

SPINAL FUSION OVERVIEW

in Congenital deformities

When is short segment fusion or resection appropriate?

When to give up on fusionless technique?

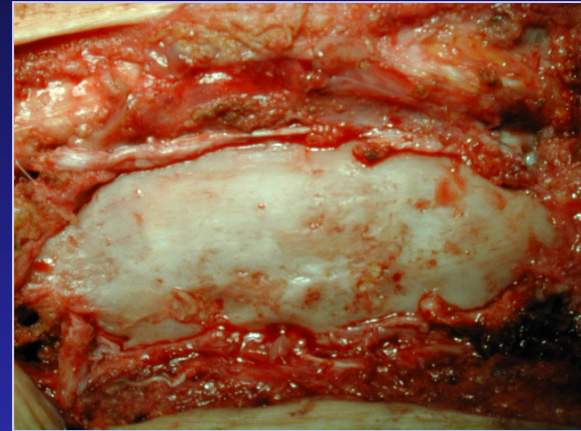
F.S. Pérez-Grueso.

Hospital La Paz. Madrid

Early Posterior fusion

Considered the gold standard

- *Advantages*
 - *Safe*
 - *Easy*
- *Disadvantages*
 - *Stabilization only*
 - *Pseudarthrosis*
 - *Crankshaft phenomenon / Adding on*



RB Winter and JH Moe

The results of spinal arthrodesis for congenital spinal deformity in patients younger than five years old

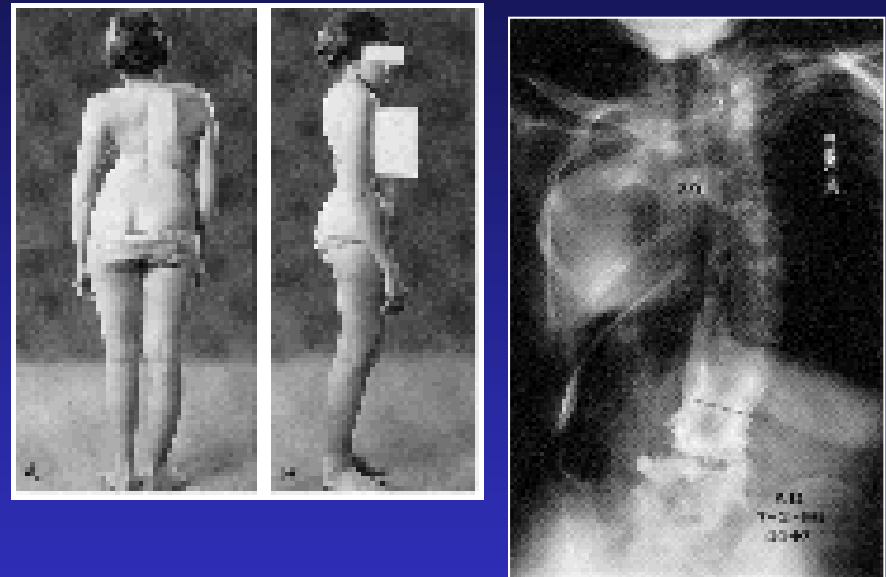
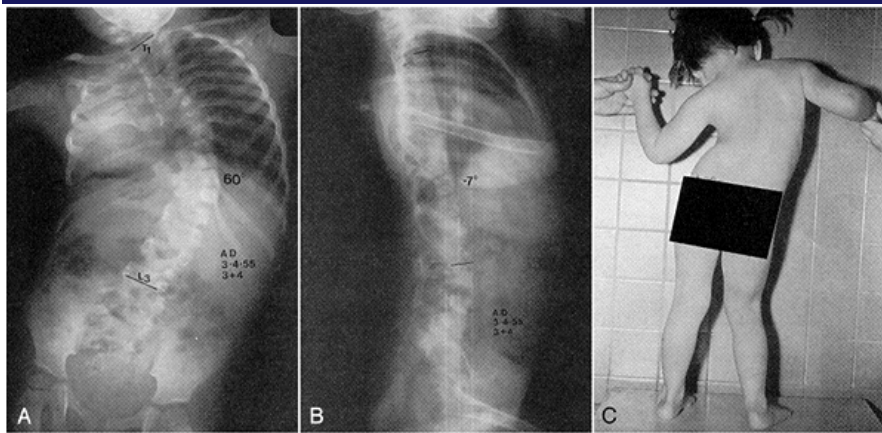
J. Bone Joint Surg. Am., Mar **1982**; 64: 419 - 432.

