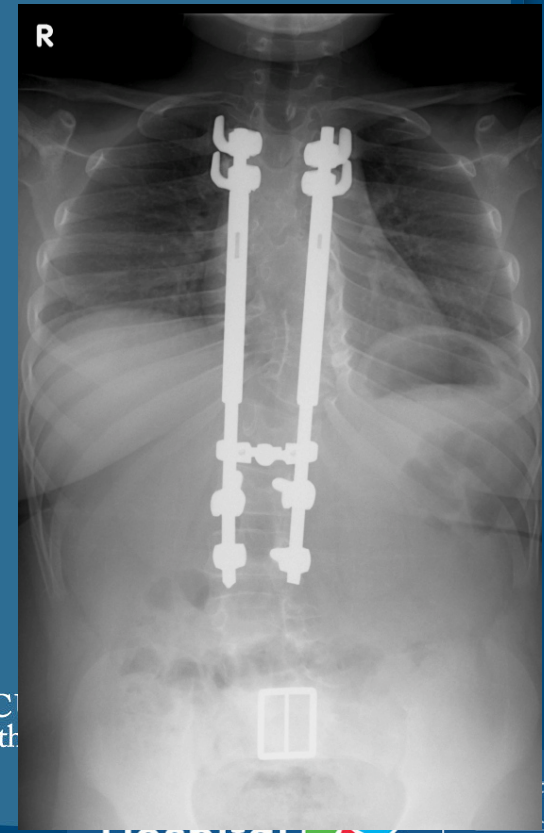
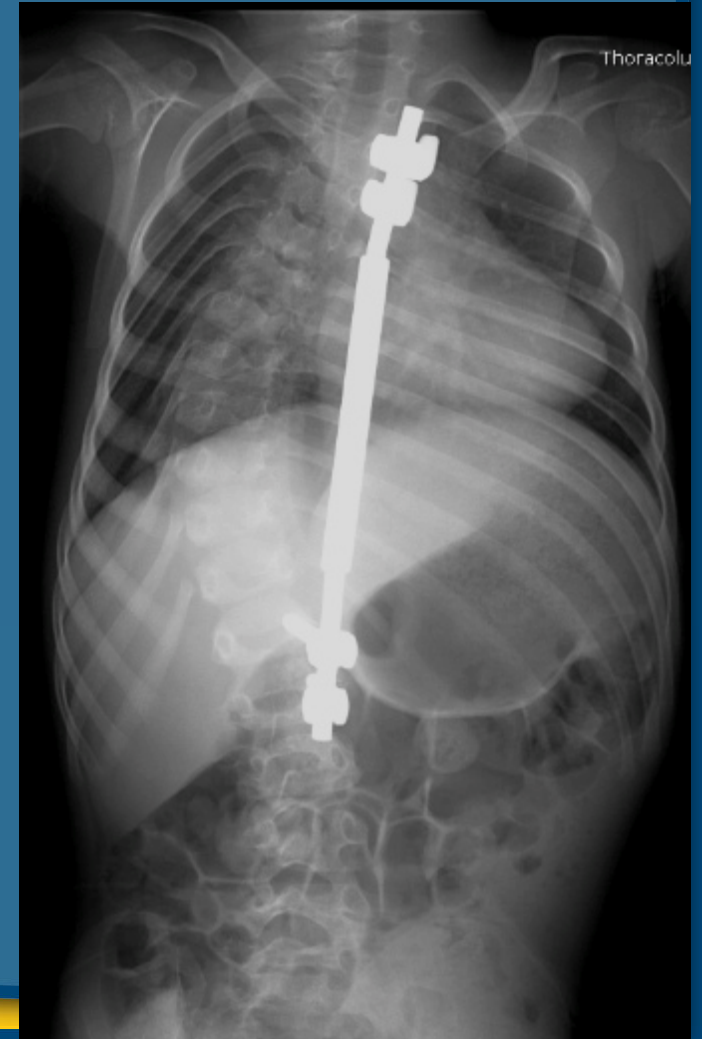


# Masters Techniques: Rib Anchored Distraction Based Growing Rods

David L. Skaggs, MD  
Professor and Chief  
Children's Hospital Los Angeles  
University of Southern California



