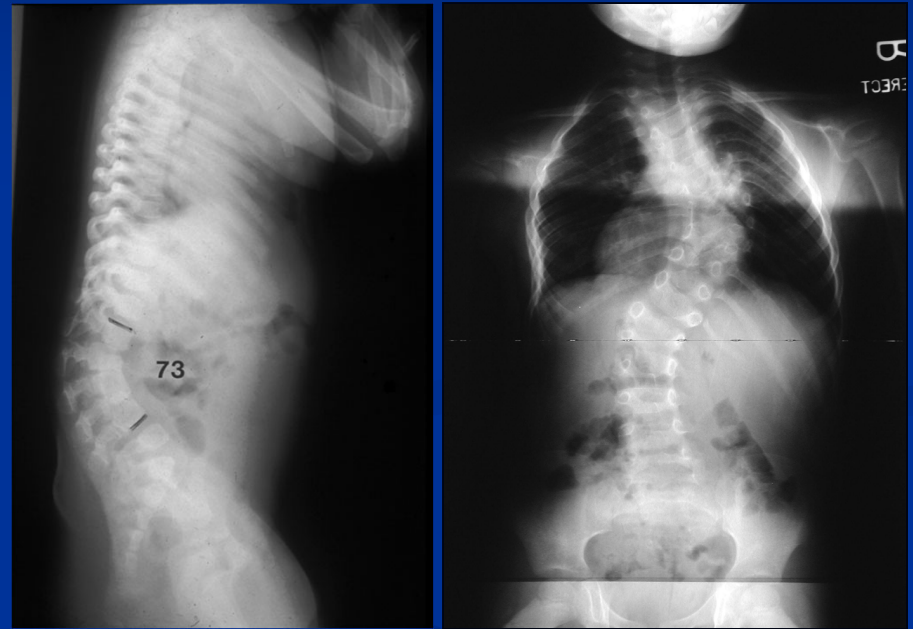


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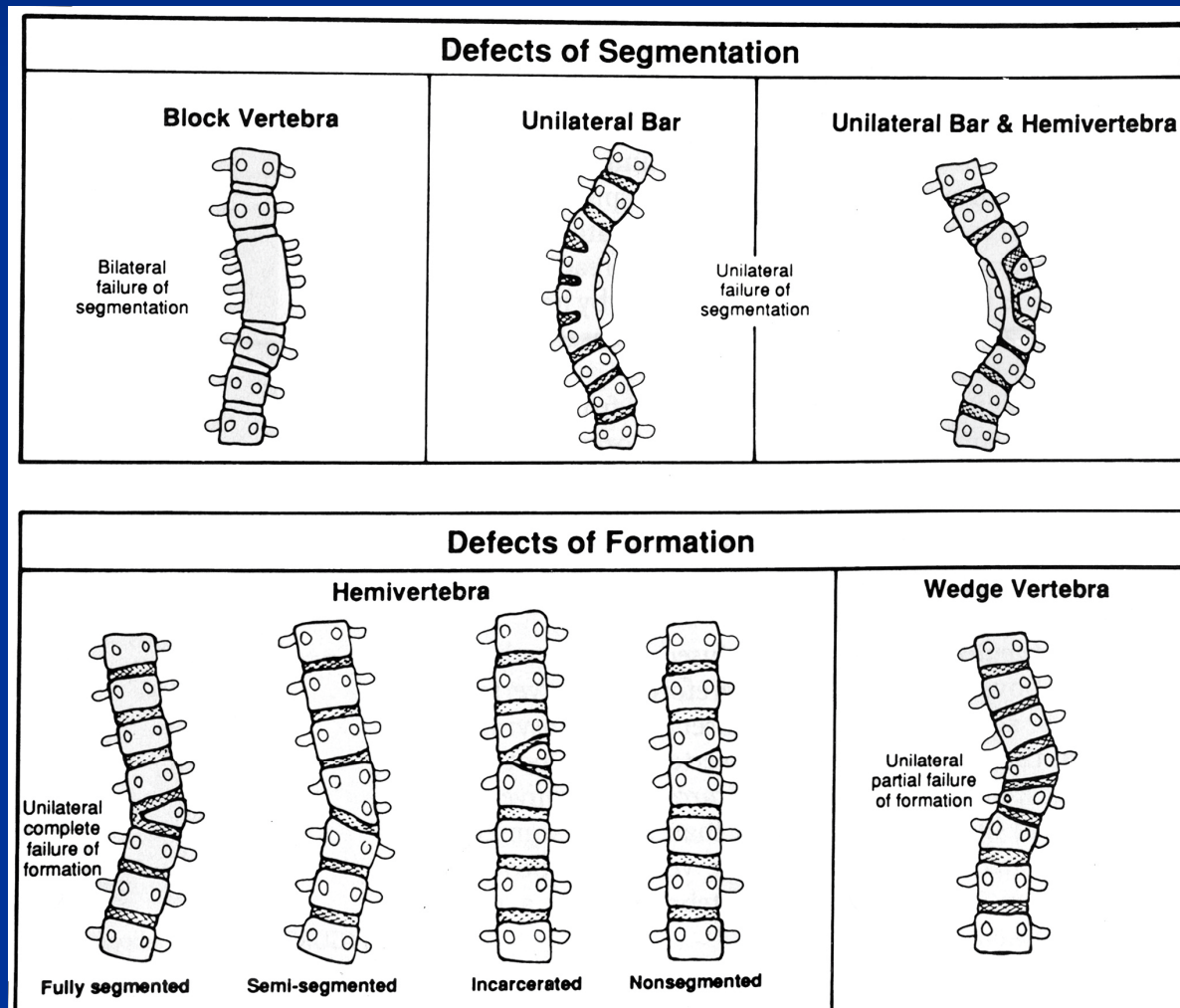
Congenital Deformities

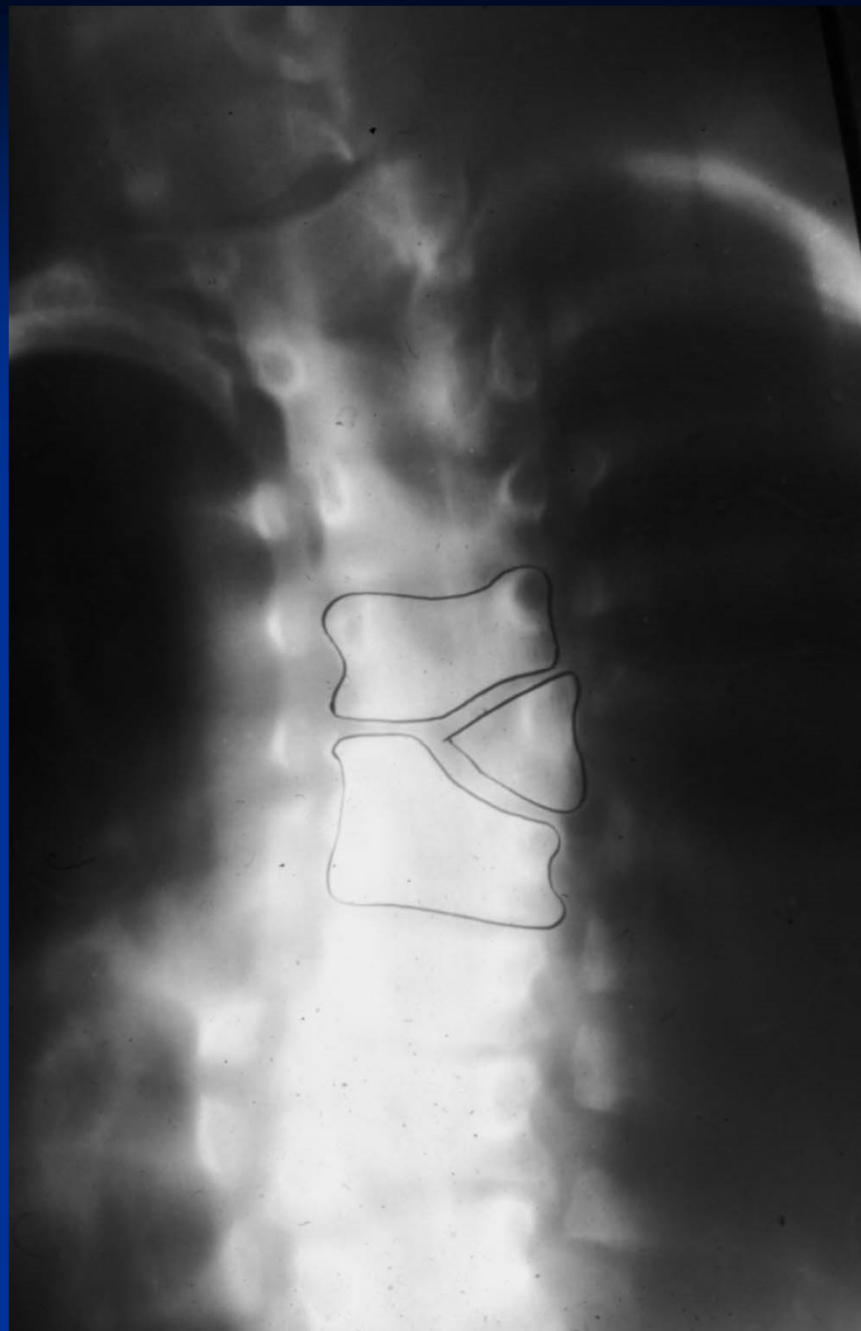
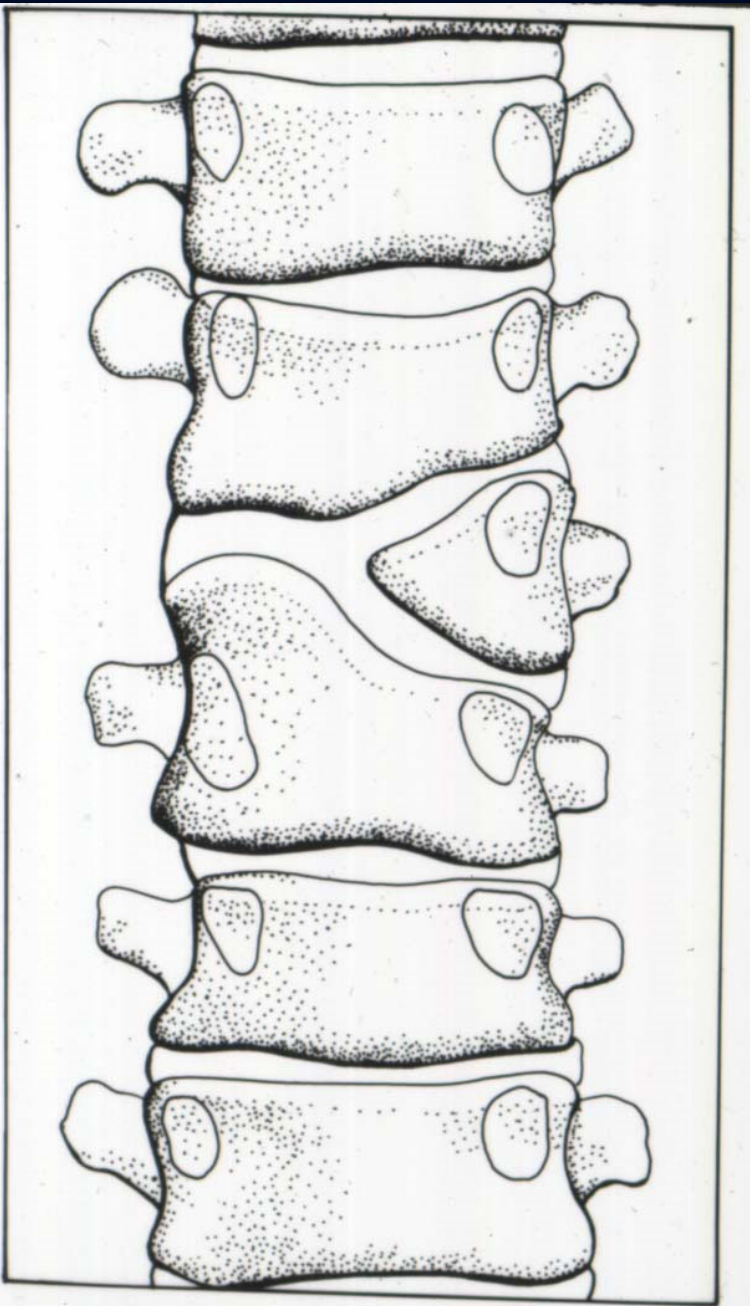
- Types of congenital spinal deformities
 - Scoliosis
 - Kyphosis
 - Lordosis
 - Combined deformities
- Defects of segmentation
 - *block vertebrae*
 - *unilateral bar formation*
- Defects of formation
 - *wedge vertebrae*
 - *hemivertebrae*
- Mixed defects