We reviewed the results of spinal arthrodesis for congenital spinal deformity in forty-nine patients who were younger than five years old. The minimum follow-up was five years, and eleven patients had completed their growth. Posterior arthrodesis alone was found to be effective in most scoliotic patients. There was minimum bending of the fusion mass in most patients, almost no creation of lordosis, and minimum effect on torso-lower limb relationships. For congenital kyphosis, posterior arthrodesis was highly effective, giving better eventual correction than when both anterior and posterior arthrodesis was done.

Congenital Scoliosis With Posterior Spinal Arthrodesis T2-L3 at Age 3 Years With 41-Year Follow-Up A Case Report

Spine 1999;24:194-197

Robert B. Winter, MD; John E. Lonstein, MD

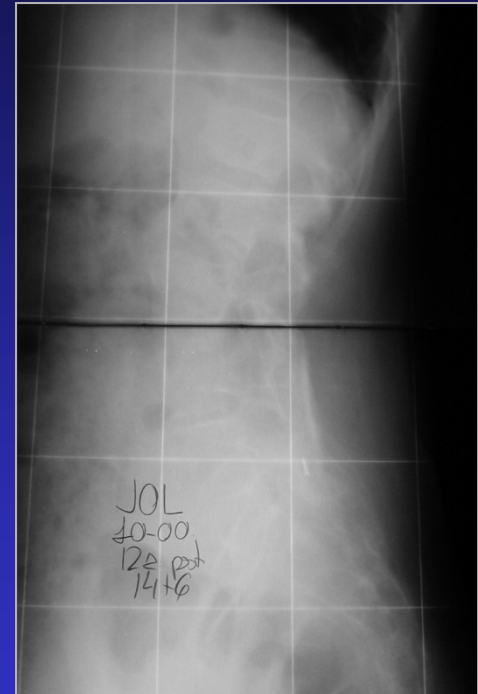
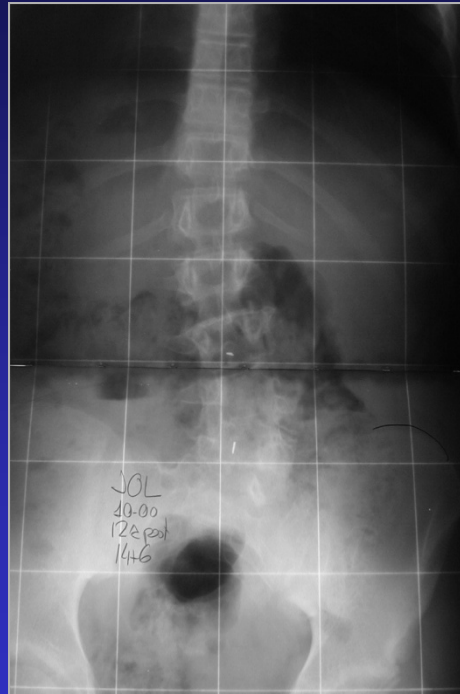
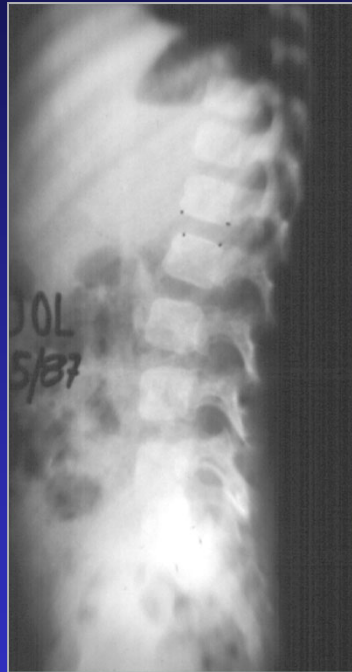
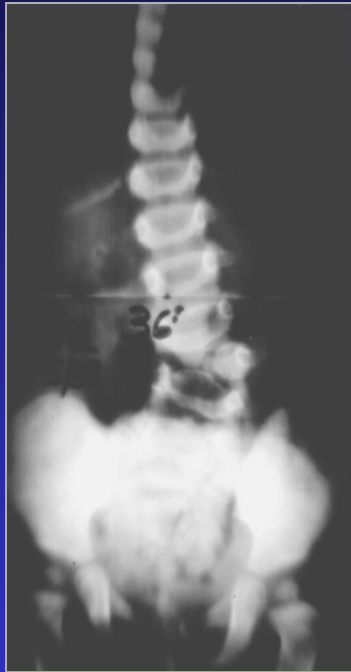


