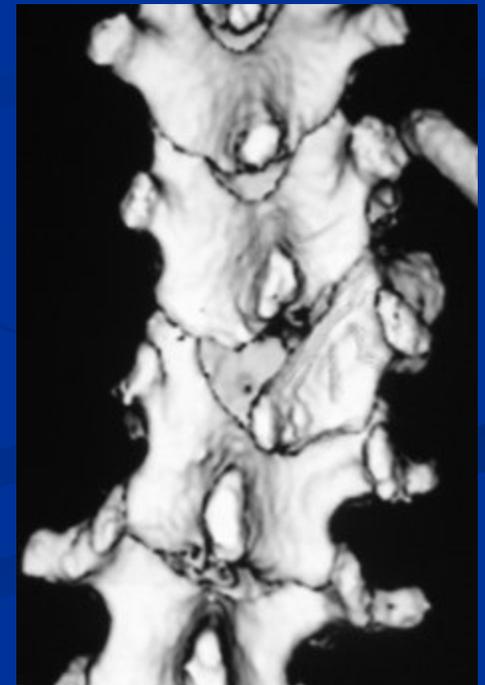


# Hemivertebrectomy: Posterior Approach Only

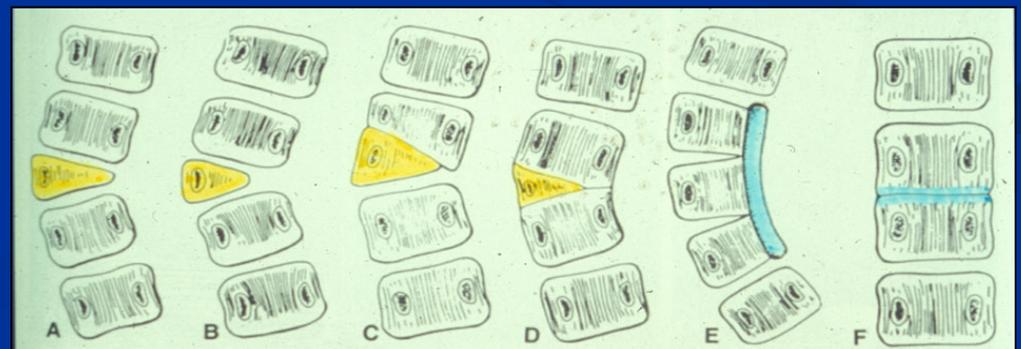
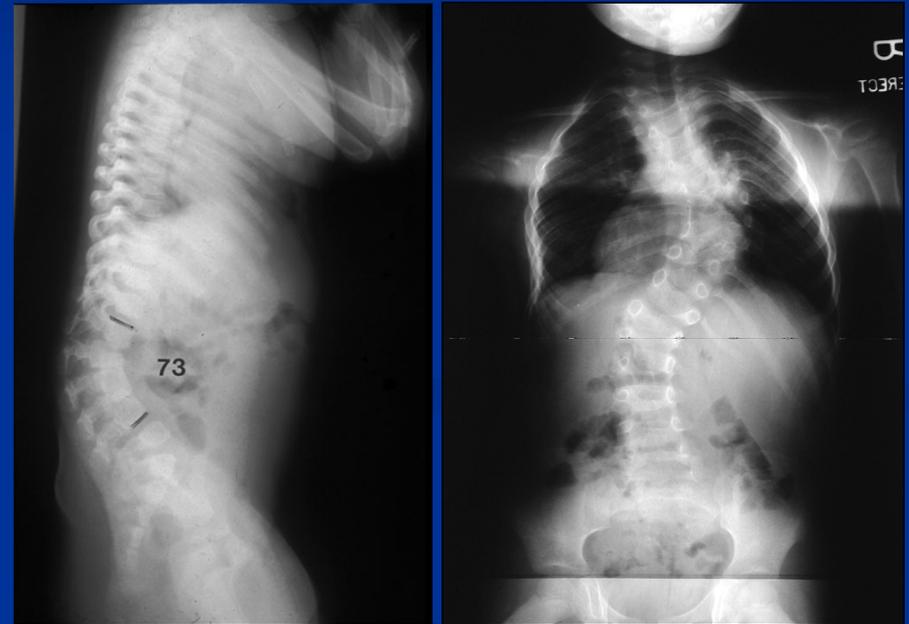


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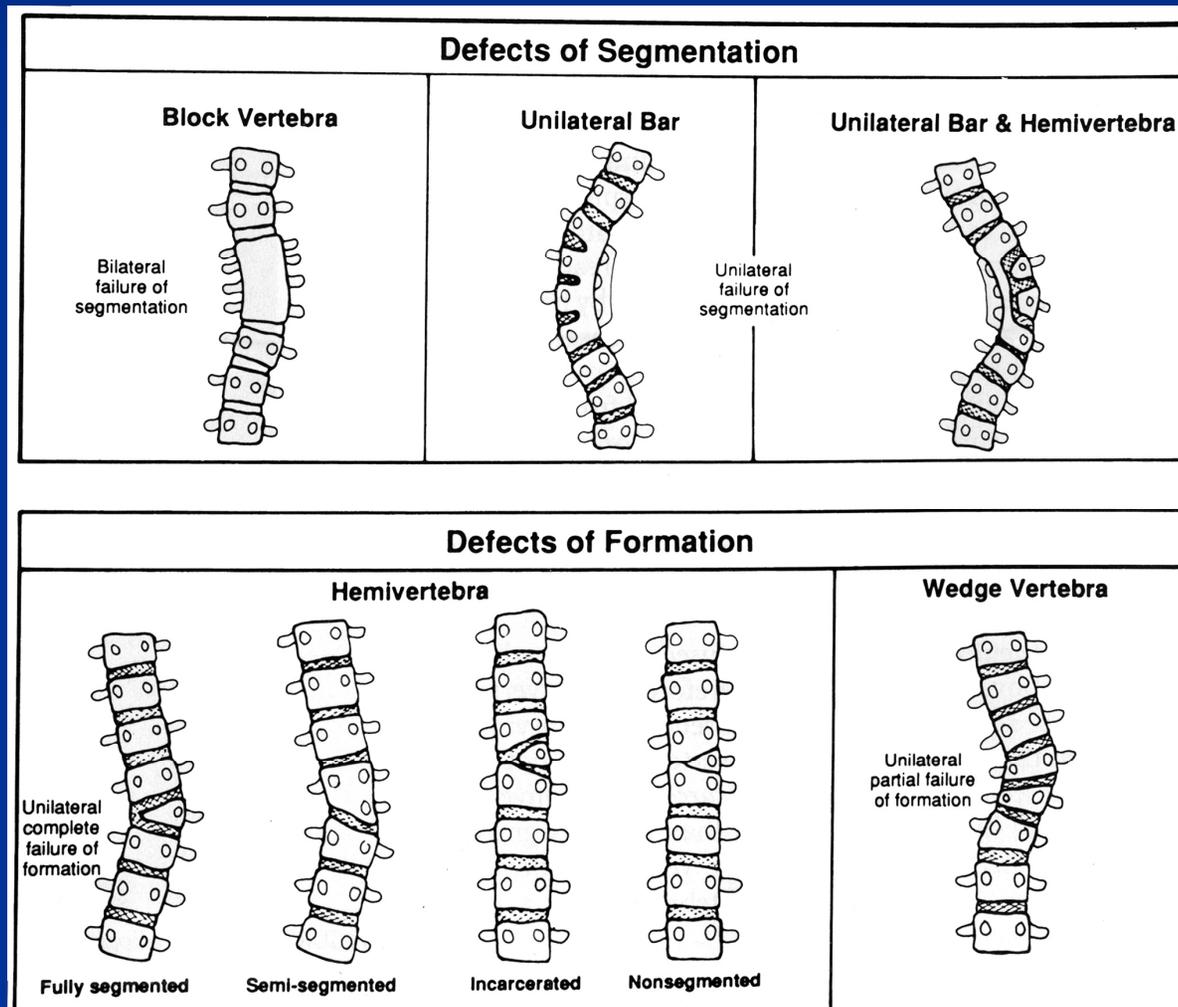
# Congenital Deformities