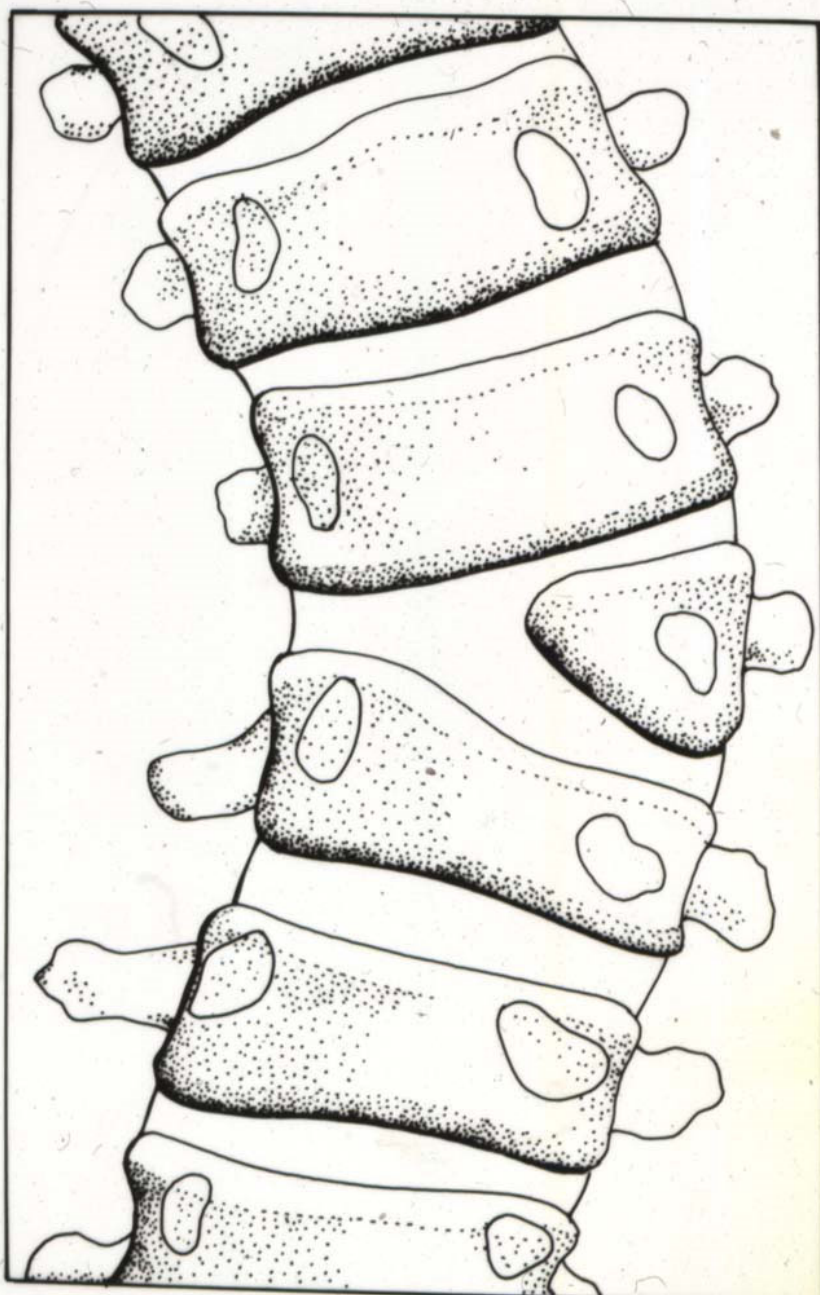


Classification – Congenital Scoliosis

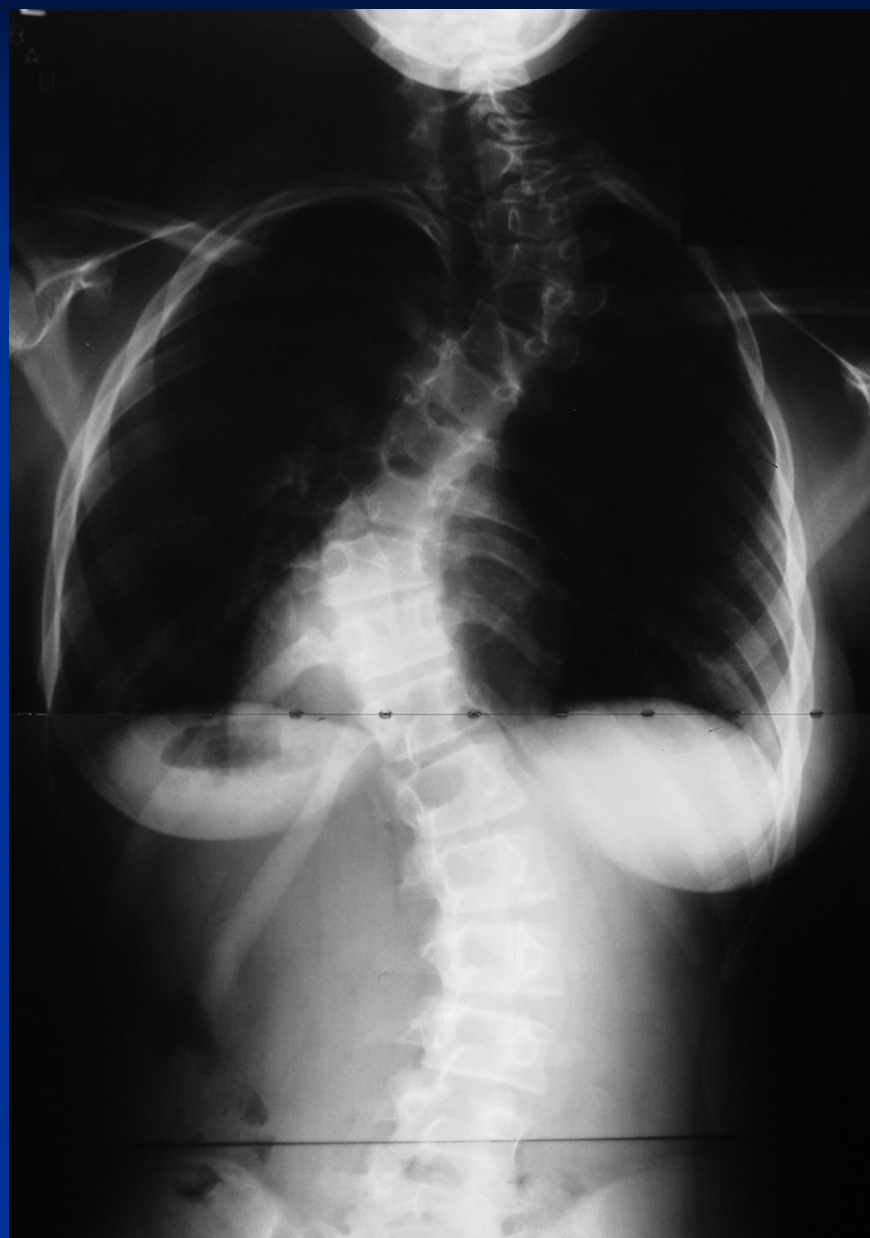
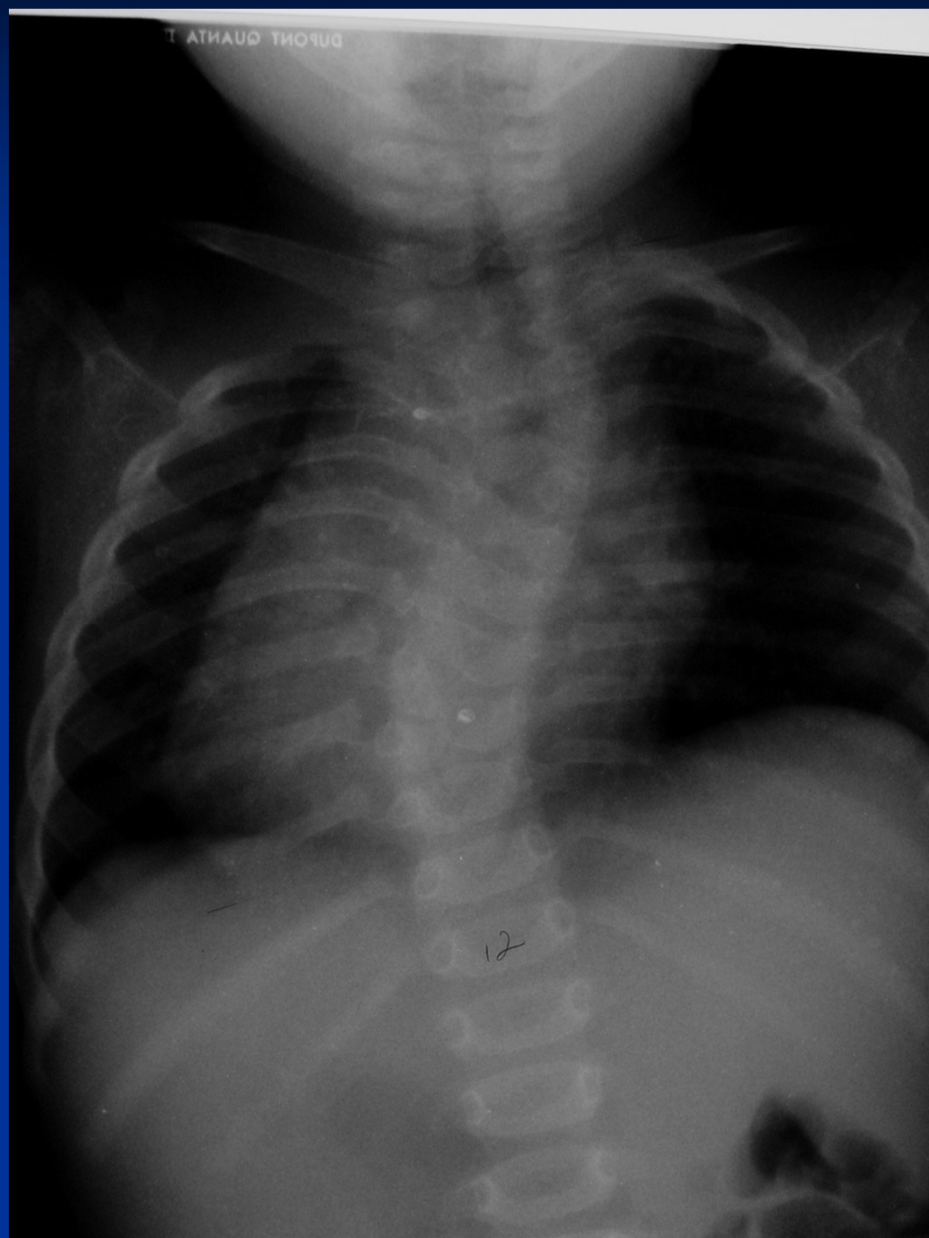
McMaster, Ohtsuka, *J Bone Joint Surg (A)*, 1982