- *Posterior fusion T2-L3*
- *Localizer Risser cast*
- *Pseudo repair*
- *Osteotomy of fusion mass*
- *Left pelvis lengthening innominate osteotomy (at age 15)*

Age 44:

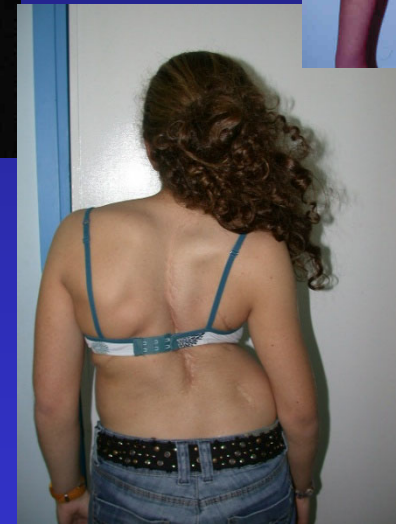
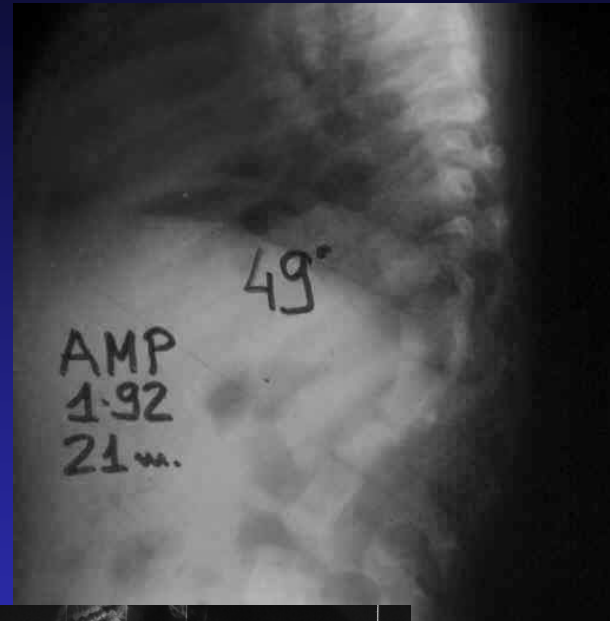
- *No back pain*
- *No pulmonary problems*
- *Height: 1,48 cm.*

Early fusion



12 year follow up

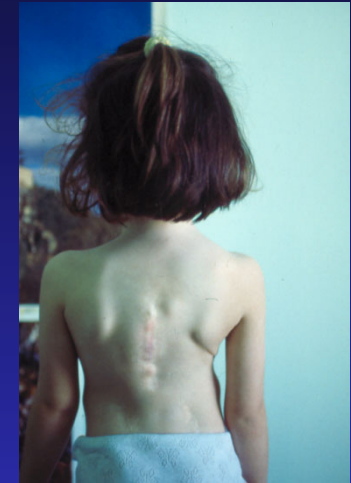
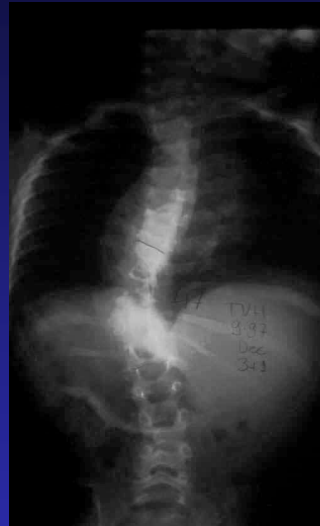
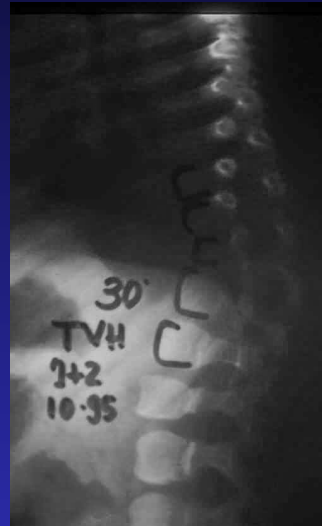
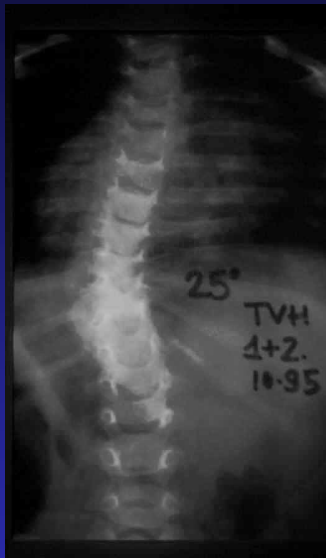
Early Fusion