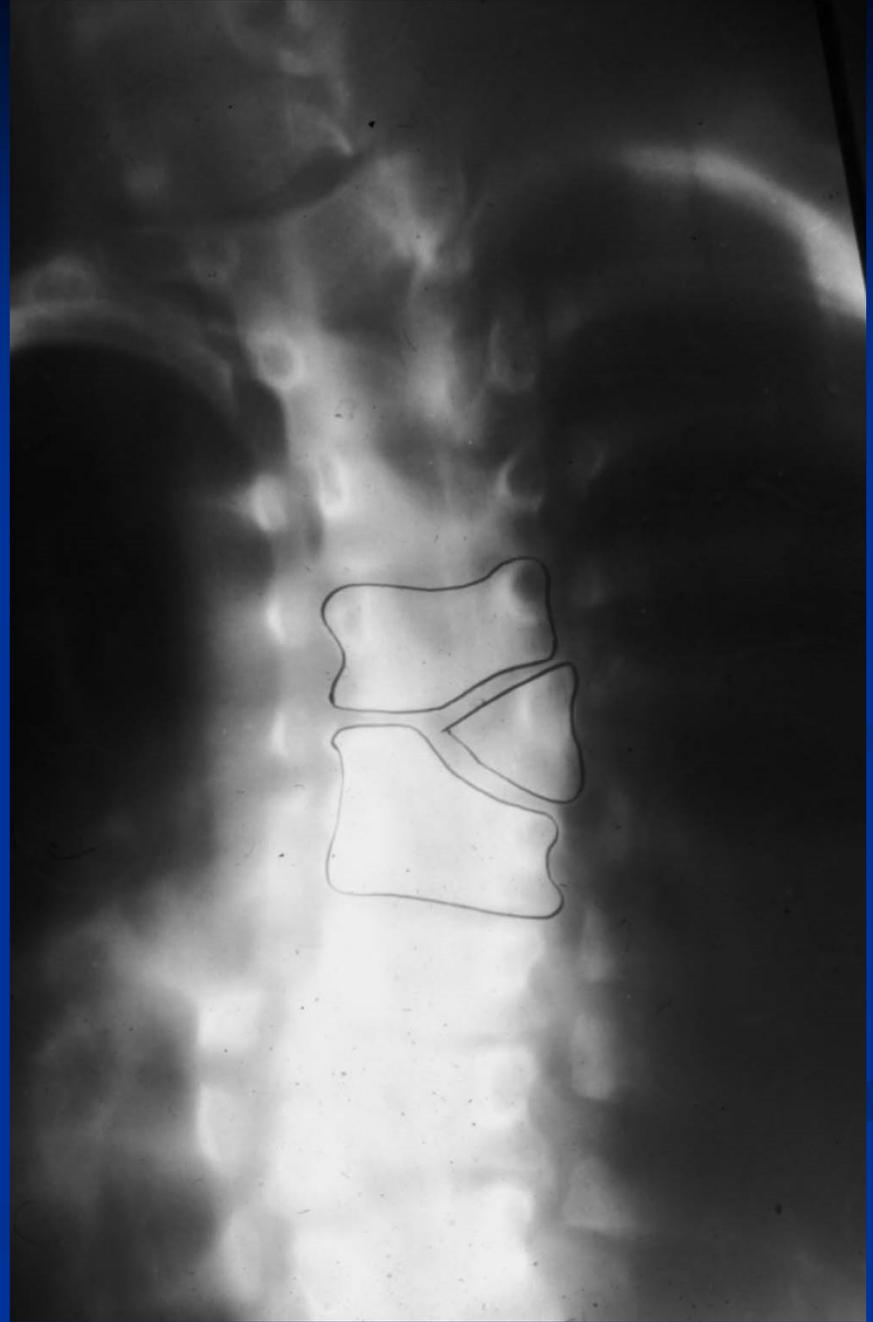
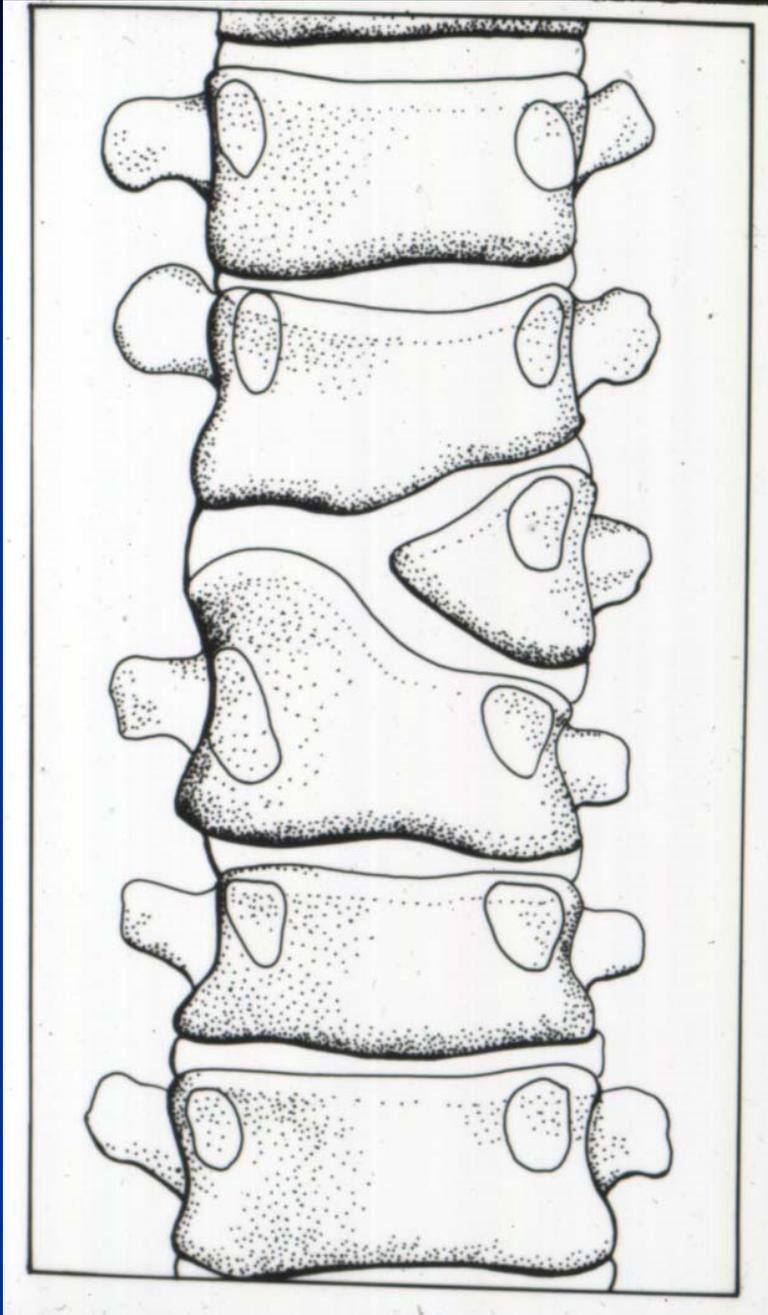
- Types of congenital spinal deformities
  - Scoliosis
  - Kyphosis
  - Lordosis
  - Combined deformities
- Defects of segmentation
  - *block vertebrae*
  - *unilateral bar formation*
- Defects of formation
  - *wedge vertebrae*
  - *hemivertebrae*
- Mixed defects