# Use of Spine Hooks on Ribs NOT FDA Approved



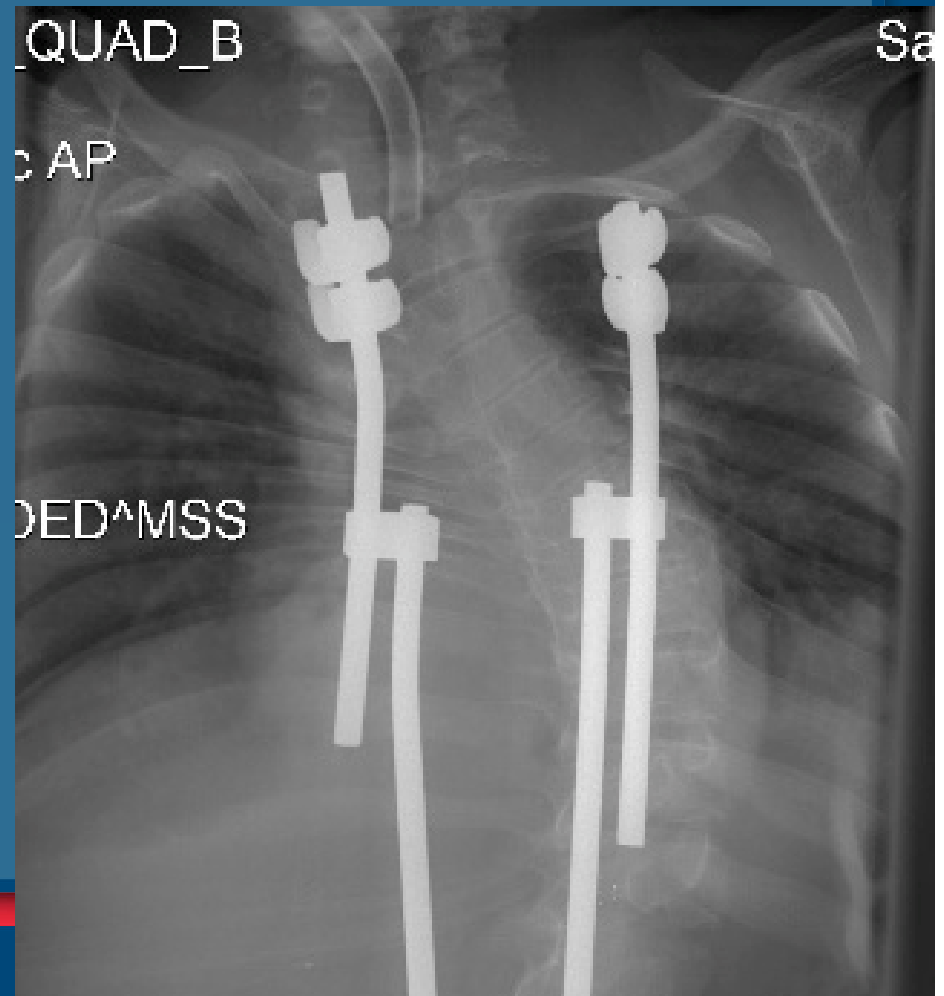
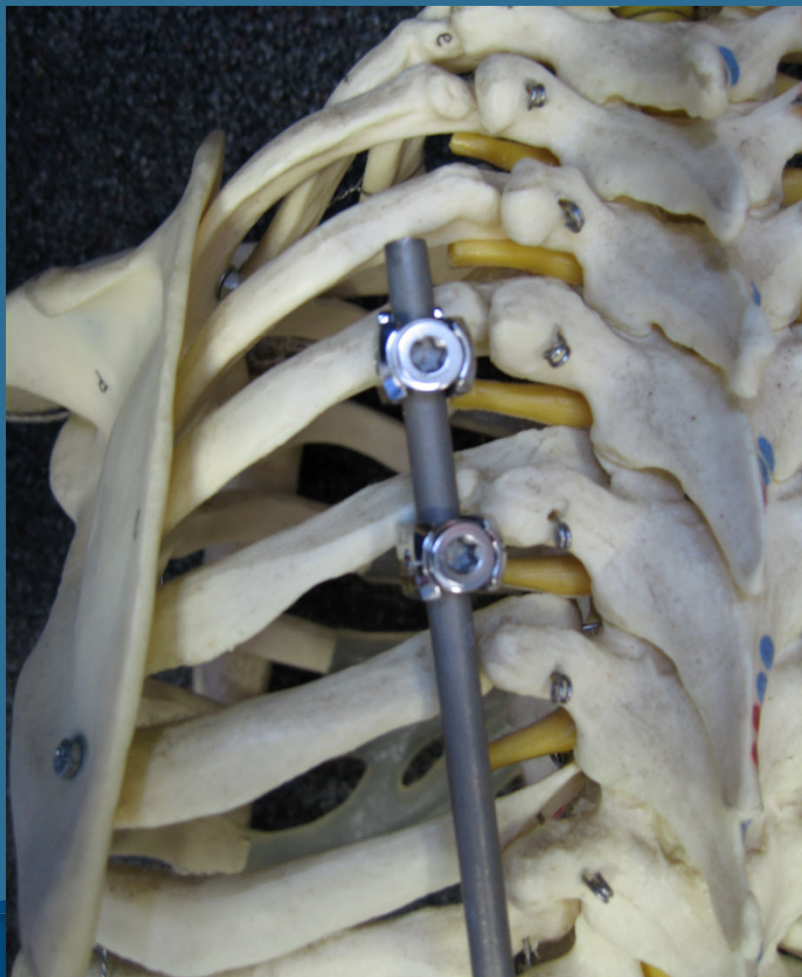
# Part 1: Theoretical Advantages