FVC : 1,39 44.9%

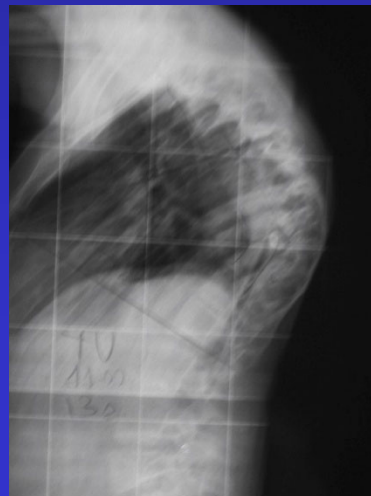
FEV 1: 1.136 51,4%

Early Fusion



*11 year
Follow up*

FVC : 50 %
FEV 1: 51,4%



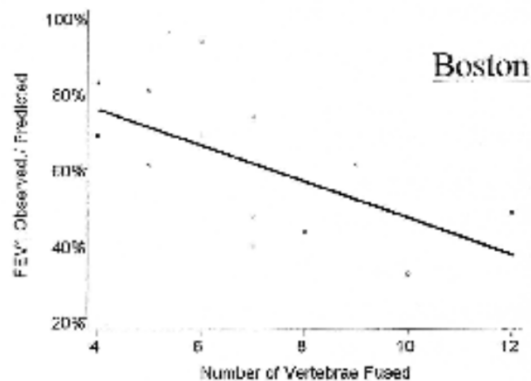
Paper # 101

Earlier and More Extensive Thoracic Fusion is Associated with Diminished Pulmonary Function. Outcome after Spinal Fusion of 4 or More Thoracic Spinal Segments Before Age 5

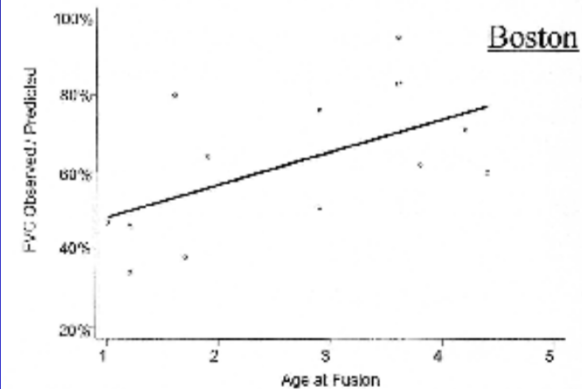
John Emans, MD, Farid Kassab, MD, Jean Francois Caubet, MD, Daniel J. Hedequist, MD (Children's Hospital, Boston, MA), Mary Ellen Wohl, MD, Robert M. Campbell, Jr., MD

Significance: Early arthrodesis of thoracic spinal segments for progressive deformity in the very young is associated with significant reductions in pulmonary function at follow-up. Separating the effect on outcome of early fusion vs. that of the underlying condition in this uncommon and heterogeneous patient population is difficult and further complicates the evaluation of treatment alternatives. The limitations of this study include the small number of patients, many of whom did not reach maturity, and the lack of a control group (without fusion). Multicenter studies with follow-up to maturity are warranted.