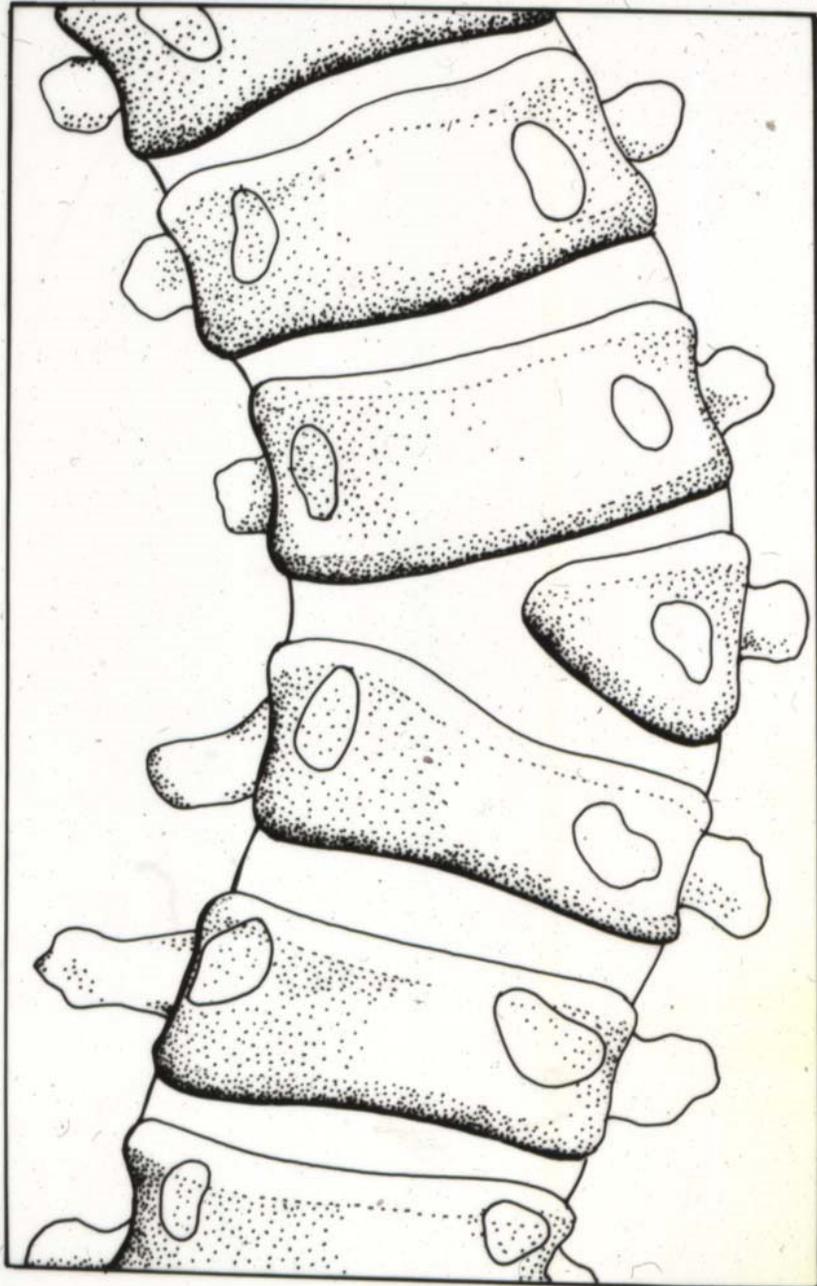


# Classification – Congenital Scoliosis

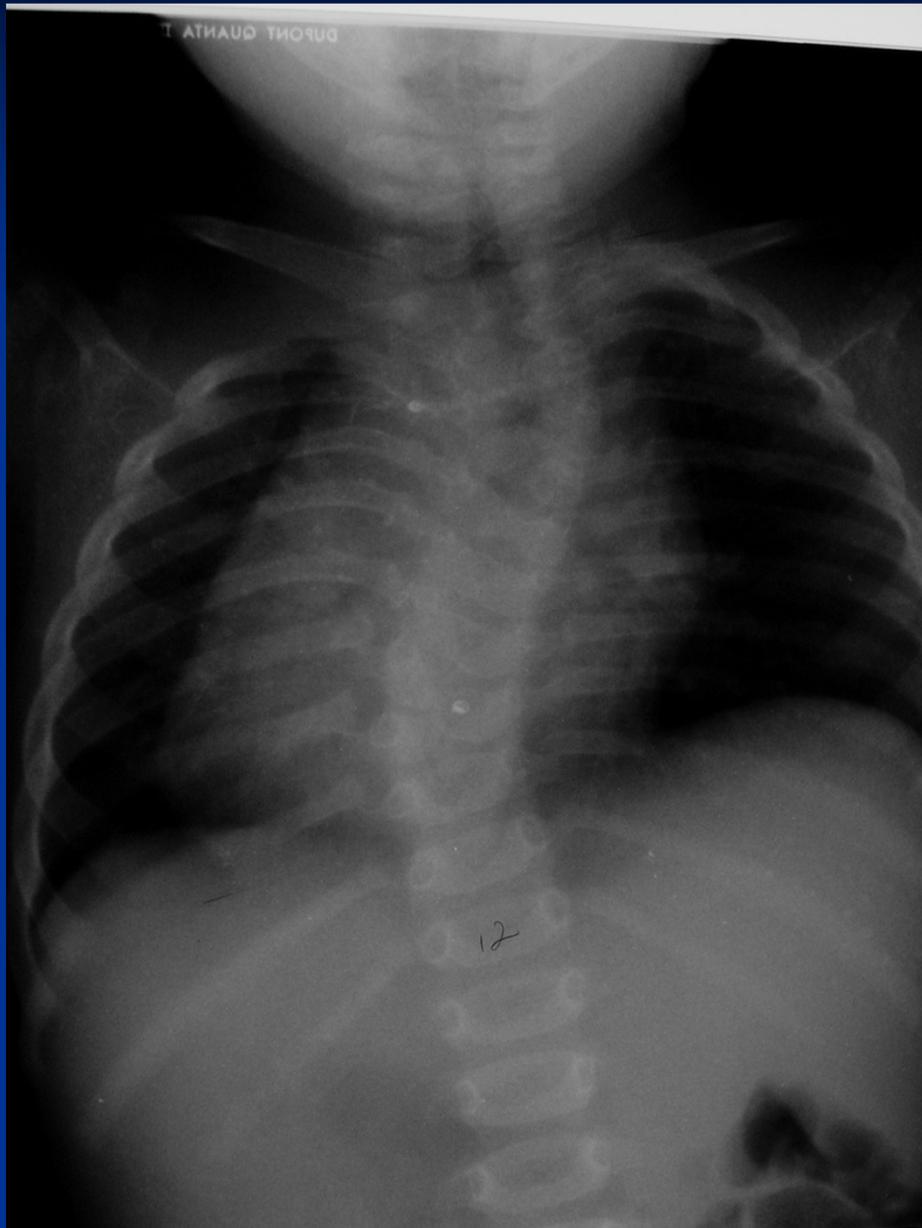
McMaster, Ohtsuka, *J Bone Joint Surg (A)*, 1982











# 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°	★	★	★

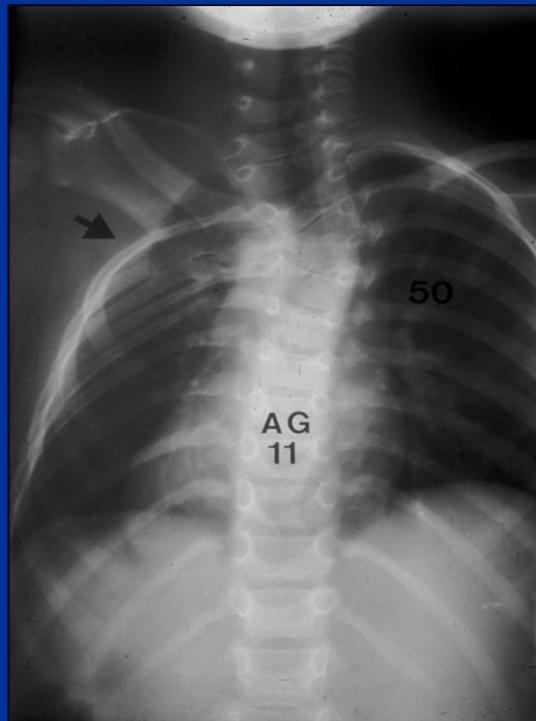
☐ No treatment required    ◻ May require spinal surgery    ◻ Requires spinal fusion    ★ Too few or no curves