# Hooks on Ribs: No intentional fusion

## Do not expose or fuse upper spine

### No thoracotomy!



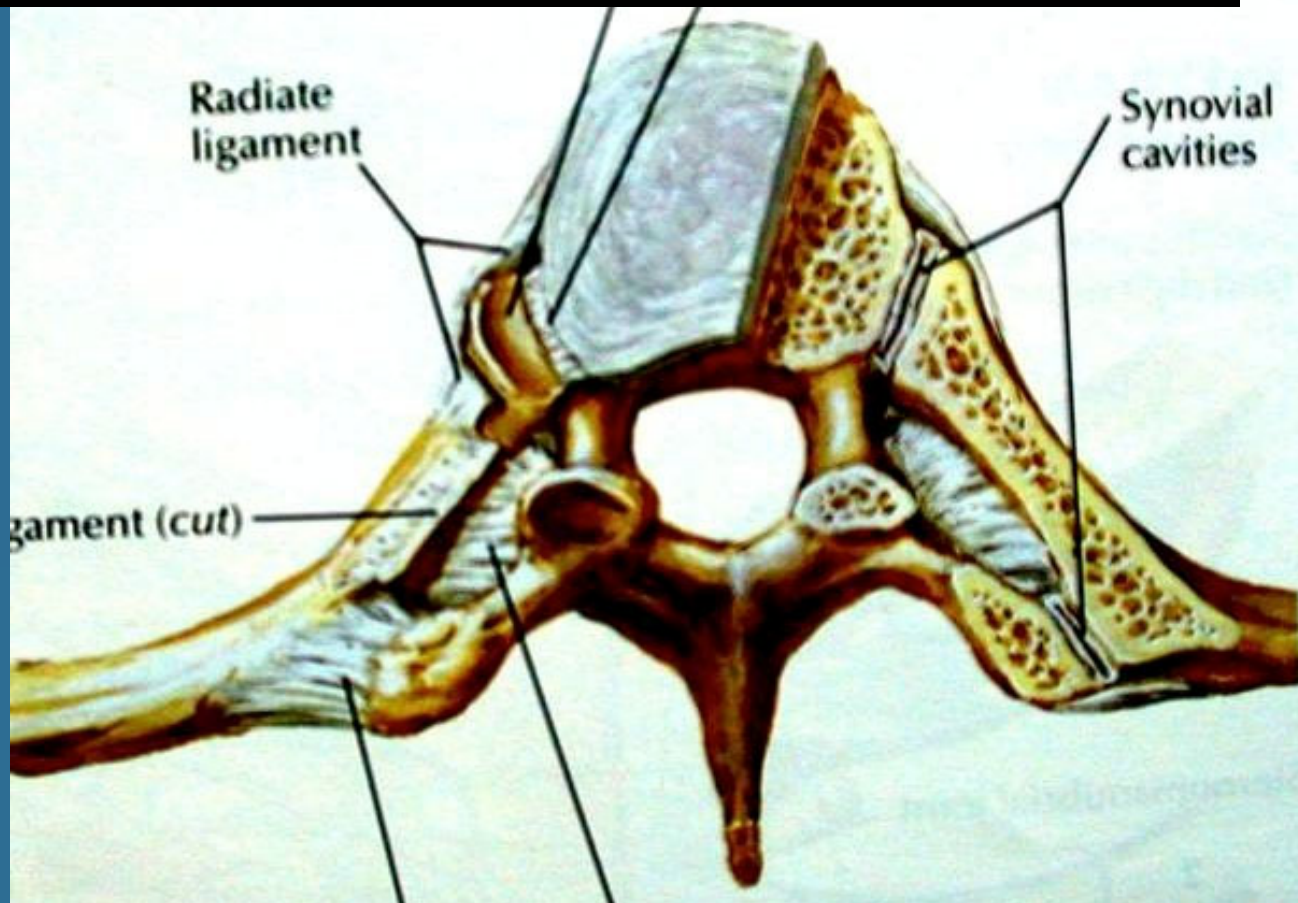


# Traditional Growing Rods Cause Autofusion

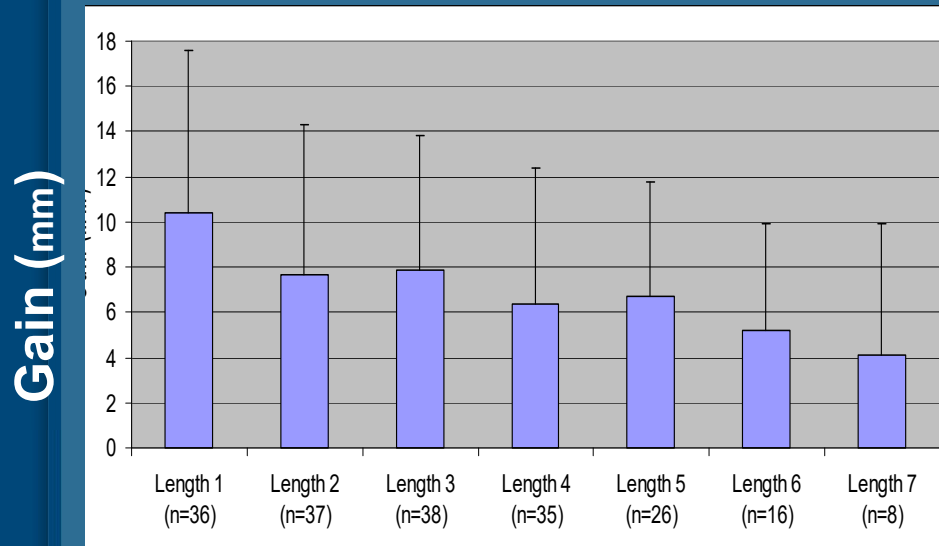
Cahil, et. Al, Spine 2010

- 8/9 patients autofused - Stiff Curves!
- Growing rods in for 7 yrs
- Mean of 7 osteotomies done at final fusion
- 44% Cobb Angle correction