FEV1 Observed/Predicted is more severely decreased when fusion involves more vertebrae (P=0.019)



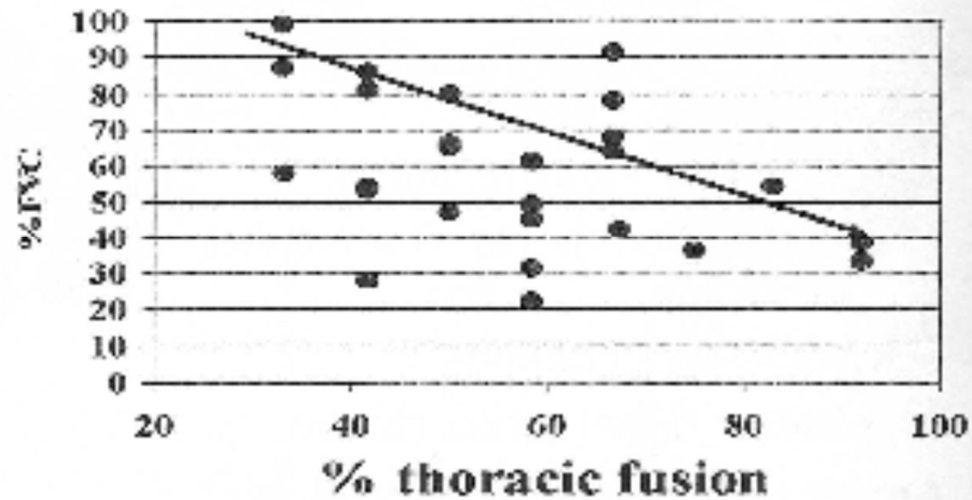
FVC Observed/Predicted is more severely decreased when fusion is performed at younger age (P=0.046)



Early fusion vs. Pulmonary function

TSRH – Johnston

• FVC vs. % thoracic fusion



Larger % of thoracic fusion correlates with diminished FVC.
($p=0.01$)

Fusion at an early age

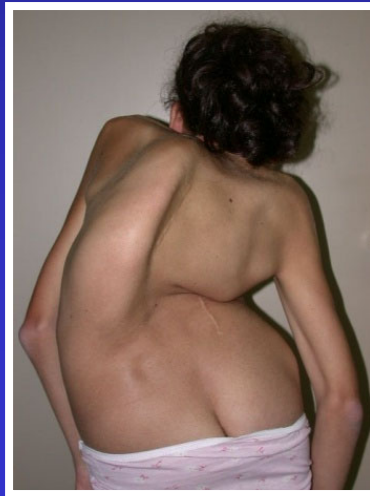
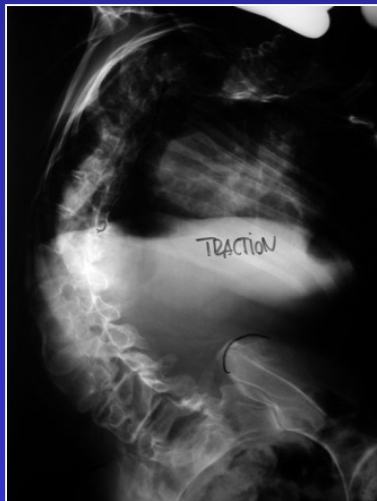
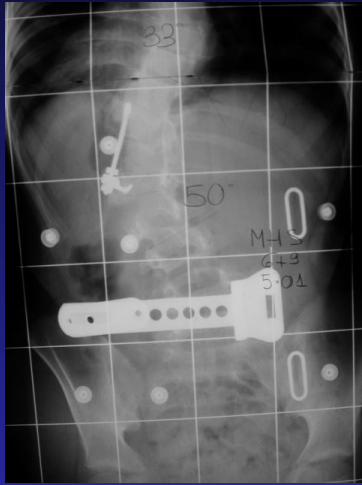
“it is always better to have a short straight spine than a shorter crooked spine”

DOES NOT WORK

Short fusion in long congenital curves

- Control the deformity while minimizing spinal growth arrest
- Simple surgery for complex deformity
- Fail to prevent progression:
 - Adding on
 - Crankshaft