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

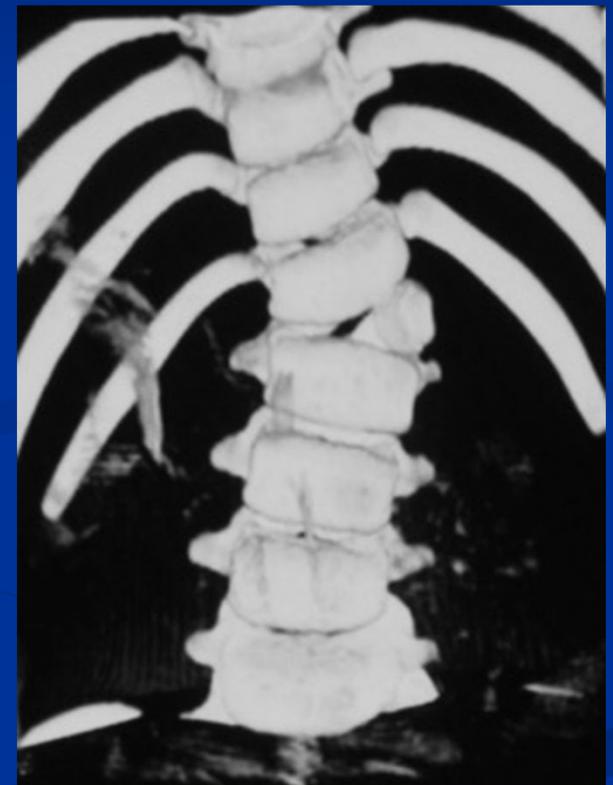


# Excision of Hemivertebra

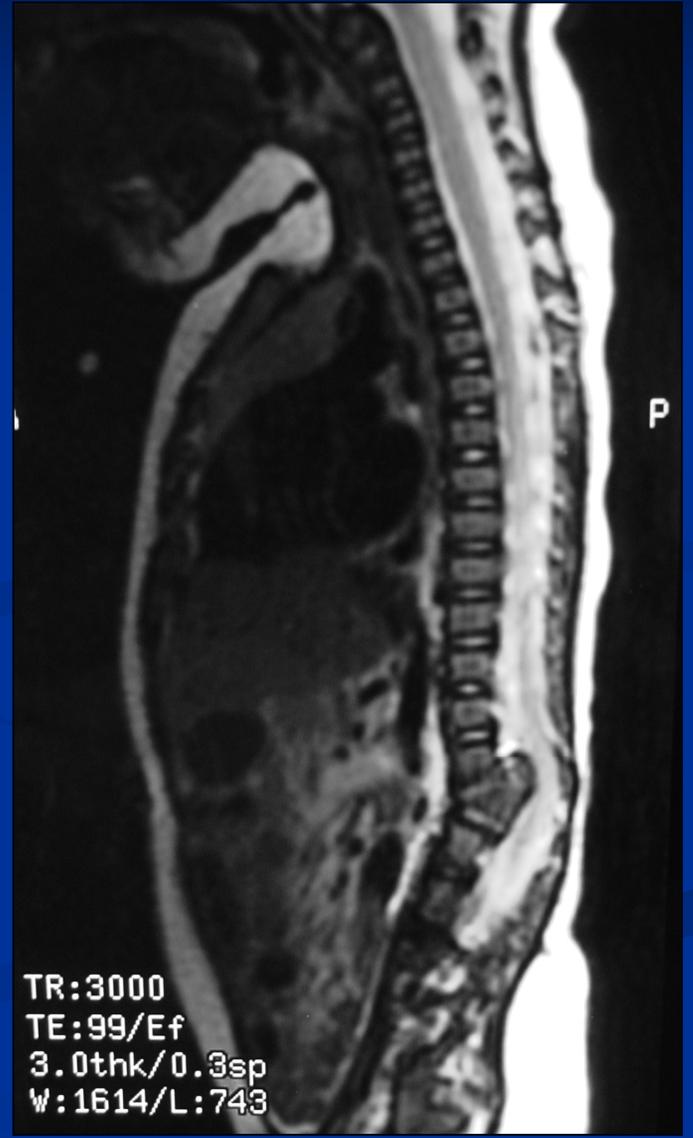
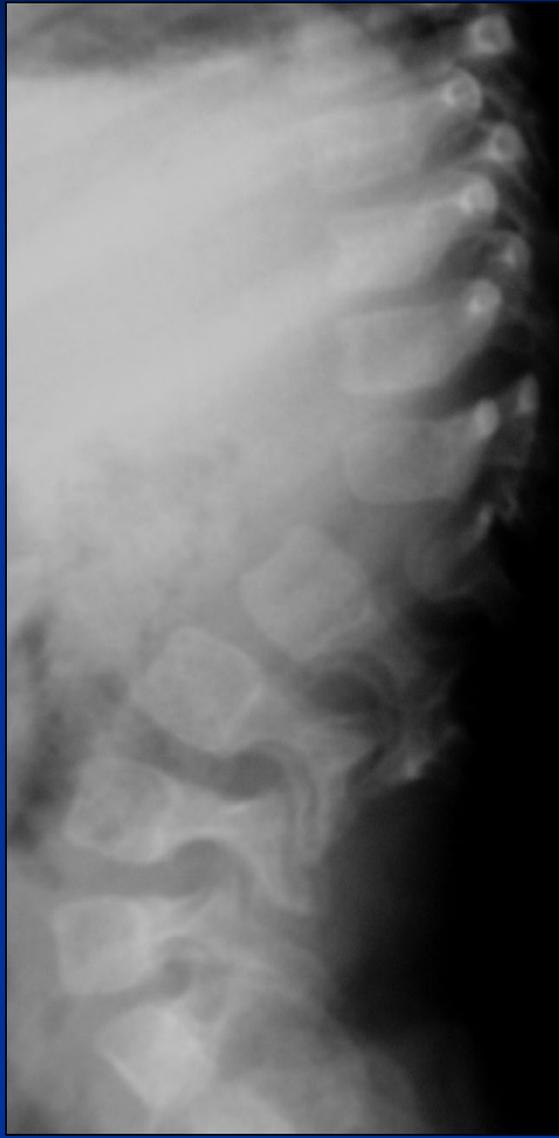
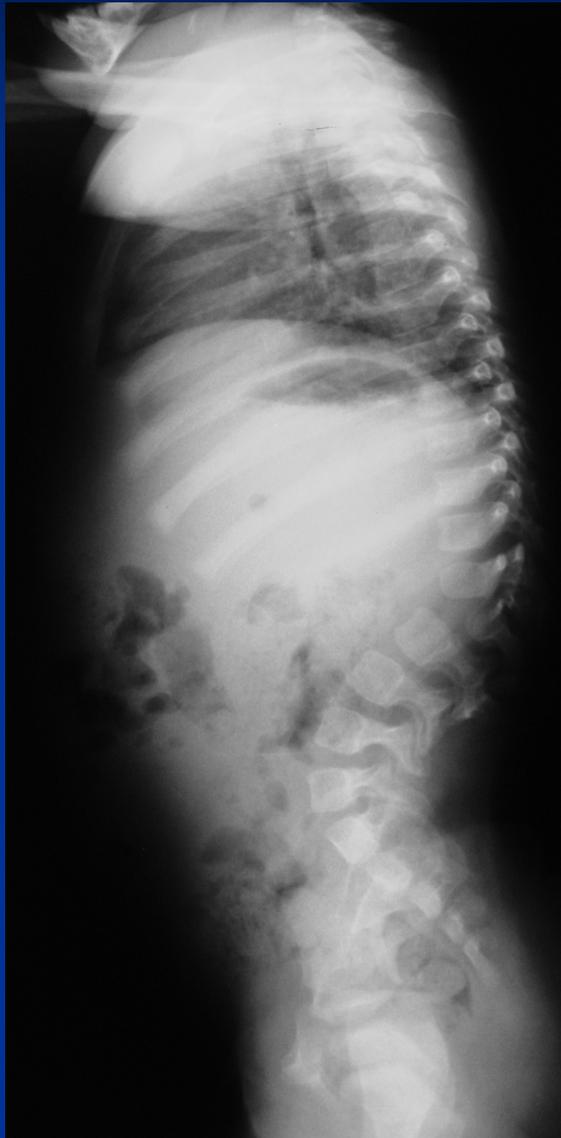
- Removes primary cause of scoliosis
- Wedge osteotomy...when closed corrects curve
- Goals:
  - Maximal correction, realignment of spine
- Requirements:
  - must be done before compensatory curves develop
  - Reliable spinal cord monitoring (TcMEP)
- Problems:
  - Neurologic risk, bleeding