- Movement of the ribs joints
- “slop” of the hooks  
?= less autofusion

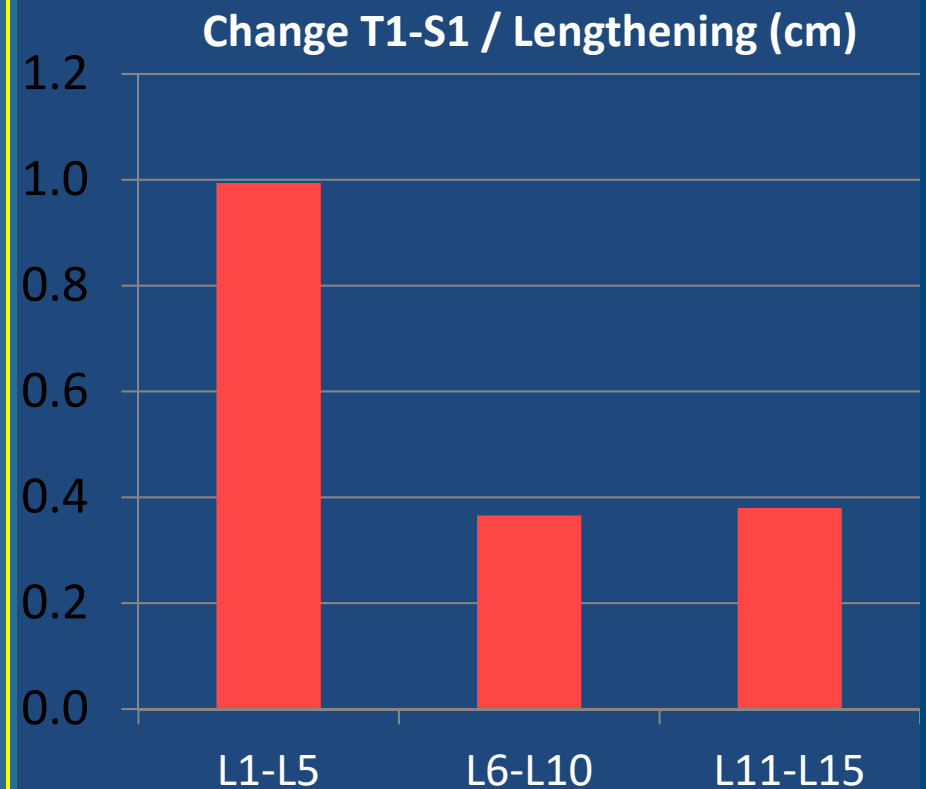


## Traditional Growth Rods Get Stiff Over Time



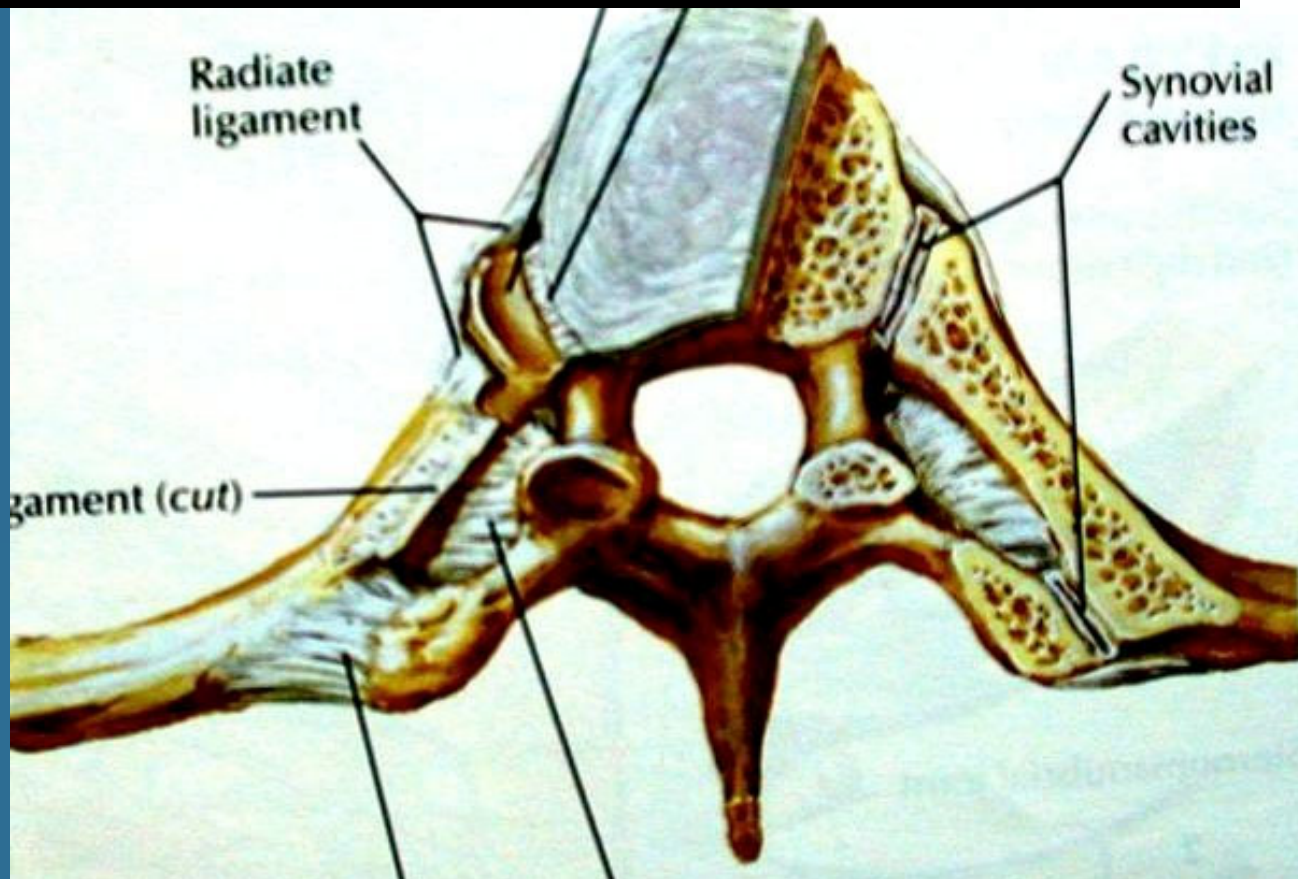
T1-S1 Gain vs. # of Lengthenings

## ? Smaller Effect with rib anchors?



**But continued gain even  
at L11-L15**

- Movement of the ribs joints
  - “slop” of the hooks
- ?= Less likely to break rods



- Movement of the ribs joints
  - “slop” of the hooks
- ?= Less likely to break rods



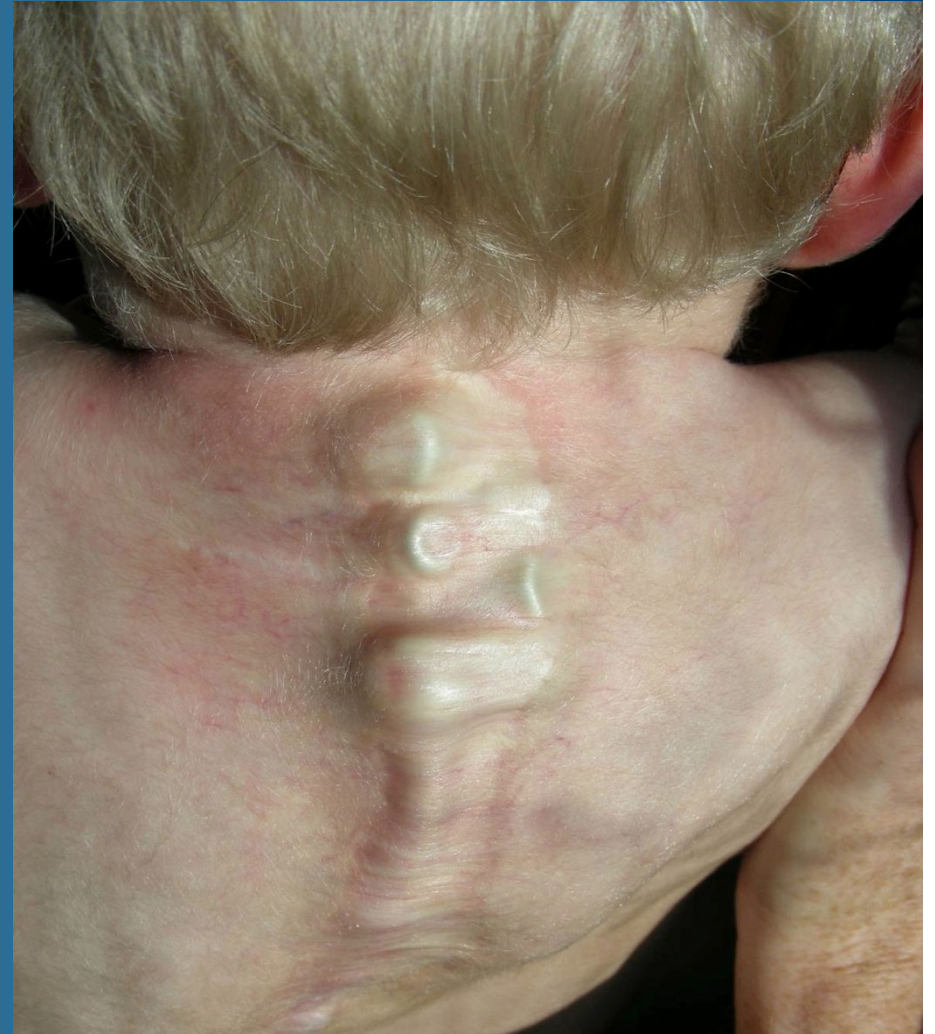
GSSG Study – 176 pts, 56 month f/u  
rib anchored growing rods 77%  
less likely to break rods than  
spine anchored





# Nutrionally Depleted Population

- Soft tissue Coverage Challenging
- 47% pts pre-op failure to thrive (<5 percentile)