Apical fusion



Early Fusion

Outcome will depend on the length of the curve

Long curves (Long/short fusion) poor outcome

Short curves (Short fusion) excellent outcome

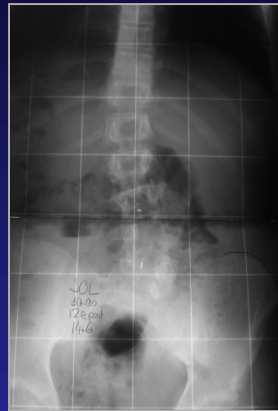


Short curves

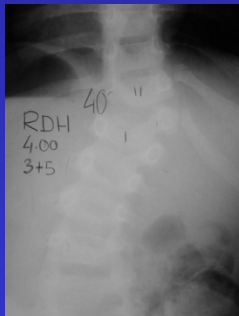
PSF



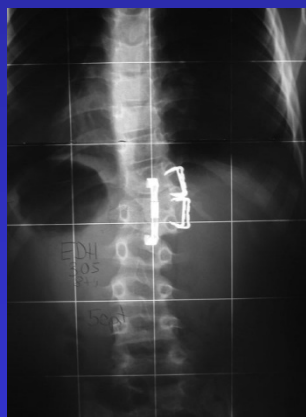
Age 2



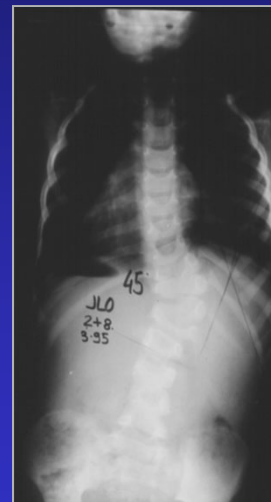
Age 14



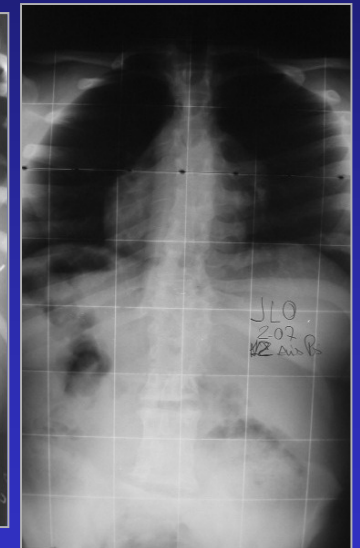
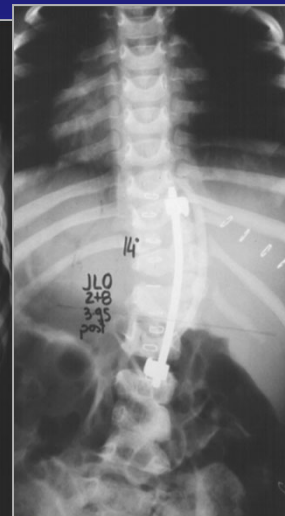
Age 3



Age 8



Age 2



Age 14

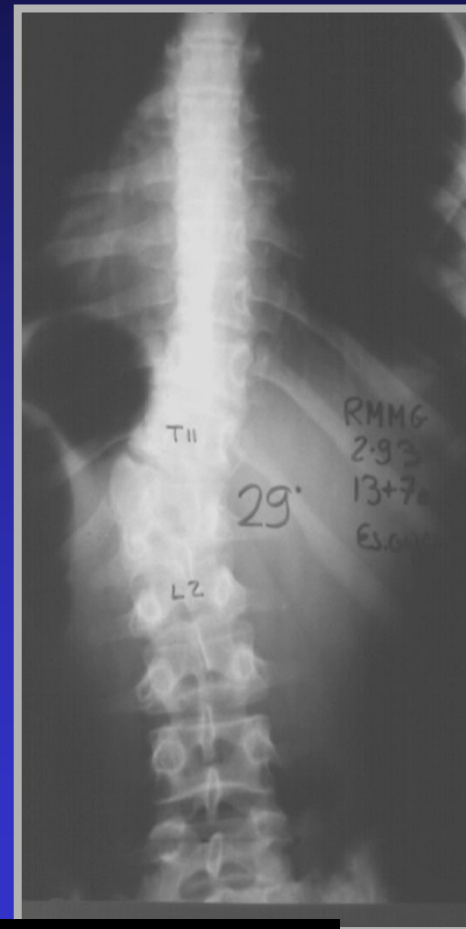
Convex growth arrest

RESECTION

- Completely eliminates the abnormal vertebra and its asymmetric growth effects
- Provides tremendous correction exactly at the site of deformity (coronal & sagittal planes)
- Usually results in fusion of only one motion segment