# Excision of Hemivertebra - Technique

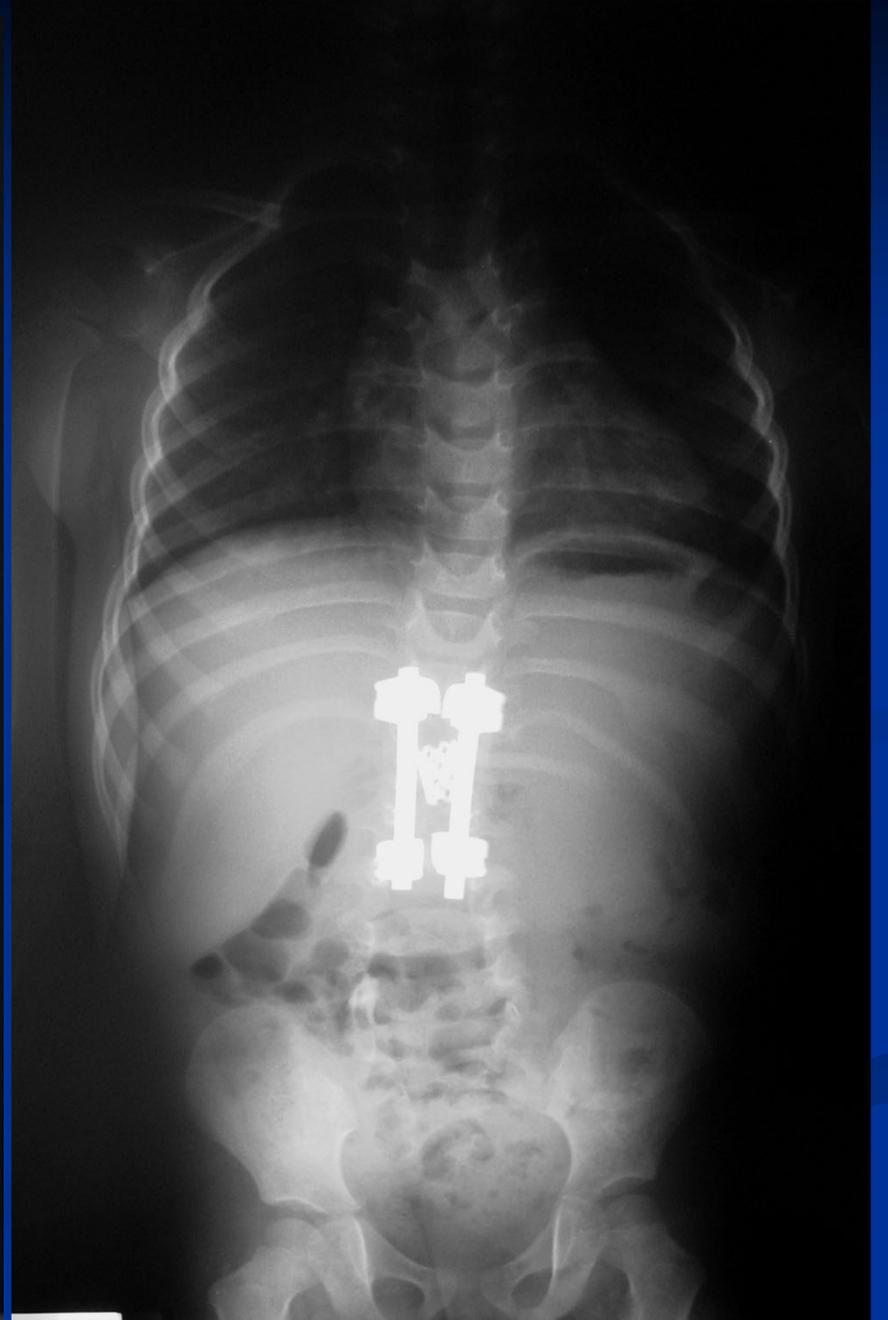
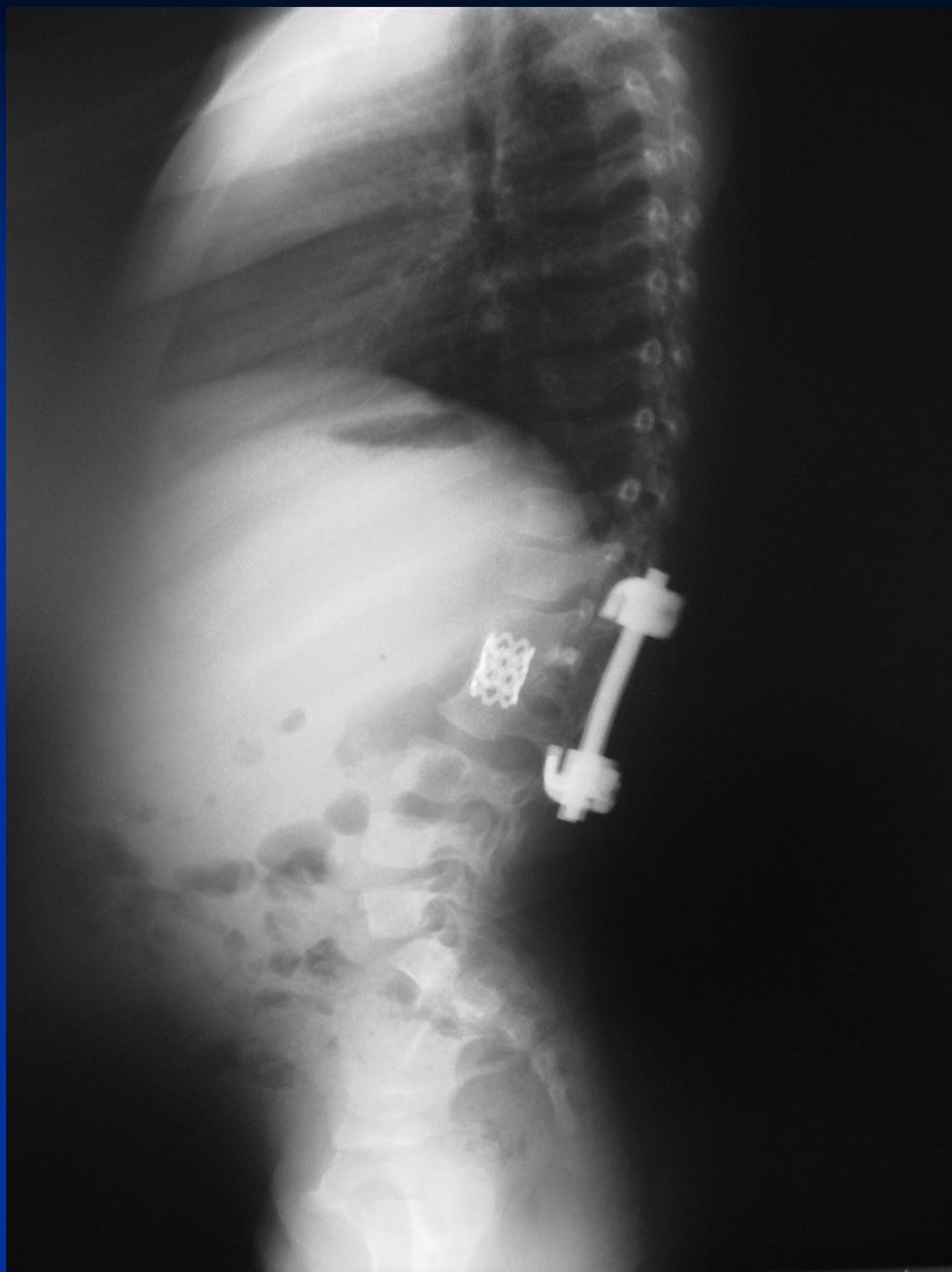
- Anterior/Posterior combined
- Costotransversectomy
- Anterior excision of hemi, end plates above & below
- Posterior excision of lamina, TP and pedicle
- Correct curve by closing wedge osteotomy, compression inst.
- Cast/brace for 3-6 months