Prognosis

- Type of vertebral anomaly and degree of growth imbalance
 - Unilateral bar with contralateral hemivertebra
- Site of anomaly
 - Most severe in thoracic and thoracolumbar regions
 - Site important in clinical appearance, cord comp.
- The age of the patient
 - Very young children – marked growth imbalance
 - Rate of deterioration increases again after age 10

Natural History – Congenital Scoliosis

TABLE 2. MEDIAN YEARLY RATE OF DETERIORATION (IN DEGREES) WITHOUT TREATMENT FOR EACH TYPE OF SINGLE CONGENITAL SCOLIOSIS IN EACH REGION OF THE SPINE

| Site of Curvature | Type of Congenital Anomaly | | | | | |
|-------------------|----------------------------|----------------|--------------|---------|----------------------------|--|
| | Block Vertebra | Wedge Vertebra | Hemivertebra | | Unilateral Unsegmented Bar | Unilateral Unsegmented Bar and Contralateral Hemivertebrae |
| | | | Single | Double | | |
| Upper thoracic | <1°–1° | ★–2° | 1°–2° | 2°–2.5° | 2°–4° | 5°–6° |
| Lower thoracic | <1°–1° | 2°–2° | 2°–2.5° | 2°–3° | 5°–6.5° | 5°–8° |
| Thoracolumbar | <1°–1° | 1.5°–2° | 2°–3.5° | 5°–★ | 6°–9° | 7°–14° |
| Lumbar | <1°–★ | <1°–★ | <1°–1° | ★ | >5°–★ | ★ |
| Lumbosacral | ★ | ★ | <1°–1.5° | ★ | ★ | ★ |

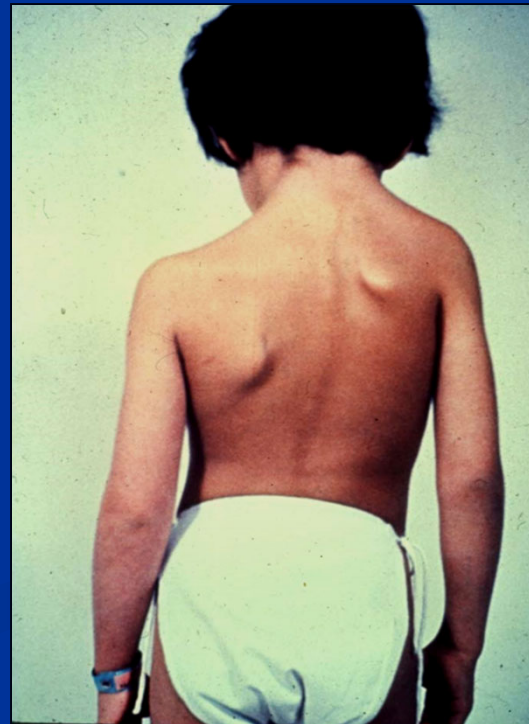
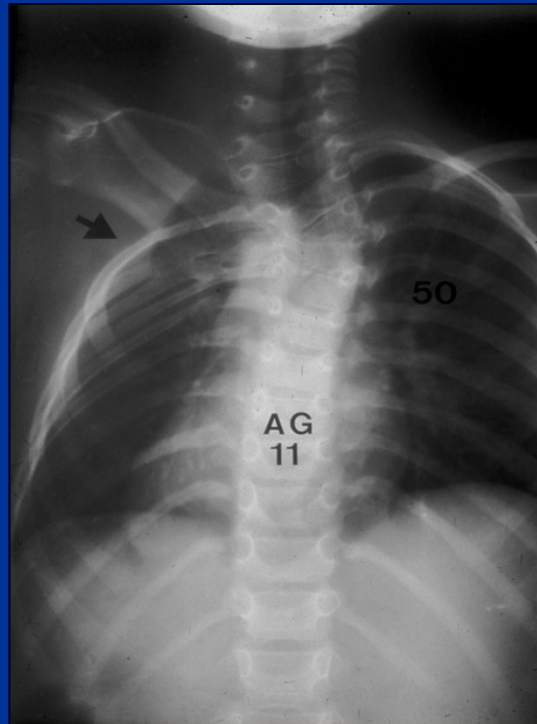
▣ No treatment required ▣ May require spinal surgery ▣ Requires spinal fusion ★ Too few or no curves

Ranges represent the degree of deterioration before and after 10 years of age.

Modified from McMaster MJ, Ohtsuka K (1982): The natural history of congenital scoliosis: a study of 251 patients. *J Bone Joint Surg Am* 66: 588–601 and McMaster MJ (1998): Congenital scoliosis caused by a unilateral failure of vertebrae segmentation with contralateral hemivertebrae. *Spine* 23: 998–1005.

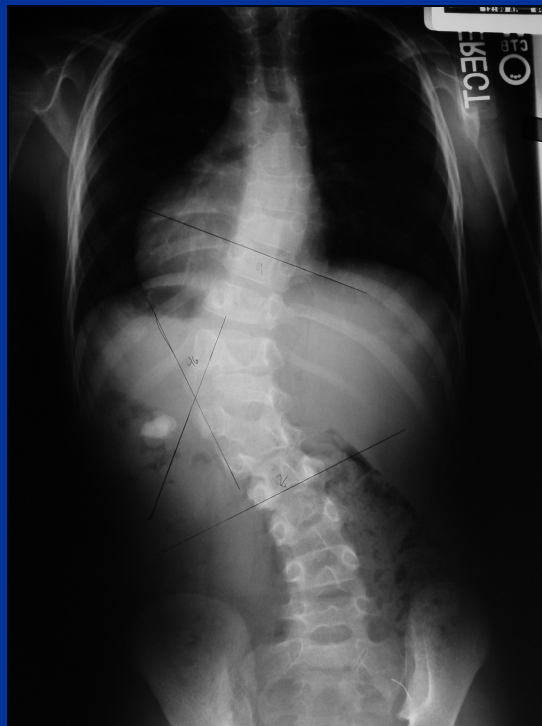
Associated Deforming Features

- Upper thoracic curves
 - Cosmetic deformities, shoulder elevation, head tilt
 - More severe deformities with higher apex



Associated Deforming Features

- Thoracolumbar/Lumbar curves
 - Fail to develop compensatory curves to balance
 - Severe truncal shift and/or pelvic obliquity