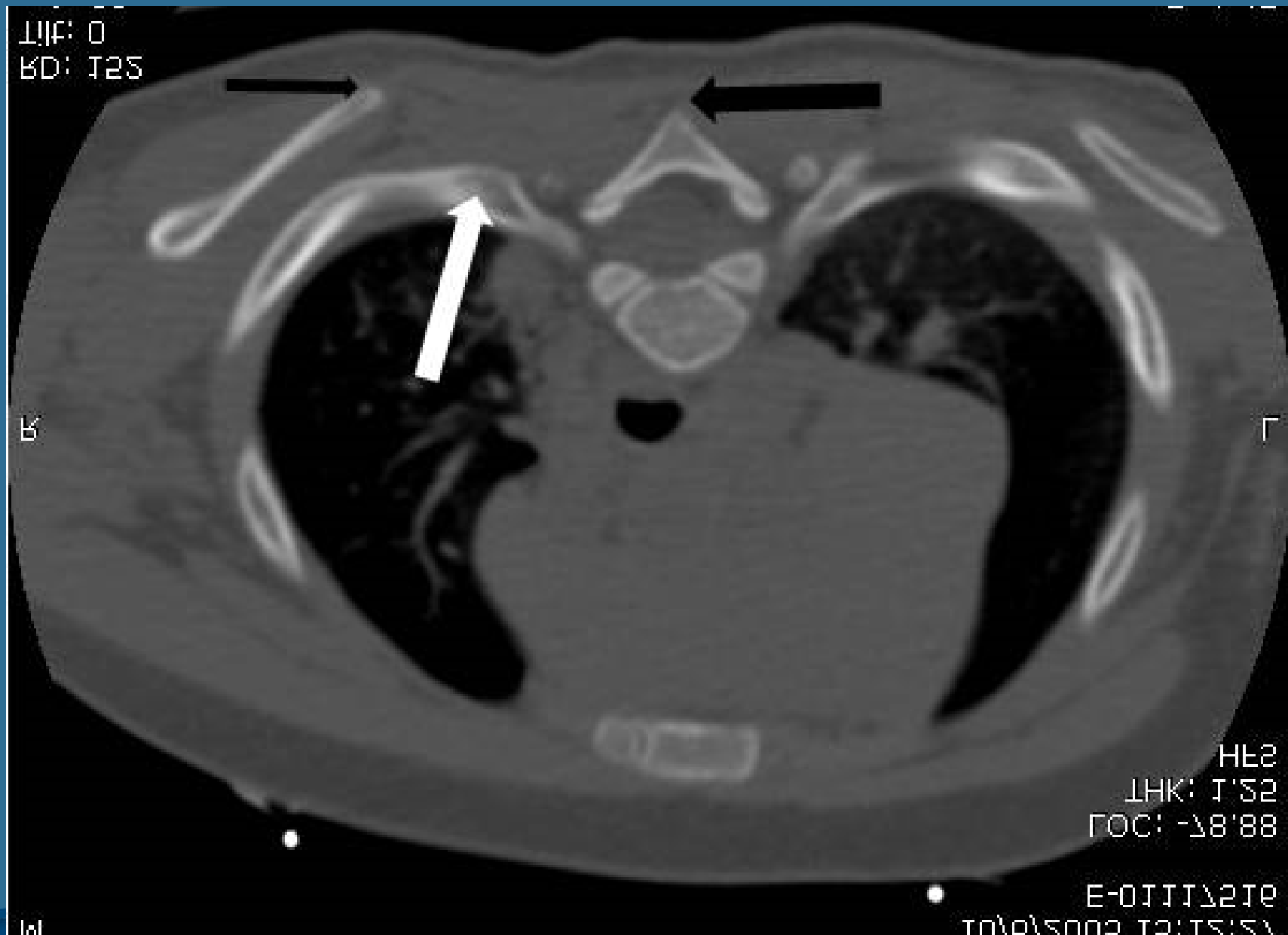


Myung, 2009

Southern California

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## Low Profile

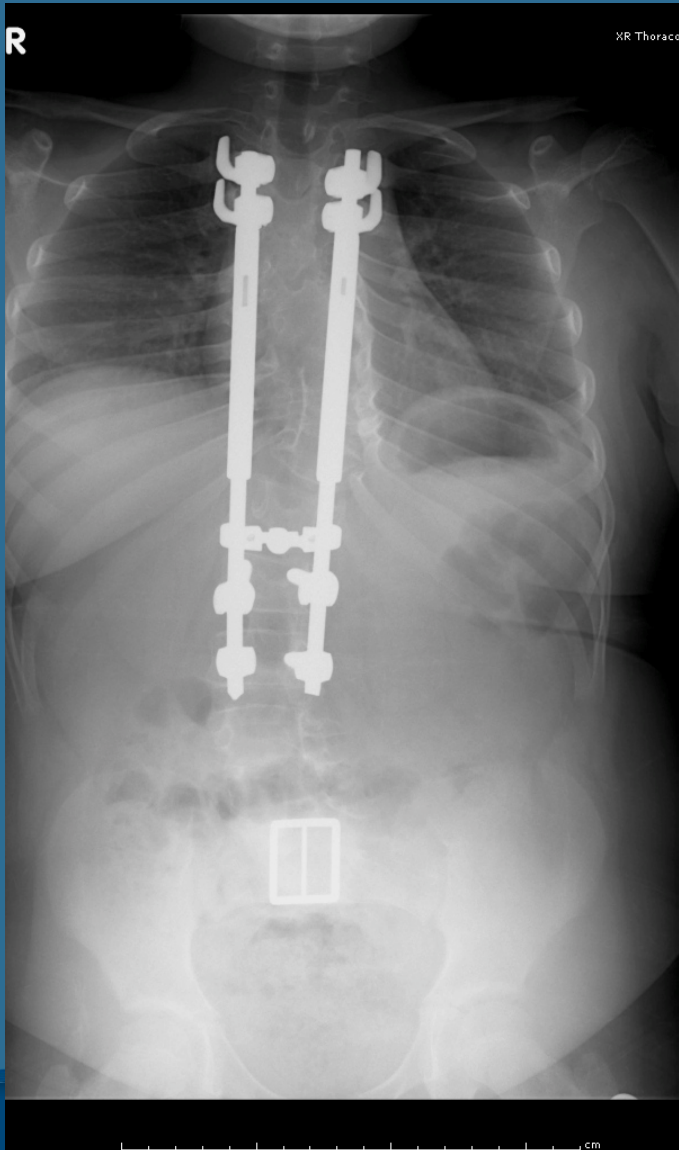


## Rib based anchors better for PJK?

- Hybrids 42% (5/12) Vs. Growing rods 62% (10/17)
  - $P=0.059$

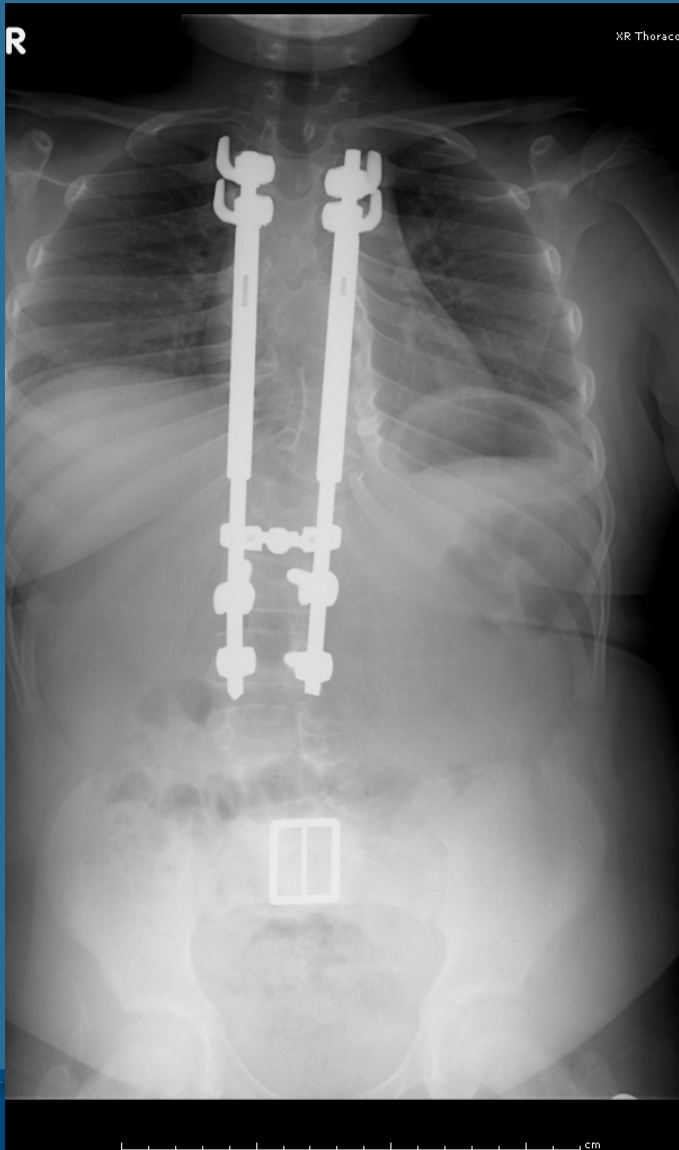
Lee, et al, PJK in Distraction-Based Growing Rods, SRS, 2011

# Advantages of rib anchors



- Avoid proximal fusion
- Less rigid system
  - Minimize autofusion?
  - Less rod breakage
- Lower Profile
- Less PJK?

# Advantages of rib anchors



- Avoid proximal fusion
- Less rigid system
  - Minimize autofusion?
  - Less rod breakage
- Lower Profile
- Less PJK?

Possible Disadvantage  
– Does it hurt  
pulmonary function?



# Why use “spine hooks” instead of VEPTR

- Already in hospital
  - Staff familiar
  - Minimize inventory
  - I am more familiar with systems I use daily
- No IRB approval needed
- Less expensive
- Easy to adjust sagittal contour and hook placement

## Why use “spine hooks” instead of VEPTR

- Already in hospital  
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– Minimize inventory  
– I am more familiar with systems I use daily
- No IRB approval needed
- Less expensive
- Easy to adjust sagittal contour and hook placement