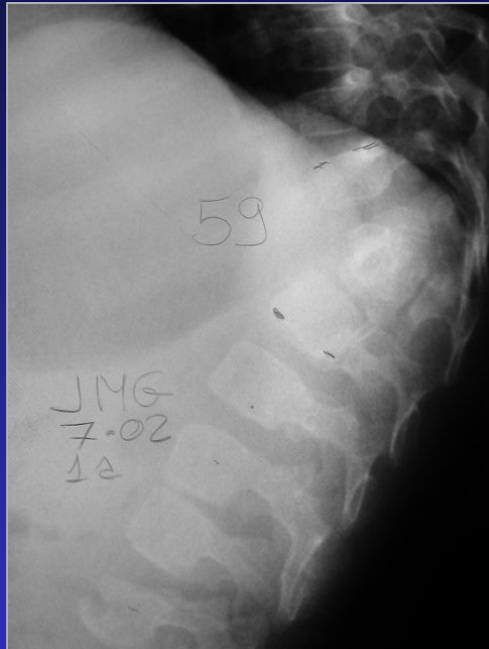


Presence of hemivertebra does not indicate its resection



Ten years follow-up

Early posterior fusion in Congenital Kyphosis



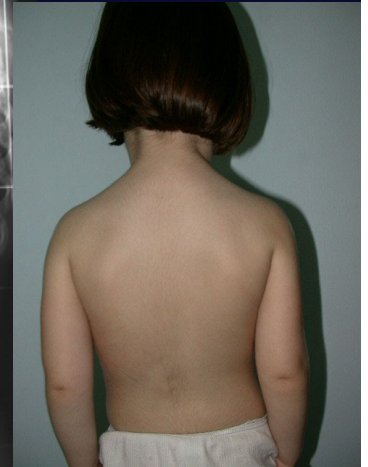
Bone & Cast:

- Progressive correction over time.
- Anterior growth

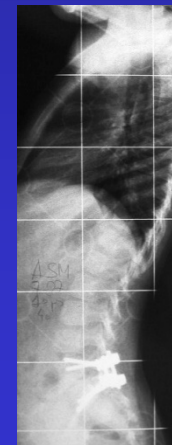
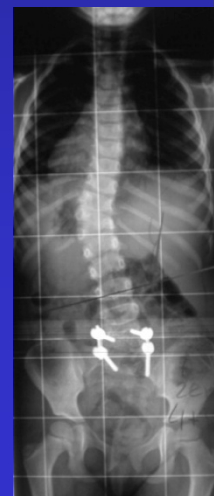
RESECTION

- *Indicated when correction advisable to prevent late progression of compensatory curves*
- *Right procedure provided enough surgical skills to minimize complications*

CSP 2+1 yrs



ASM 2+9 yrs



2 yr. Follow up

Spinal Growth after Transpedicular Instrumentation in One and Two year old children- a ten year follow-up

Michael Ruf MD; Jurgen Harms

PAPER #28

SRS 41 Annual Meeting. Monterey. Ca.

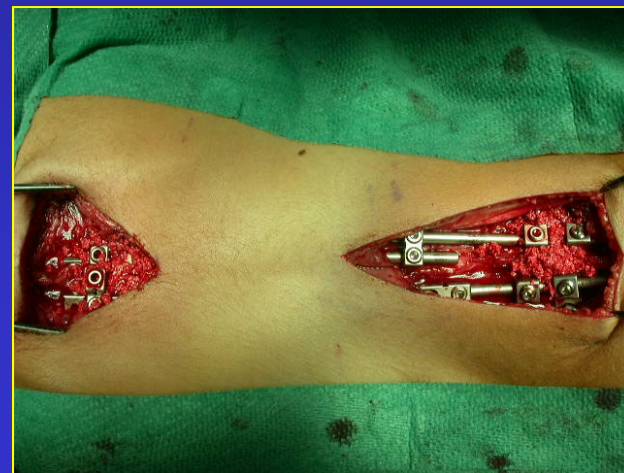
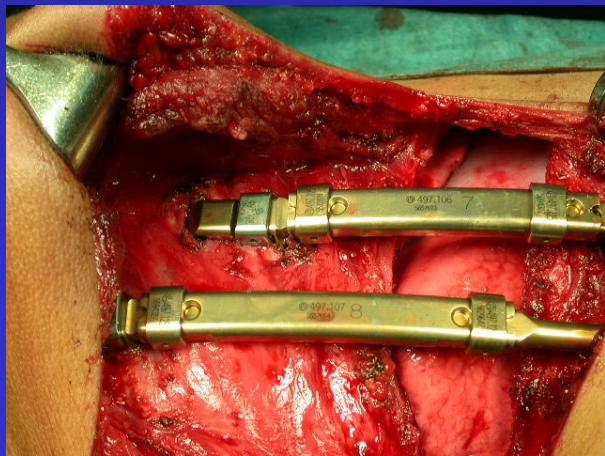
Methods: Twenty-two operations in 19 one and two year old children were performed between 1991 and 2003. A total of 120 transpedicular screws were inserted; 20 in the upper thoracic spine (T1-T4), 26 in the midthoracic spine (T5-T9), 53 in the thoracolumbar region (T10-L1), and 21 in the lumbar spine (L2-S1). Screw diameter was 3.5 mm.