Treatment Goals

- Balanced or straight spine at end of growth
- Problem: Little or no growth on concavity
- “Optimal result is a short, relatively straight spine rather than the severely crooked spine that would have developed without treatment.”
 - M.J. McMaster
- Advanced techniques: growth stimulation or resection

Treatment Objectives

- Early diagnosis
 - Prophylactic surgery before deformity develops
- Anticipation
 - Amount of growth
 - Type, site of anomaly
- Prevention of deterioration
 - “Easier to prevent a severe deformity than to correct one.”
 - Common error: failure to see slow, relentless progression until it is too late for prevention

Timing of Operative Treatment

- Documented progression of spinal and/or thoracic deformity
- Large curve on presentation
- Known bad prognosis:
 - Unilateral bar +/- contralateral hemivertebra
 - Congenital kyphosis
 - Congenital lordosis
- Age, site, type of anomaly, size of curve

Management Themes – Operative Treatment

- Prophylactic Procedures
 - Convex growth arrest
 - Arthrodesis in situ
 - Excision of hemivertebra
- Late Surgical Procedures
 - Correction and arthrodesis
 - Spinal osteotomy, VCR and arthrodesis

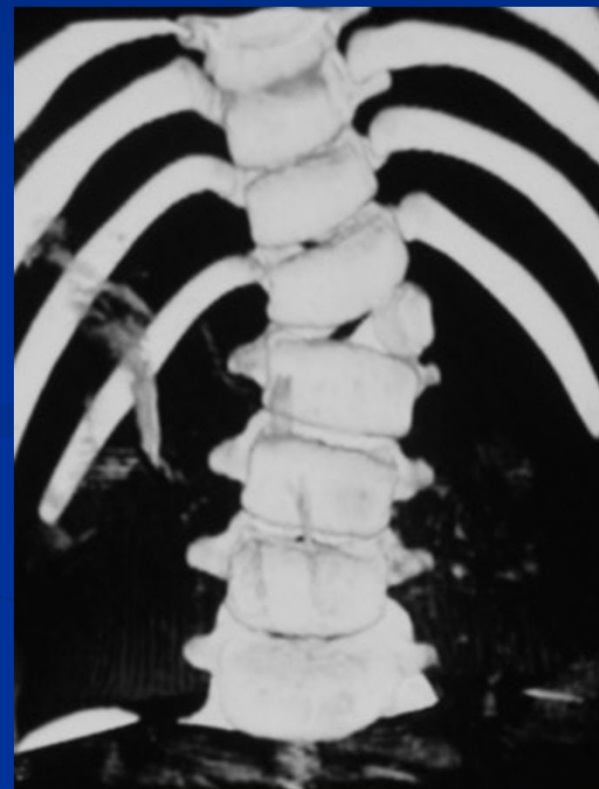


Excision of Hemivertebra

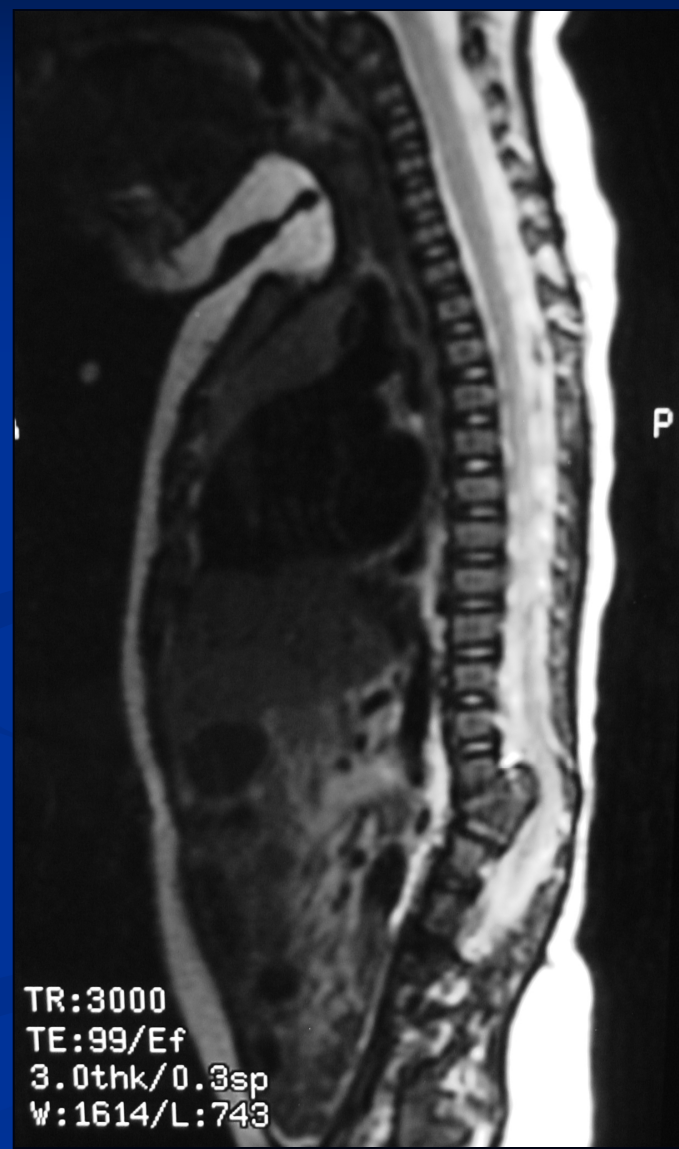
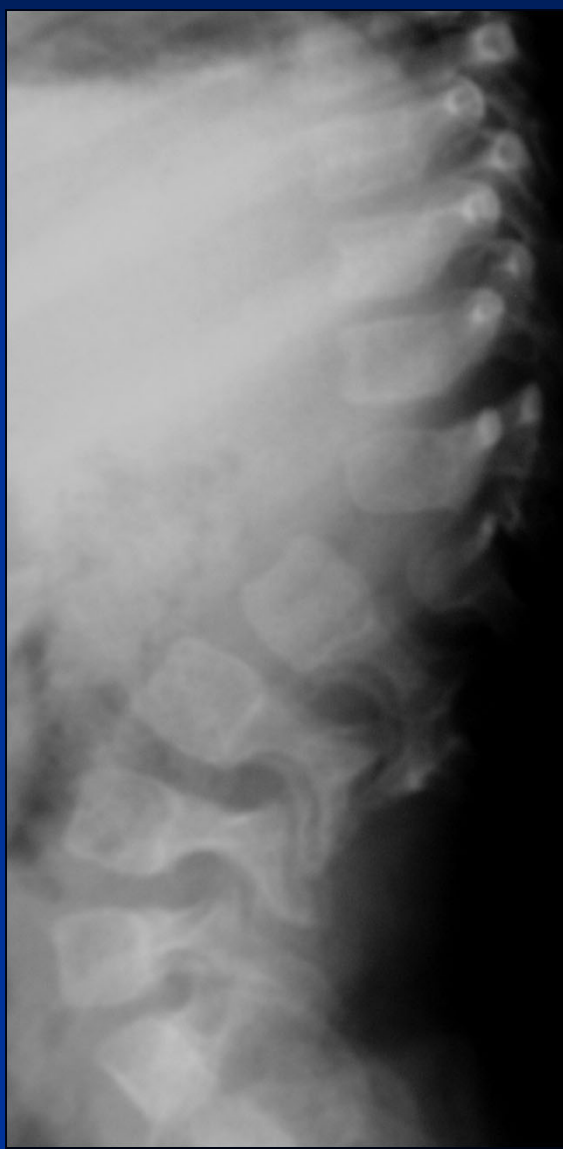
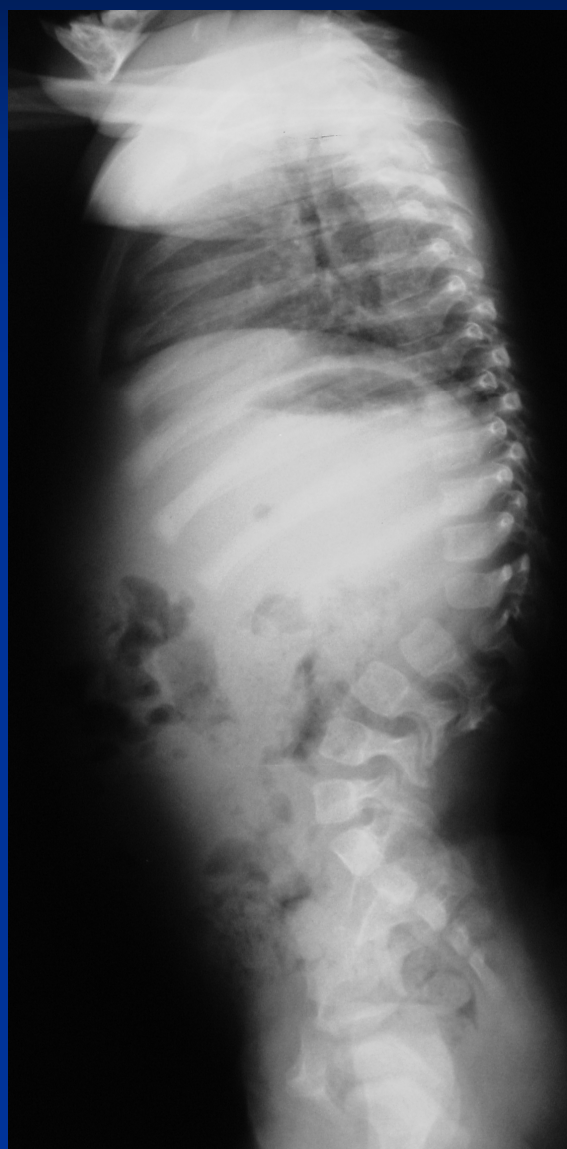
- Removes primary cause of scoliosis
- Wedge osteotomy...when closed corrects curve
- Goals:
 - Maximal correction, realignment of spine
- Requirements:
 - must be done before compensatory curves develop
 - Reliable spinal cord monitoring (TcMEP)
- Problems:
 - Neurologic risk, bleeding