My opinion  
Clinical Equipose Between  
“spine hooks” and VEPTR

## Part 2: Technique

- Disclosure - Technique is pretty straightforward
- Few Problems

# Midline Incision - Plan for final fusion

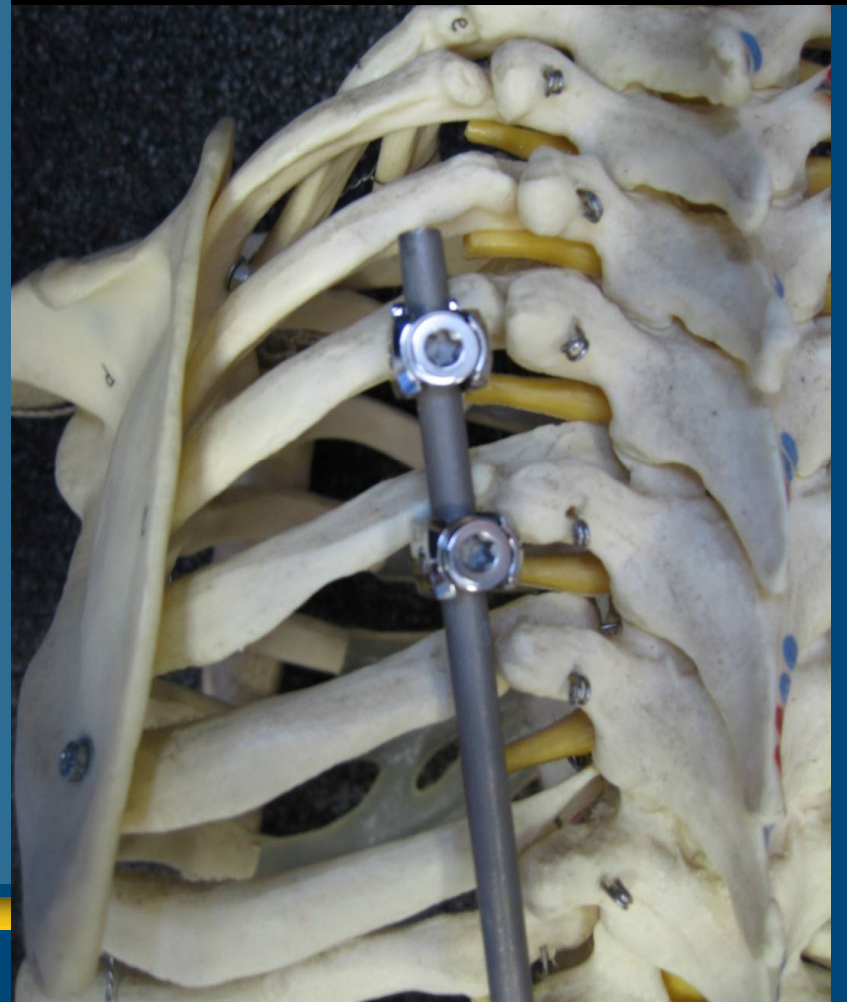


**Single Rod Case  
3 and 5 cm incisions  
no thoracotomy**

# Midline Incision - Plan for final fusion

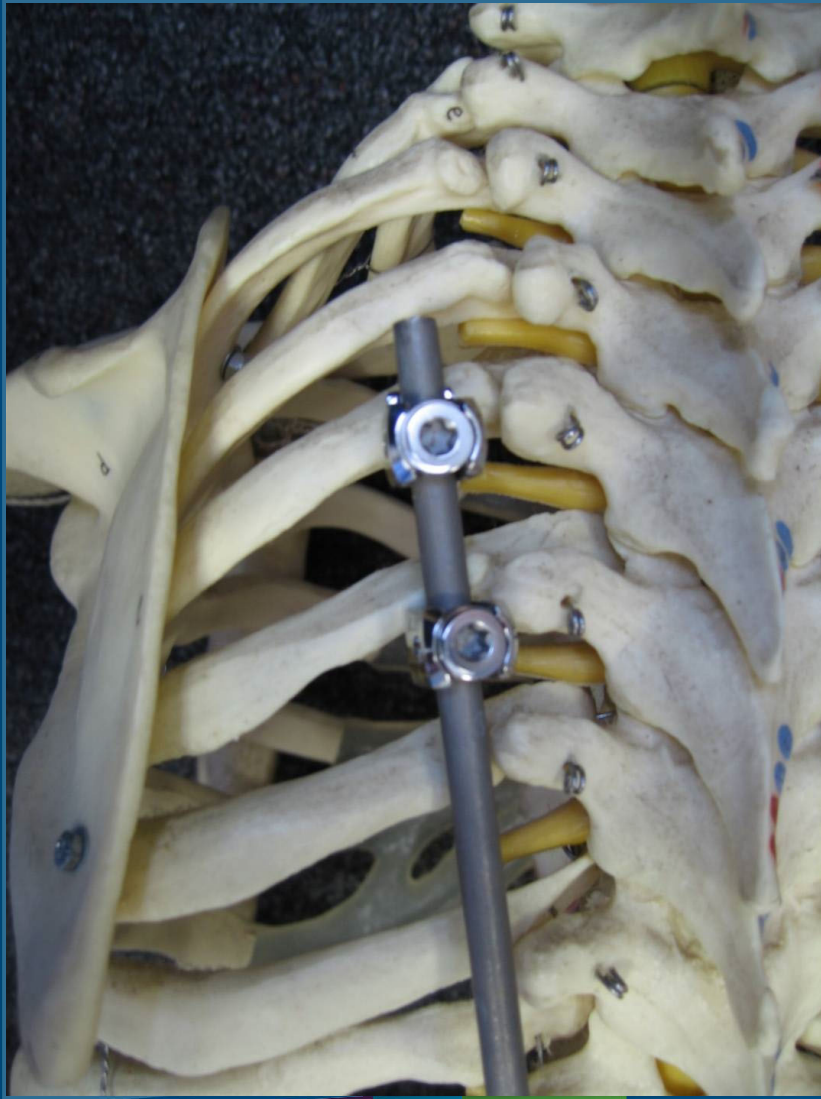
- No Dissection of Proximal Spine
- Feel bump of transverse process
- Split muscles just lateral to TP