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

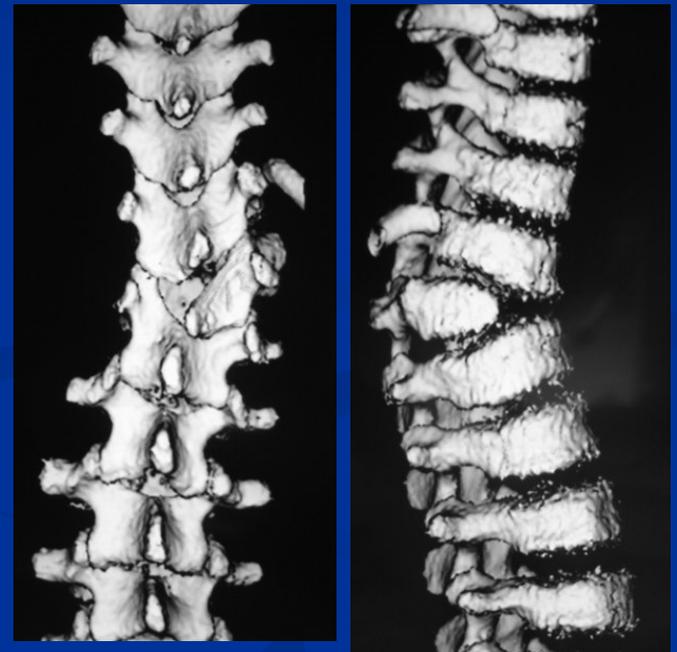


TR:3000  
TE:99/Ef  
3.0thk/0.3sp  
W:1614/L:743



# 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° → 15°, 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° → 13°, 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 =  $3 \pm 4$       correction = 27%
- Group 2: correction w/o resection (n=20)
  - Levels fused =  $7 \pm 3$       correction = 42%
- Group 3: correction w/ hemi resection (n=42)
  - Levels fused =  $3 \pm 2$       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*