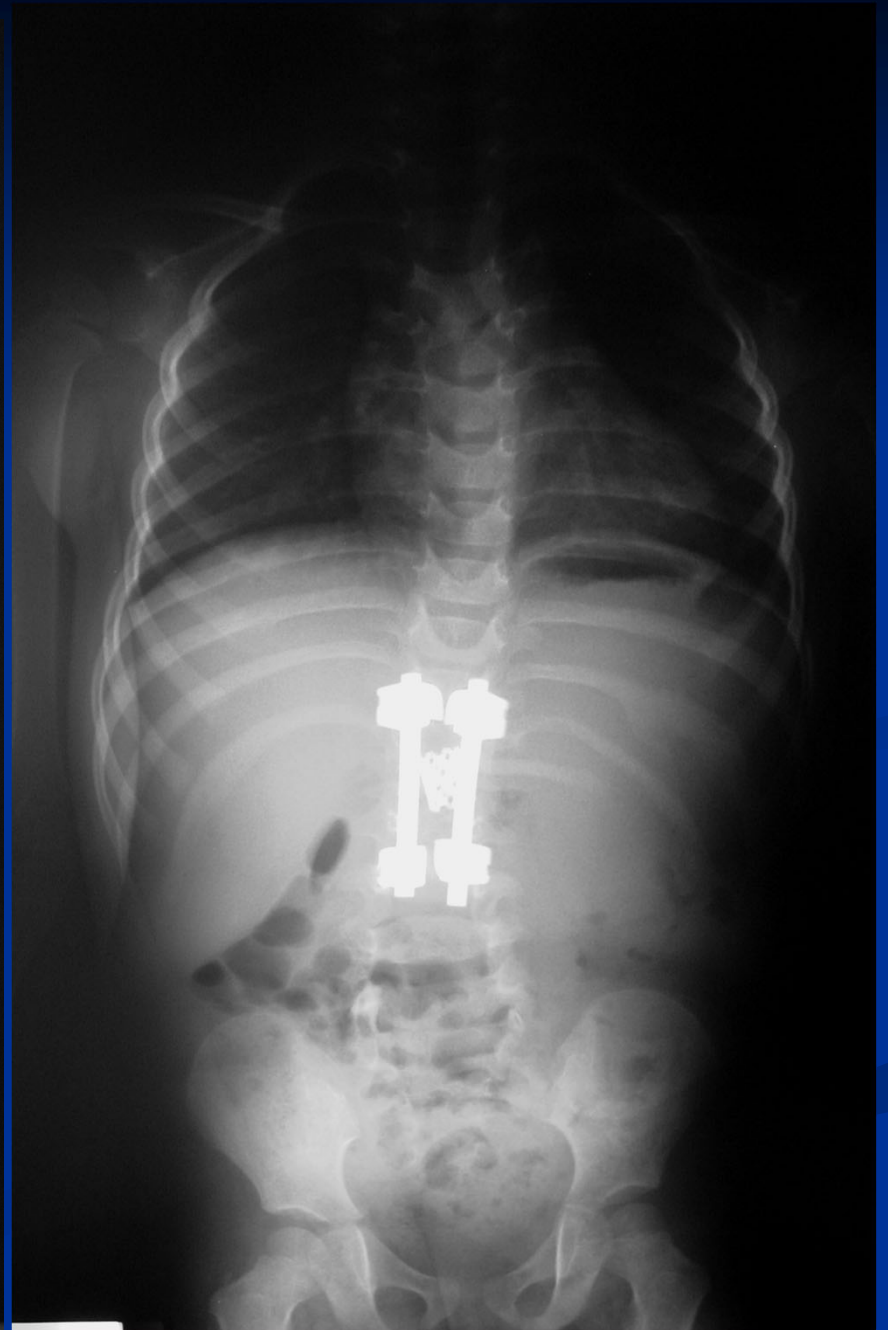
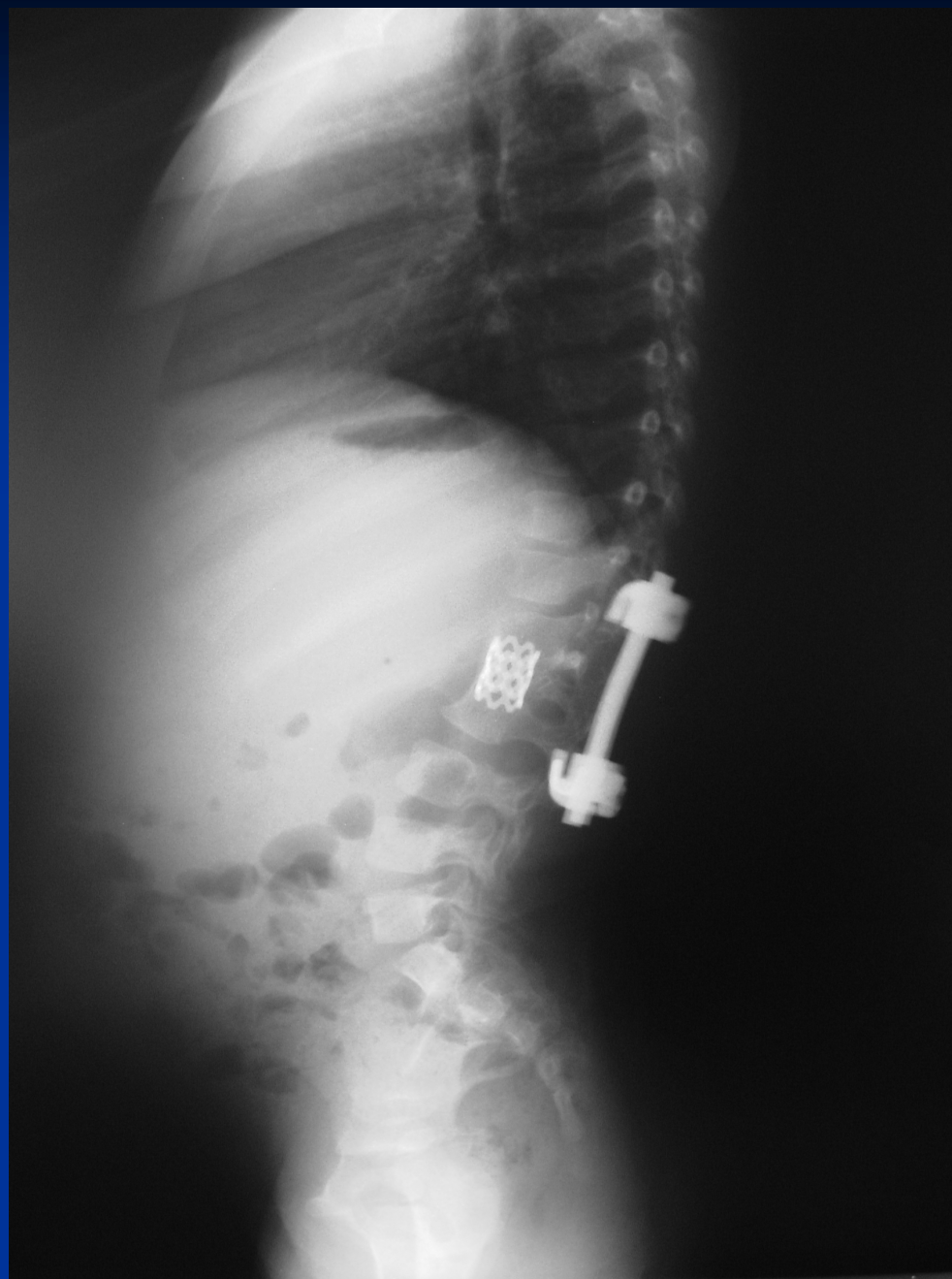
Excision of Hemivertebra - Technique

- Anterior/Posterior combined
- Costotransversectomy
- Anterior excision of hemi, end plates above & below
- Posterior excision of lamina, TP and pedicle
- Correct curve by closing wedge osteotomy, compression inst.
- Cast/brace for 3-6 months



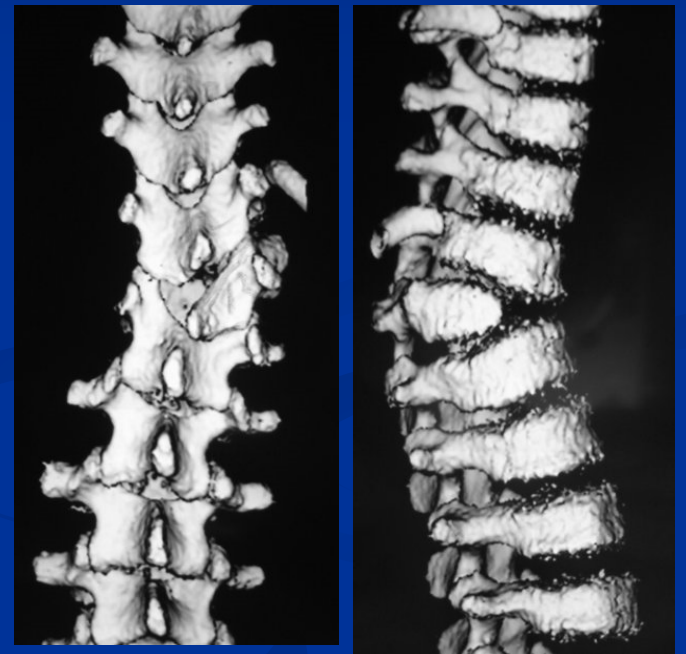
Lazar R, Hall J, CORR 1999
Deviren V, Berven S, JBJS Br 2001
Bollini G, et al Spine 2006





Excision of Hemivertebra - Technique

- Posterior only
- Posterior excision of lamina, TP and pedicle
- Remove hemi, discs and end plate above & below
- Correct curve by closing wedge osteotomy, compression inst.