Adjacent to TP





# Adjacent to TP

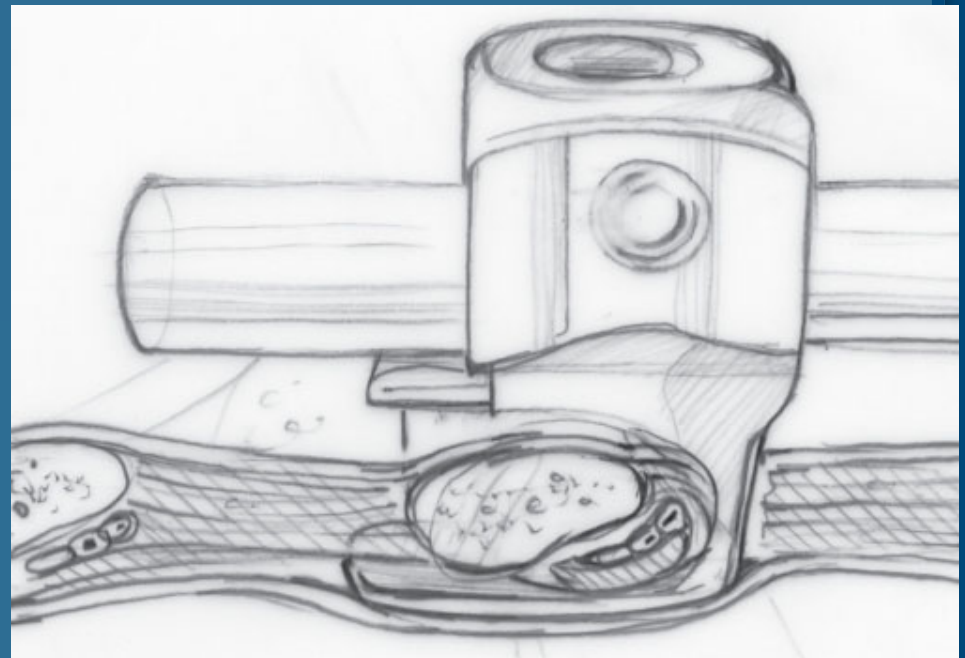


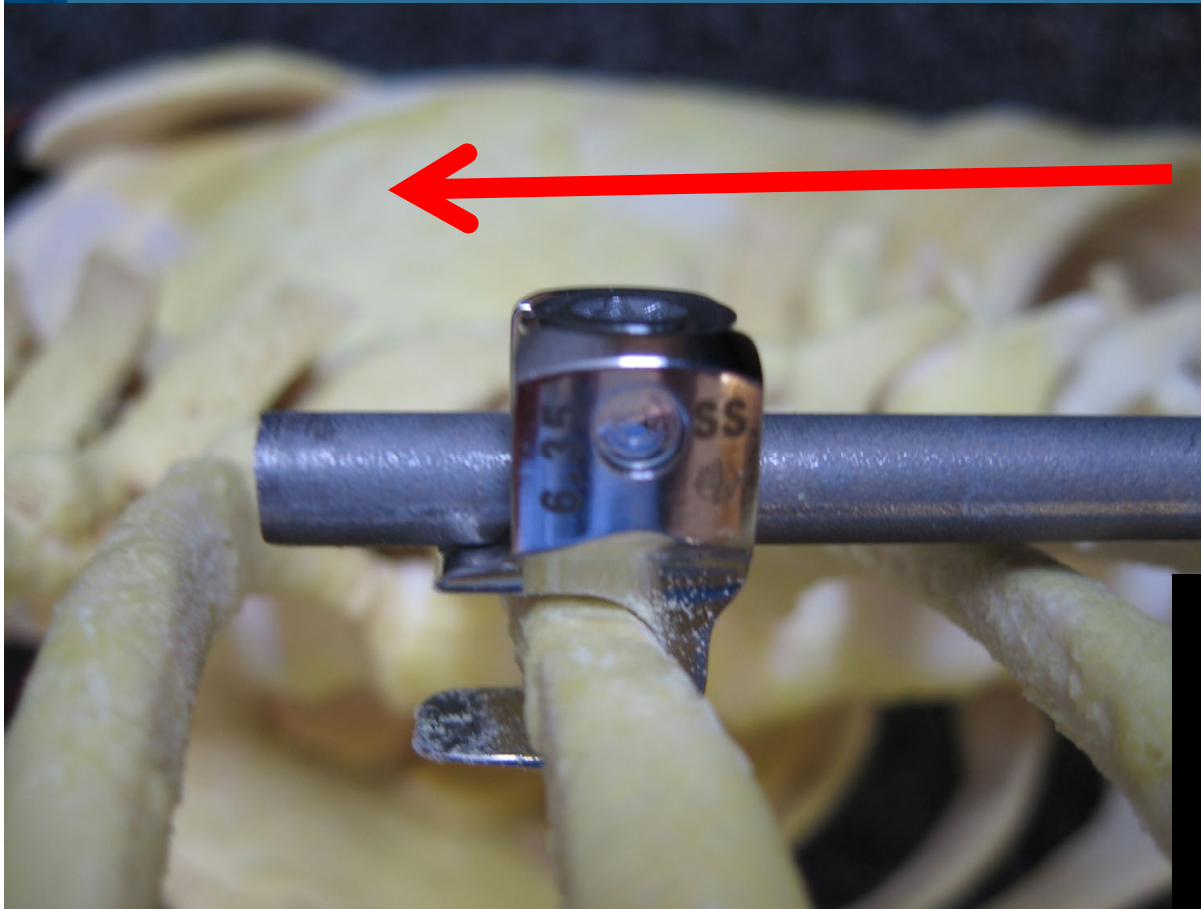
Extra-Periosteal

Want ribs to hypertrophy