Five patients (group 1) were evaluated with a minimum follow-up of 10 years, 14 patients (group 2) with a follow-up of 2 to 10 years.

Results: None of the patients showed neurologic deficits, neither by placement of the screws nor during further growth. MRI or CT studies were performed in 3 patients of group 1; they showed no stenosis of the spinal canal. Radiographic results demonstrated growth of the instrumented vertebral bodies comparable to adjacent vertebrae. Complications of pedicle screws: 6 malpositions (5%), 2 screw breakages (1.7%), and one pedicle fracture (0.8%).

When to give up on Fusionless Techniques in congenital deformities

- Growing rods*
- Rib Distractors*



Growing rods

Consider:

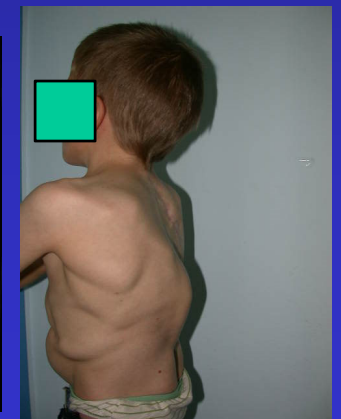
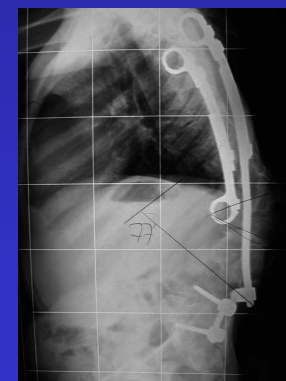
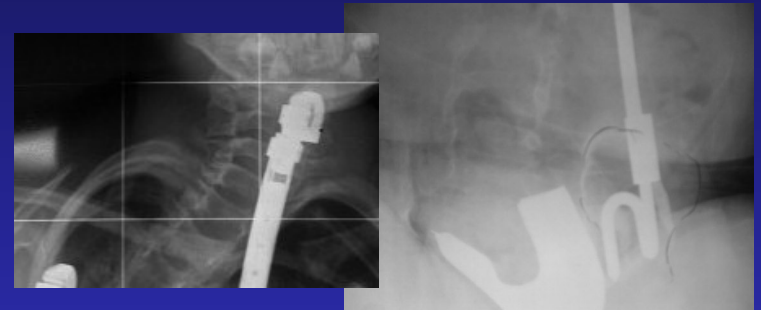
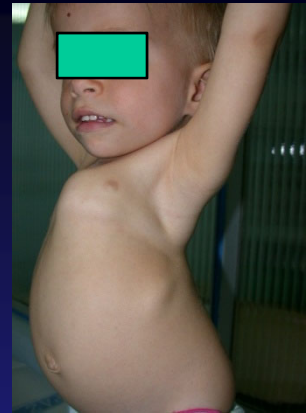
- *Significant rigid curves*
- *Associated hyperkyphosis*
- *Inadequate spinal growth remaining*
- *Co-morbidities making multiple distractions impossible*



Rib distractors

Consider:

- *Soft tissues coverage*
- *Bone quality (rib; lamina; Pelvis)*
- *Associated Hyperkyphosis*
- *Co-morbidities making multiple distractions impossible*



When to give up

When treatment goals cannot be achieved due to repeated complications

- Control / Improve spine and chest deformity*
- Allow spinal growth and normal pulmonary function*