Excision of Hemivertebra - Technique

- Strive for complete correction
- Works best when performed early (flexible)
- For larger curves, include all vertebra in curve
 - Avoids late progression
- Thoracic spine: ribs resist correction
- Lumbar spine: preserve nerve roots

Excision of Hemivertebra - Results

- Shono, Abumi, Kaneda, *Spine* 2001
 - 12 pts (8-24 yrs) kyphoscoliosis – 64% correction
- Ruf, Harms, *Spine* 2002
 - 21 pts, preop Cobb $41^{\circ} \rightarrow 15^{\circ}$, no neuro deficits
- Nakamura, Matsuda, Konishi, et al, *Spine* 2002
 - 5 pts, 54% correction scoli, 67% correction kyphosis
- Ruf M, Harms J, *Spine* 2003
 - 28 children (avg age 3 yrs + 4 mo)
 - Posterior hemi resection, transpedicular instrum.
 - Preop Cobb $45^{\circ} \rightarrow 13^{\circ}$, no neuro deficits

Hemivertebra Resection

- O'Brien MF, Shufflebarger HL, et al., SRS 2008
- “Efficacy of Hemivertebra Resection for Congenital Scoliosis: A multicenter comparison of three surgical techniques”
- Group 1: fusion w/o correction (n=14)
 - Levels fused = 3 ± 4 correction = 27%
- Group 2: correction w/o resection (n=20)
 - Levels fused = 7 ± 3 correction = 42%
- Group 3: correction w/ hemi resection (n=42)
 - Levels fused = 3 ± 2 correction = 73%

HV resection – higher complication rate, but best correction and shortest fusion

Excision of Hemivertebra - Technique

- Adequate monitoring mandatory (TcMEP)
- Expose spine
- Define levels



Courtesy of Harry Shufflebarger, MD

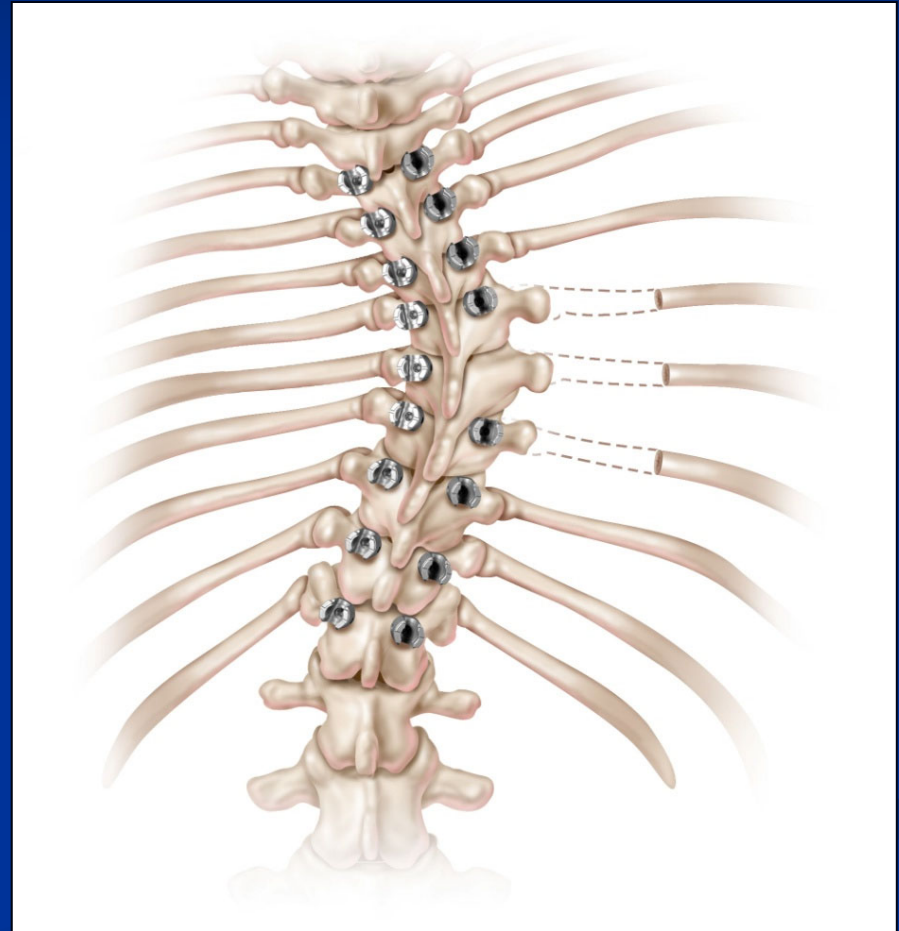
Excision of Hemivertebra - Technique

- Implant screws at all levels except hemi to be excised



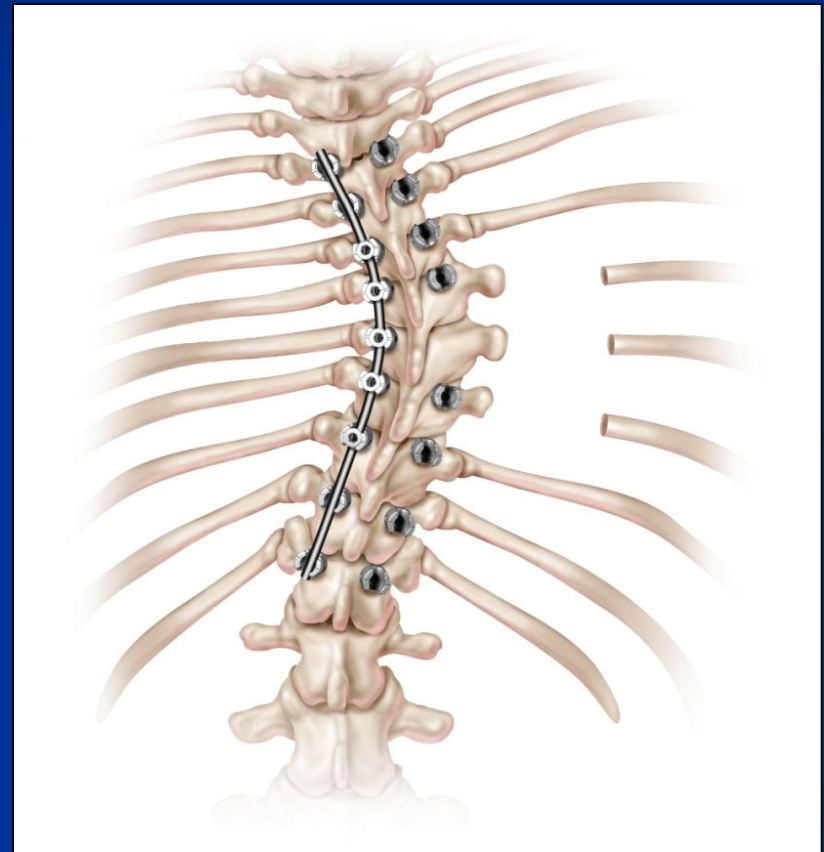
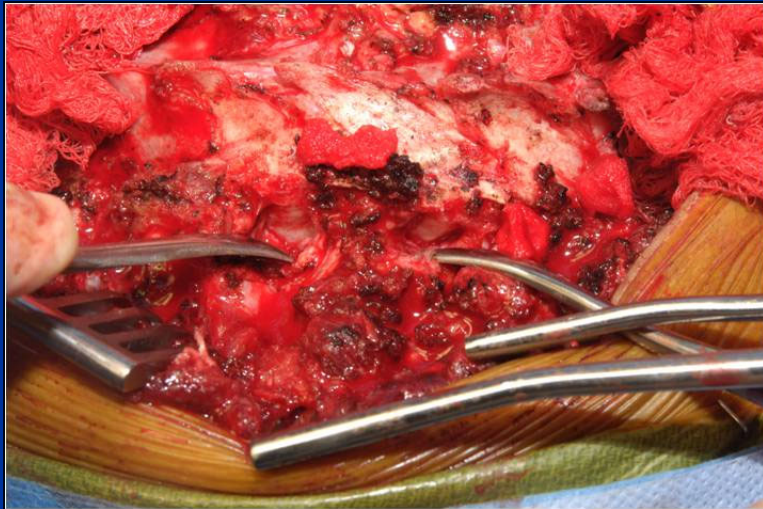
Excision of Hemivertebra - Technique

- Expose rib at level of the hemi
- Expose ribs above and below that level



Excision of Hemivertebra - Technique

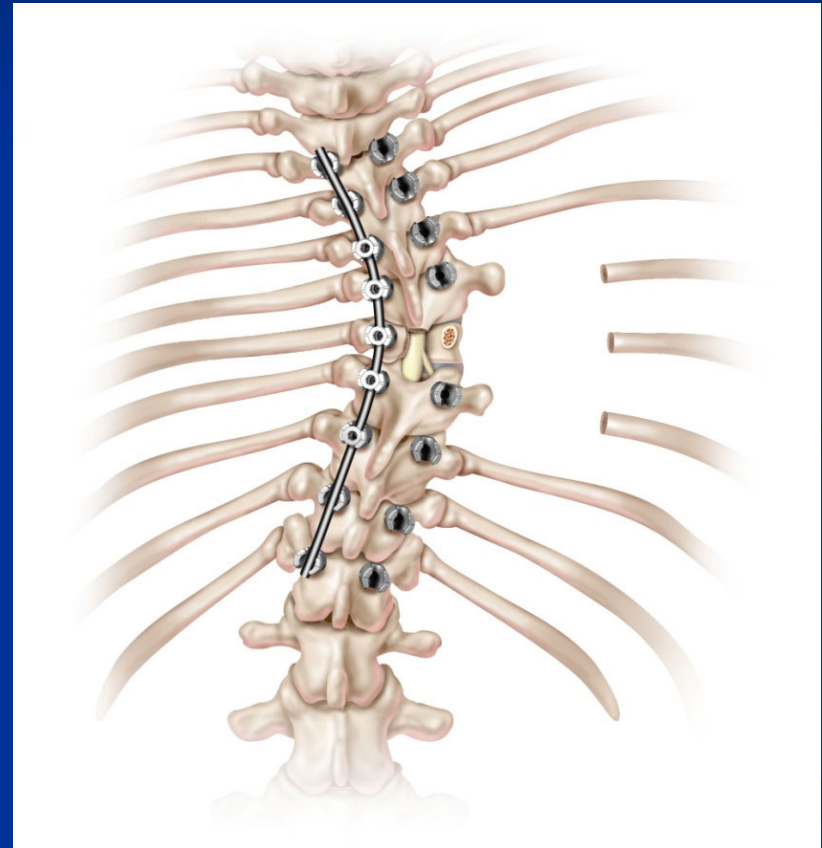
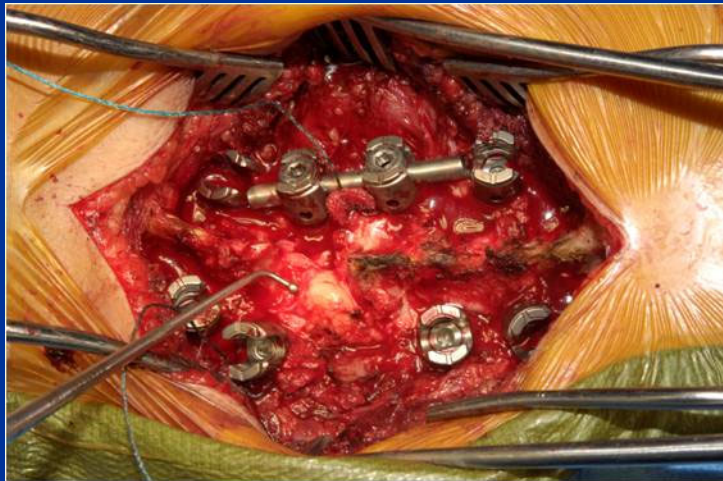
- Excise ribs and rib heads