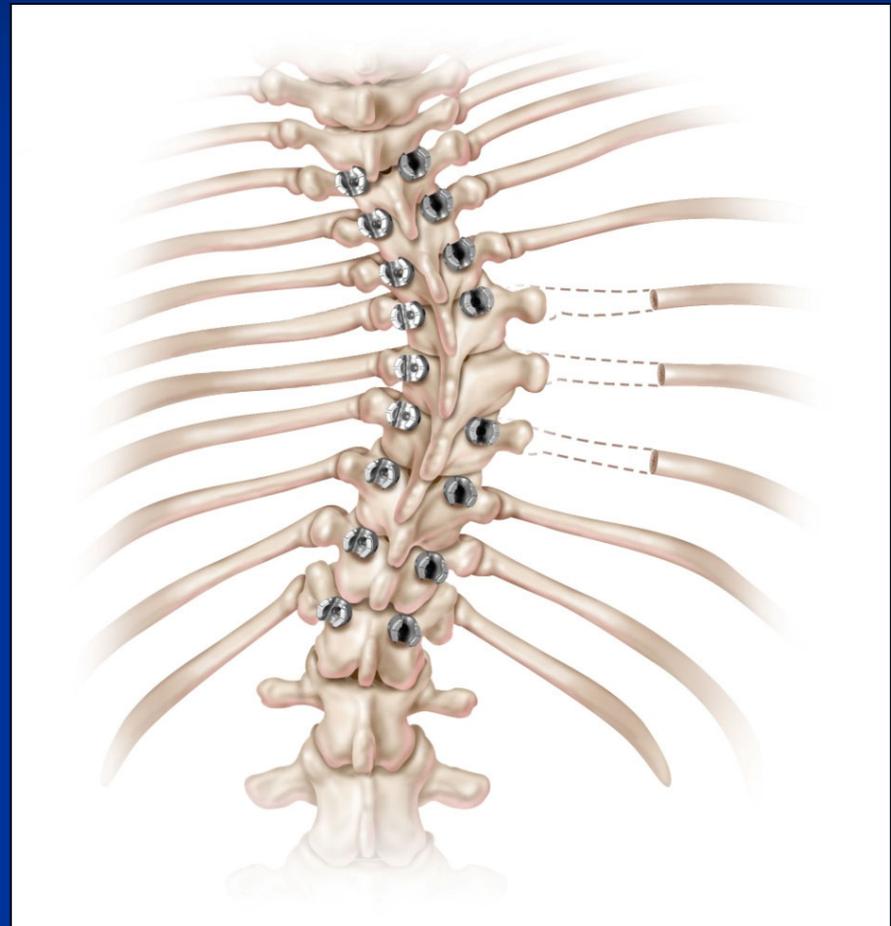
# Excision of Hemivertebra - Technique

- 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

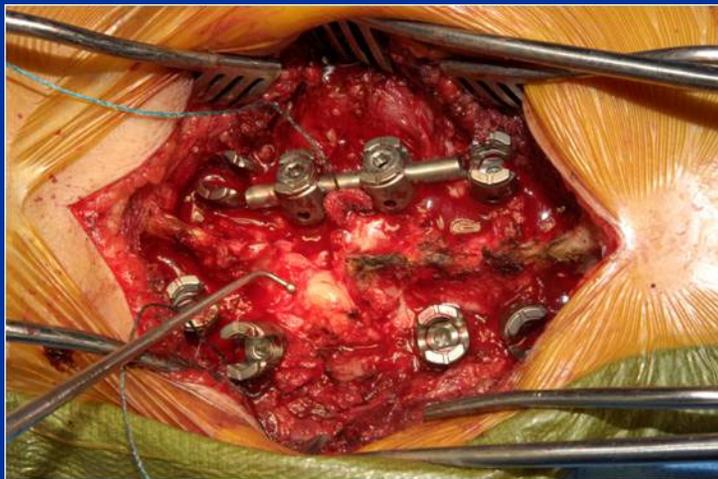
- Excise ribs and rib heads



Place temporary concave rod

# Excision of Hemivertebra - Technique

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



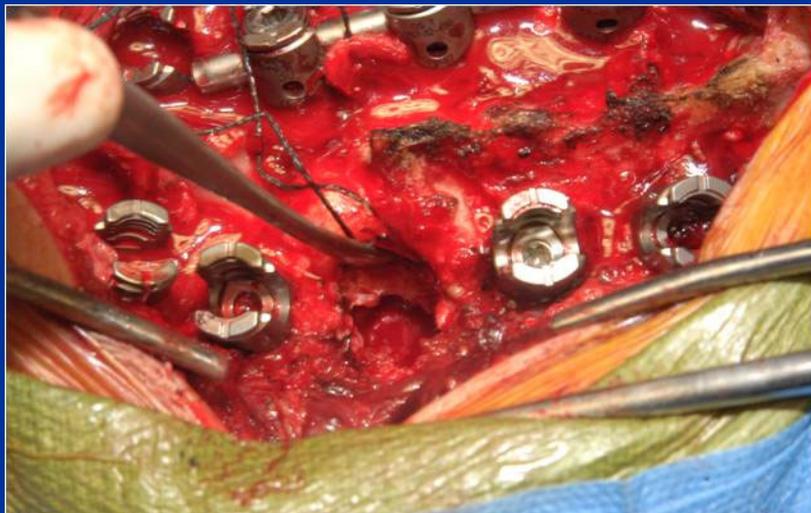
# Excision of Hemivertebra - Technique

- Isolate pedicle
- Curette body
- Excise lateral body



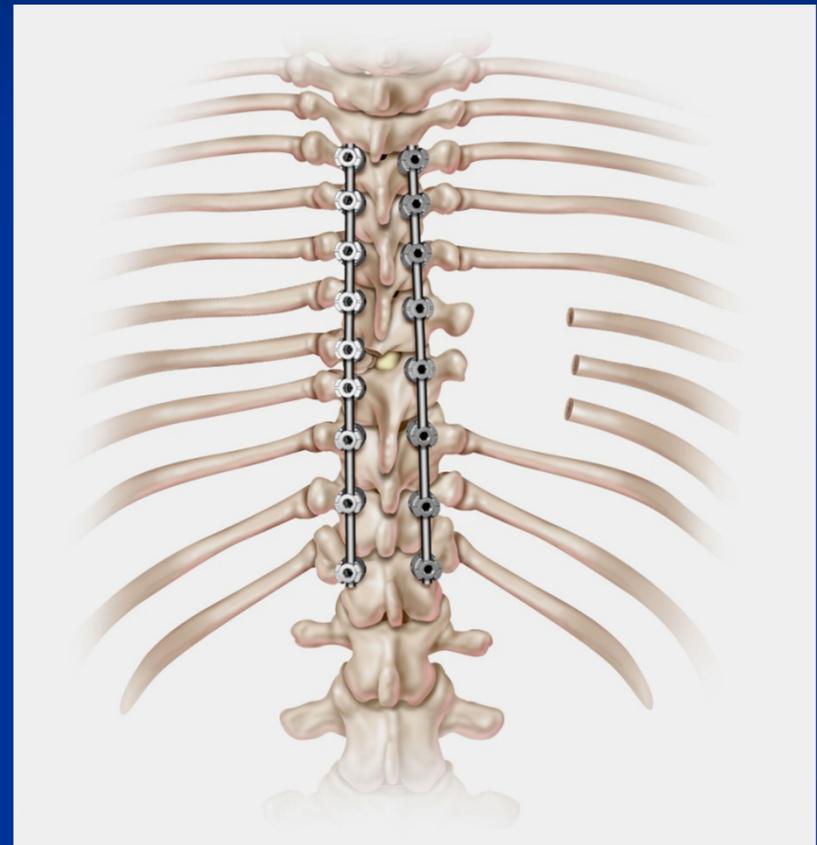
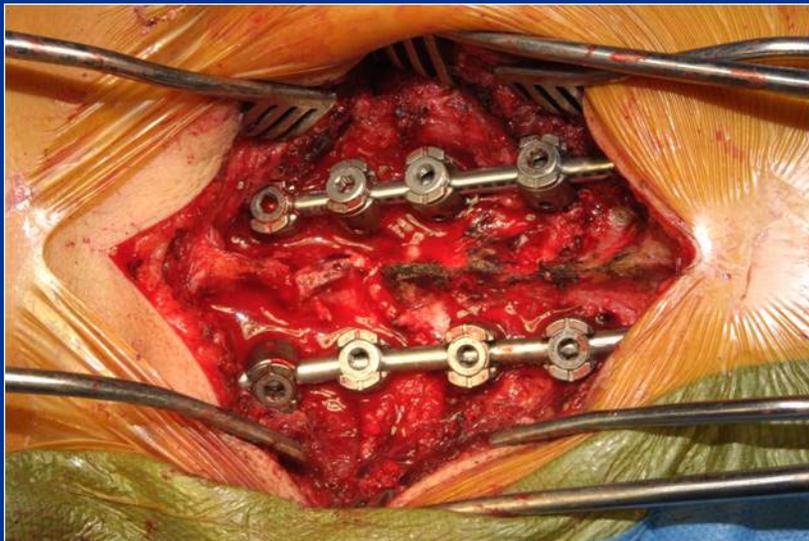
# Excision of Hemivertebra - Technique

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

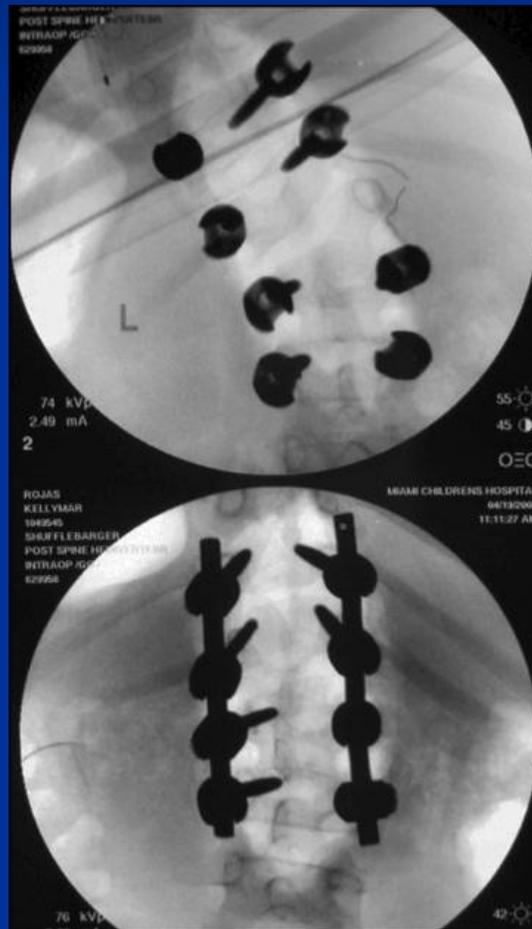
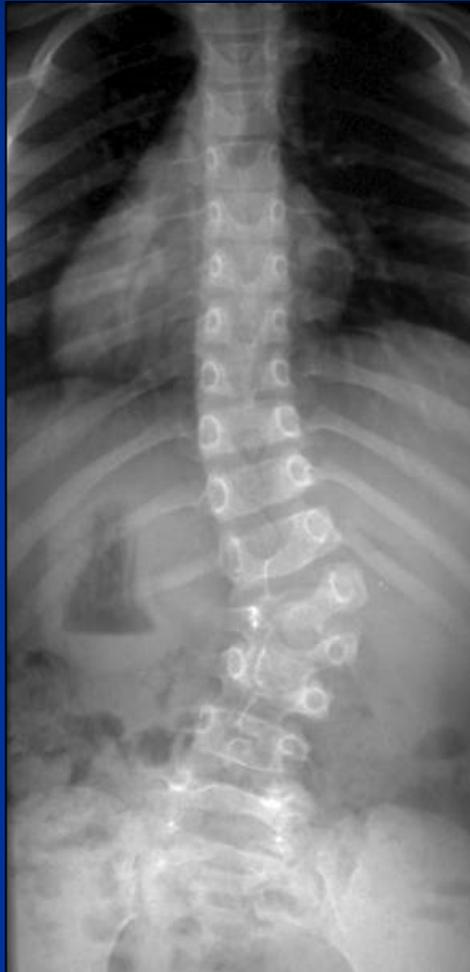