Place temporary concave rod

Excision of Hemivertebra - Technique

- Laminectomy
- Excise TP
- Expose pedicle
- Expose lateral wall



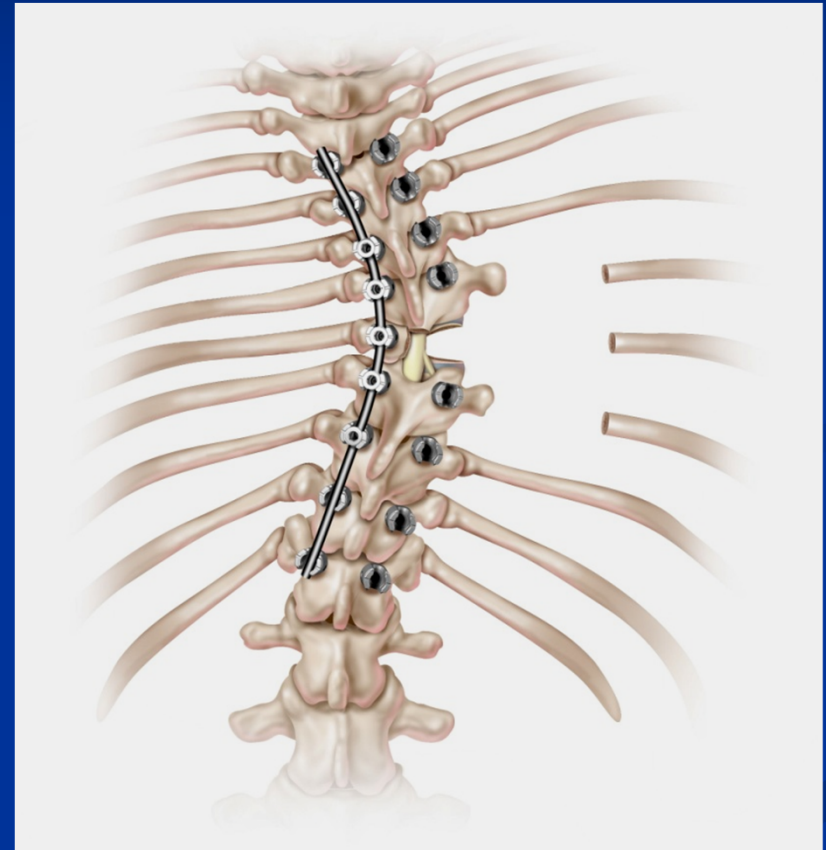
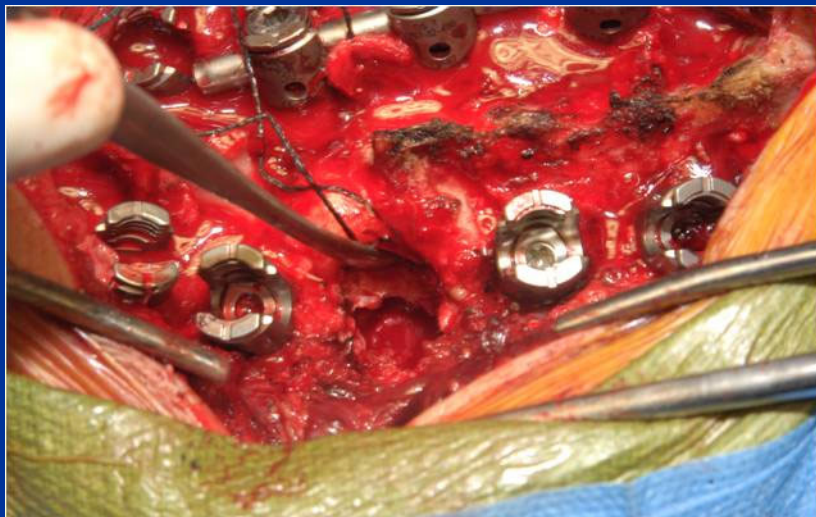
Excision of Hemivertebra - Technique

- Isolate pedicle
- Curette body
- Excise lateral body



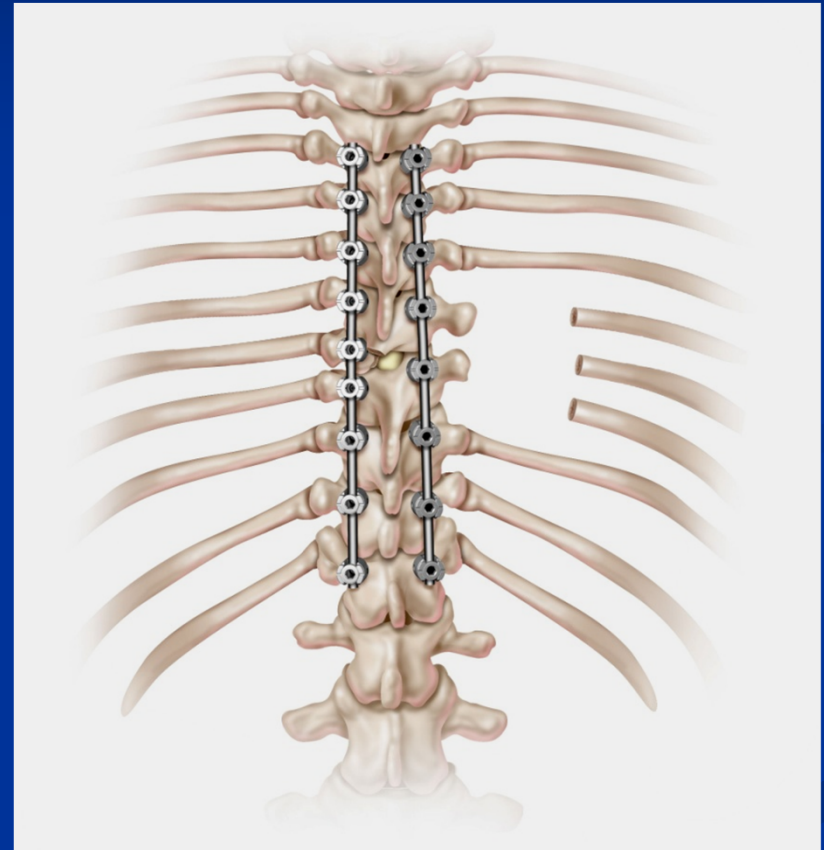
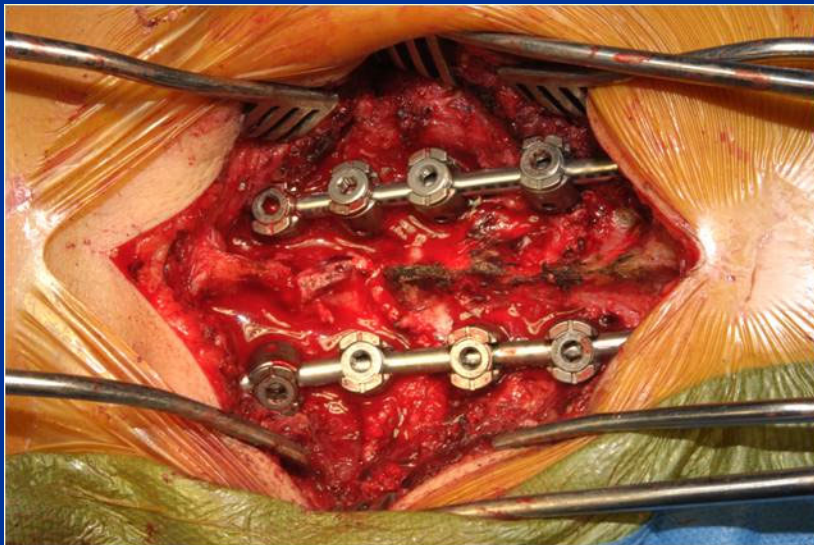
Excision of Hemivertebra - Technique