# Excision of Hemivertebra - Technique

- Temporary convex rod
- Remove concave rod
- Compress convexity



# Posterior Hemivertebra Excision



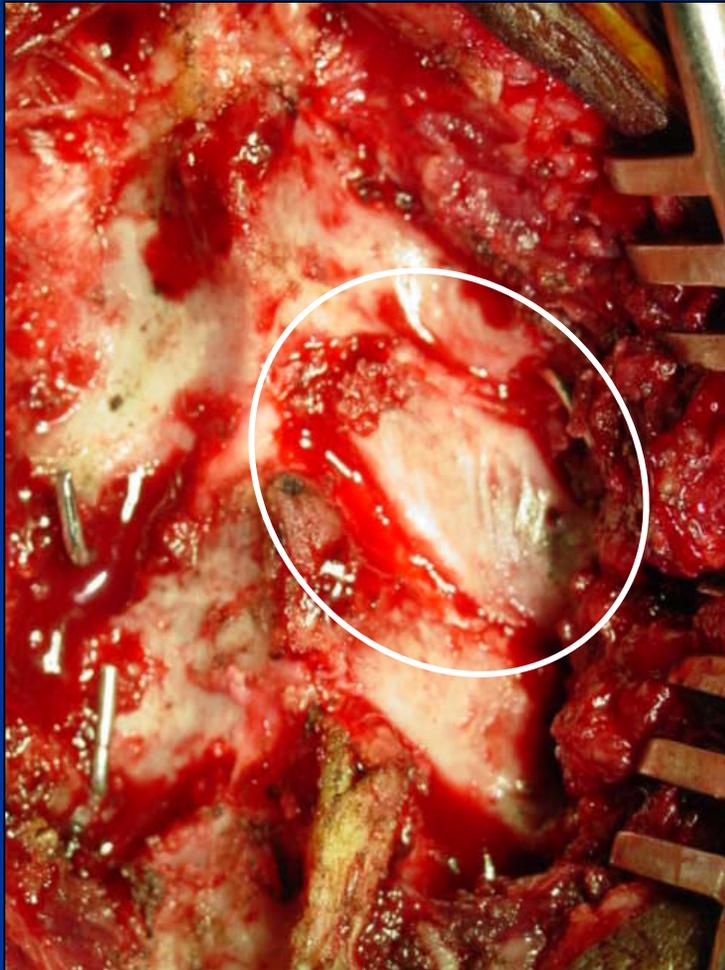
*Courtesy of Harry Shufflebarger, MD*

# Posterior Hemivertebra Excision

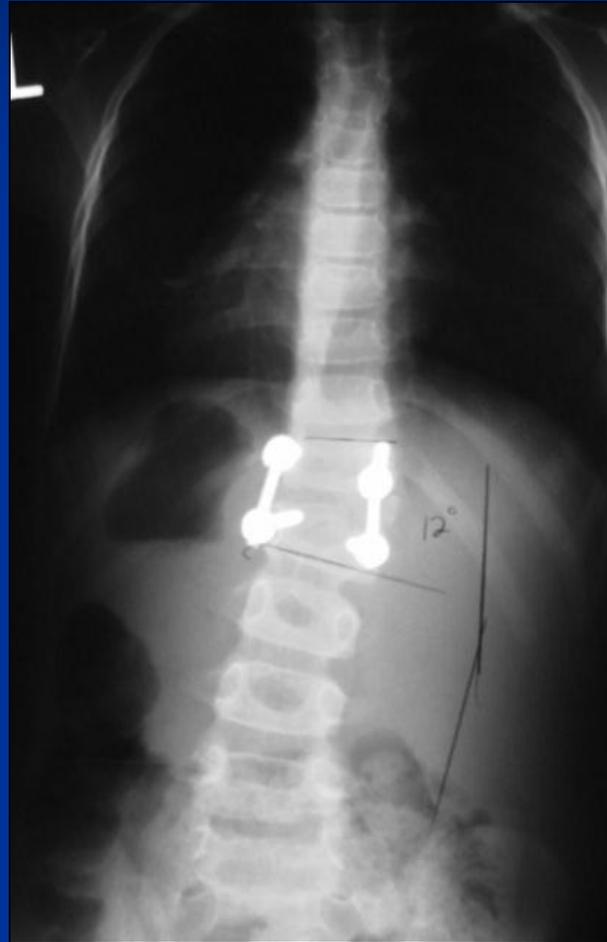
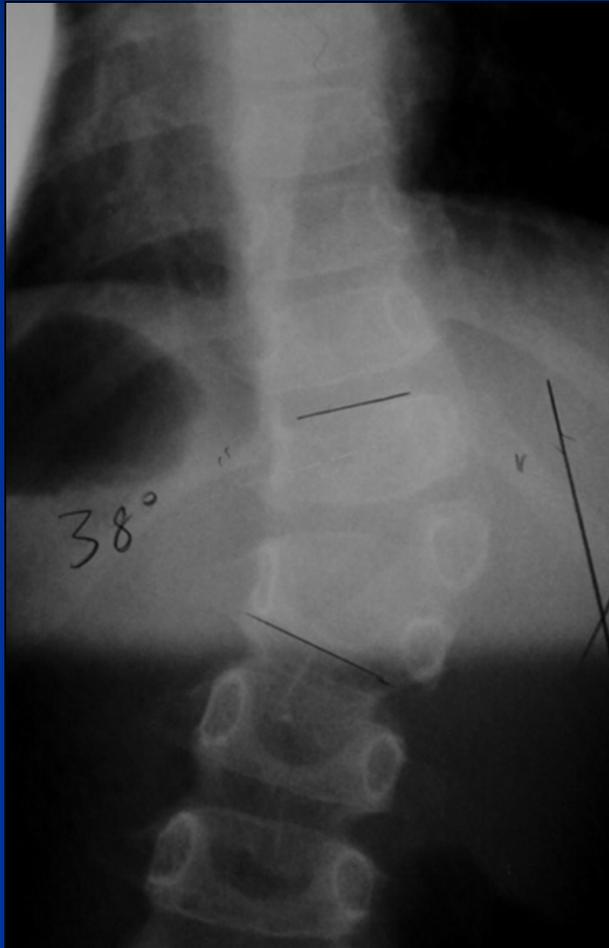


*Courtesy of Harry Shufflebarger, MD*

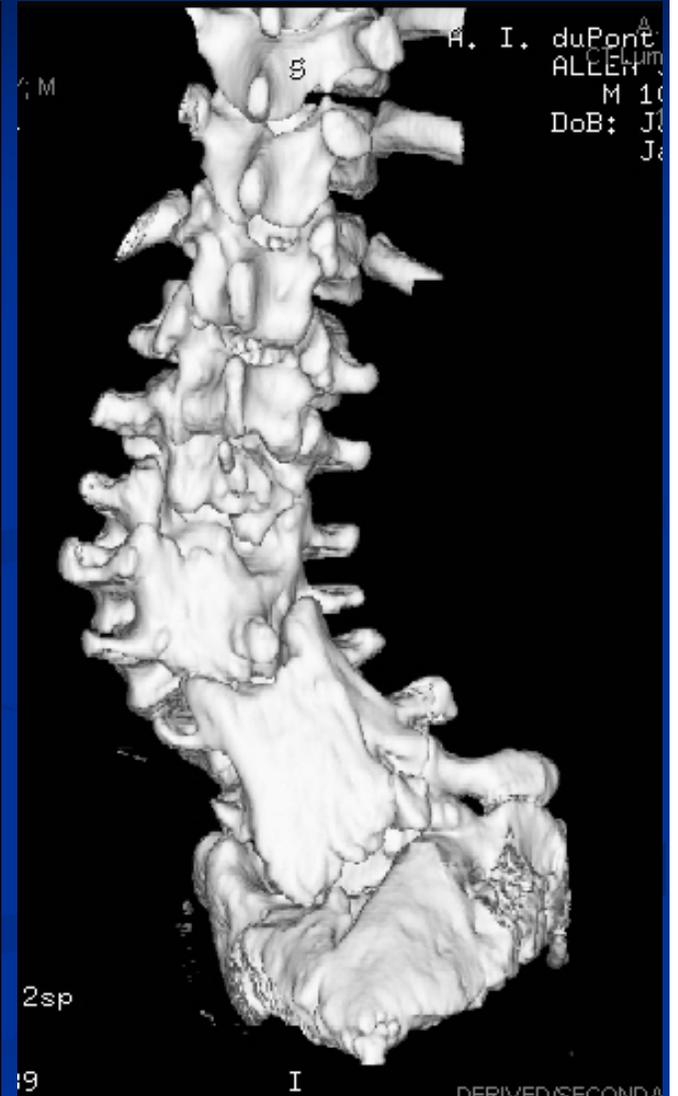
# Posterior Hemivertebra Excision



# 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