- Excise anterior and posterior body walls
- Remove disks above and below

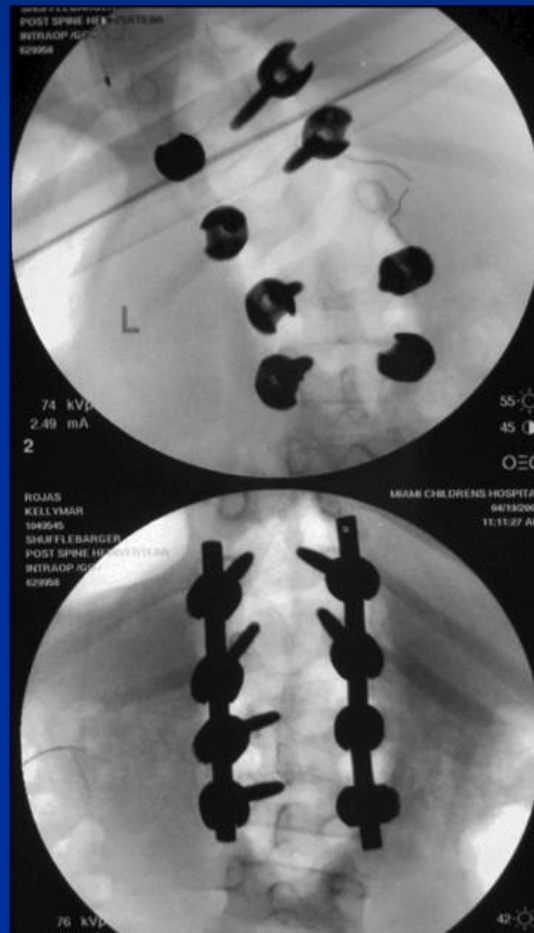
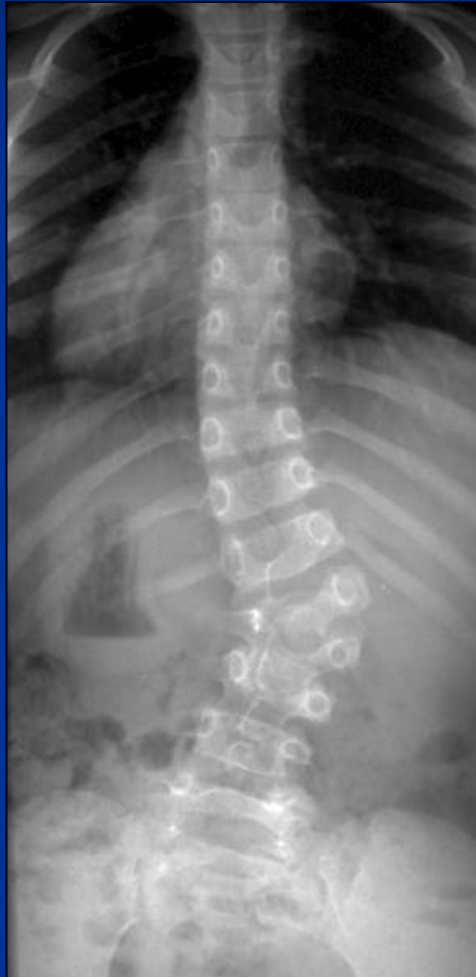


Excision of Hemivertebra - Technique

- Temporary convex rod
- Remove concave rod
- Compress convexity



Posterior Hemivertebra Excision



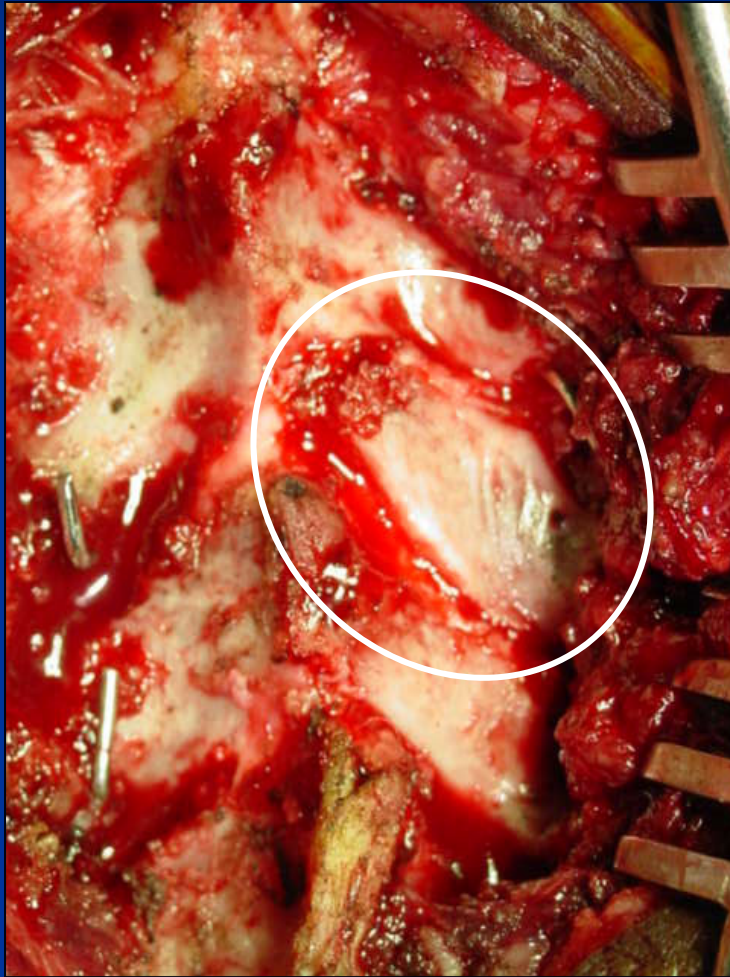
Courtesy of Harry Shufflebarger, MD

Posterior Hemivertebra Excision

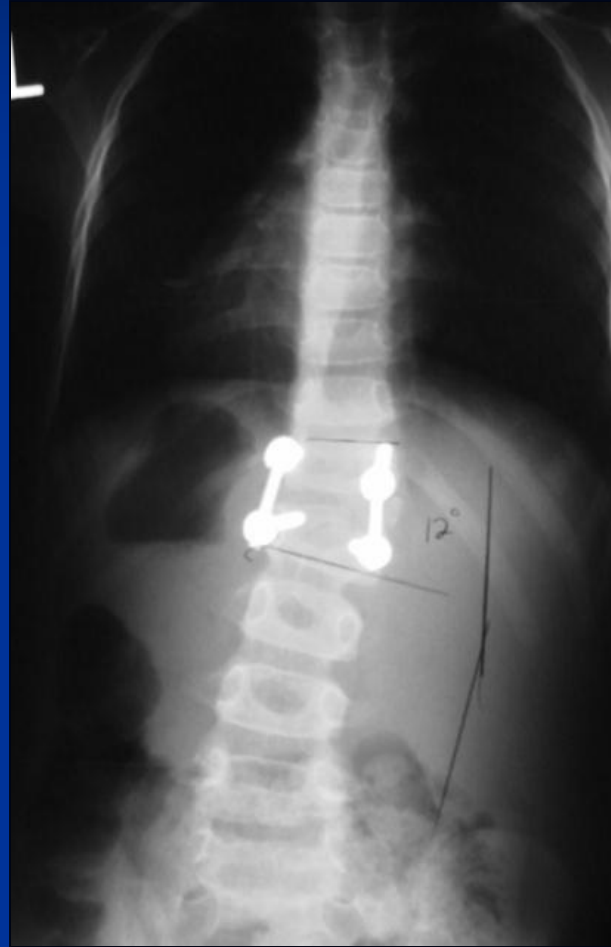
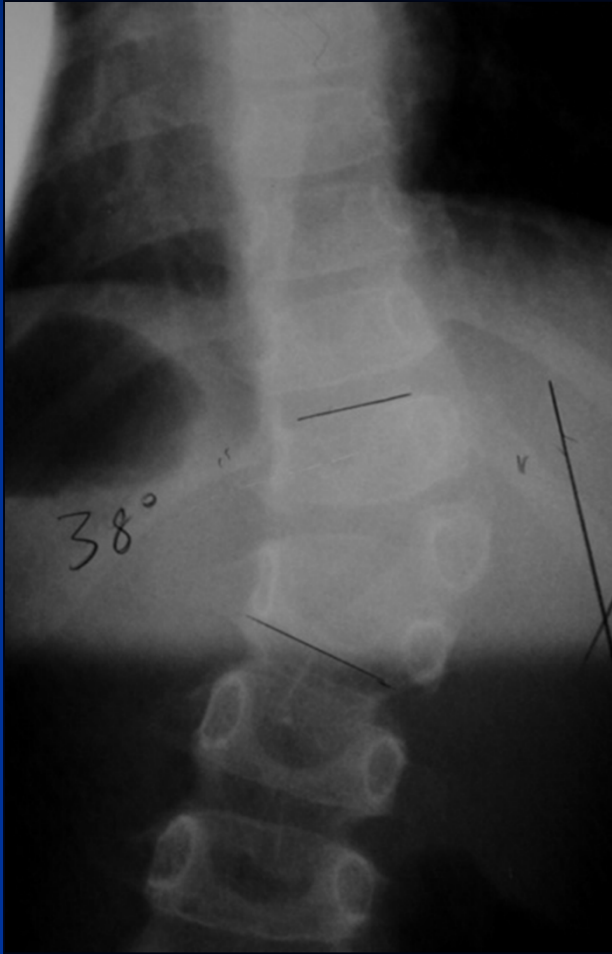


Courtesy of Harry Shufflebarger, MD

Posterior Hemivertebra Excision



Posterior Hemivertebra Excision



10 yo♂ Previous PSF

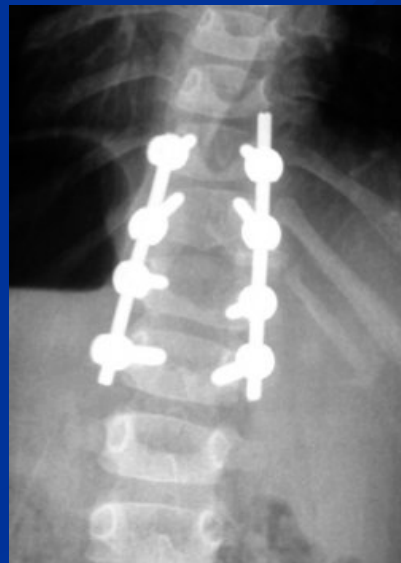


Posterior Hemivertebra Excision



Conclusions – Hemivertebra Excision

- Most effective correction
- Avoids/treats compensatory curvature(s)
- Shortest fusion
- Best option for preservation of growth
- Best option for preservation of motion



Treat the
disease,
not just the
symptom!

Thank you

Nemours



Alfred I. duPont
Hospital for Children

Nemours
Children's Clinic