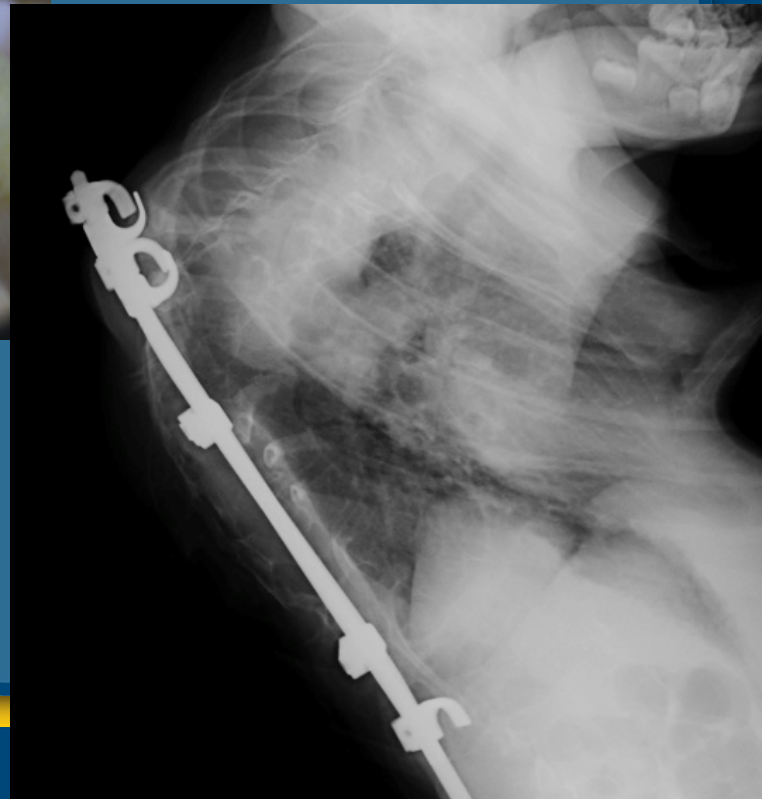
NOT in chest

No chest tube

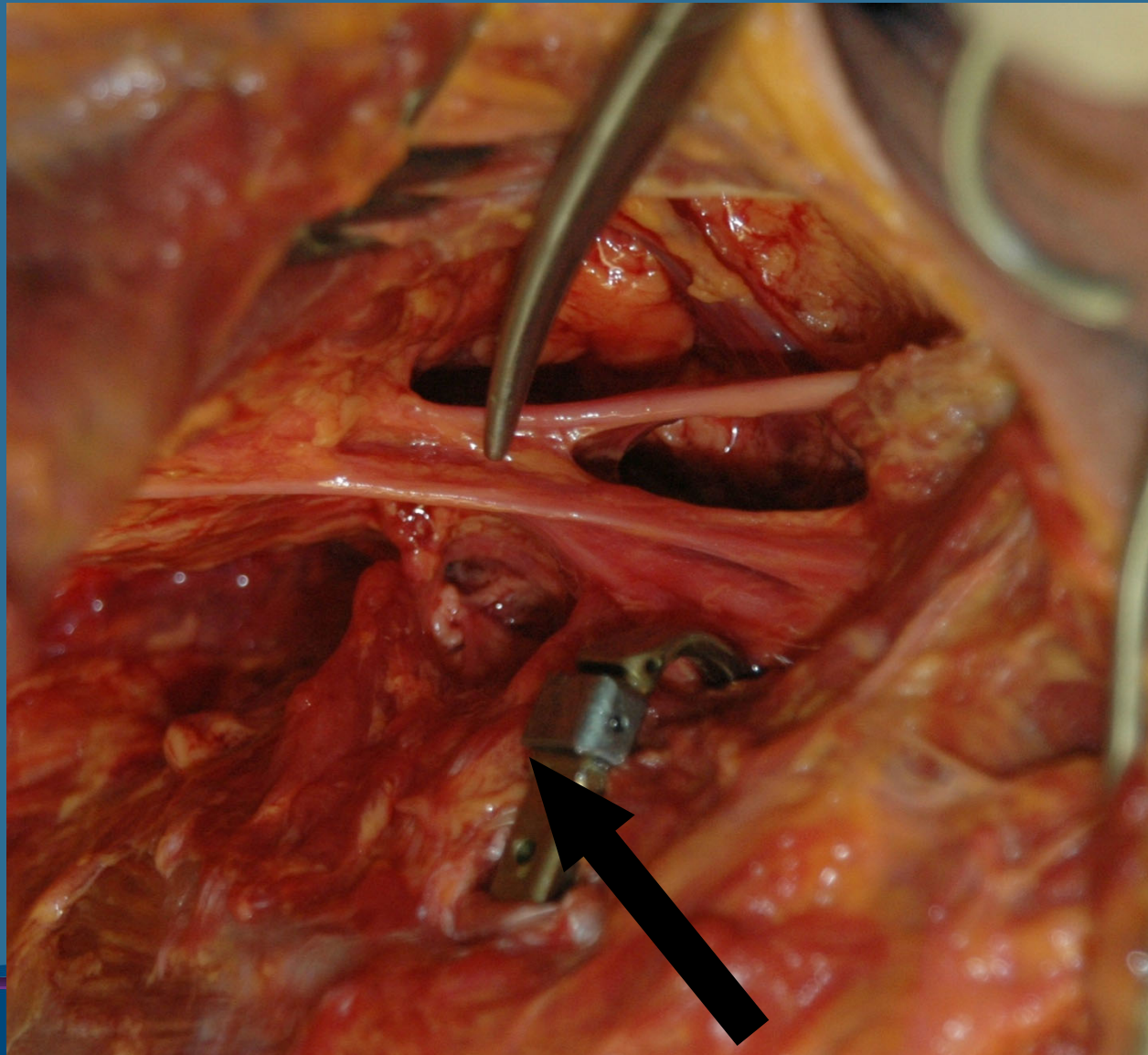




No Advantage to  
“Claw”

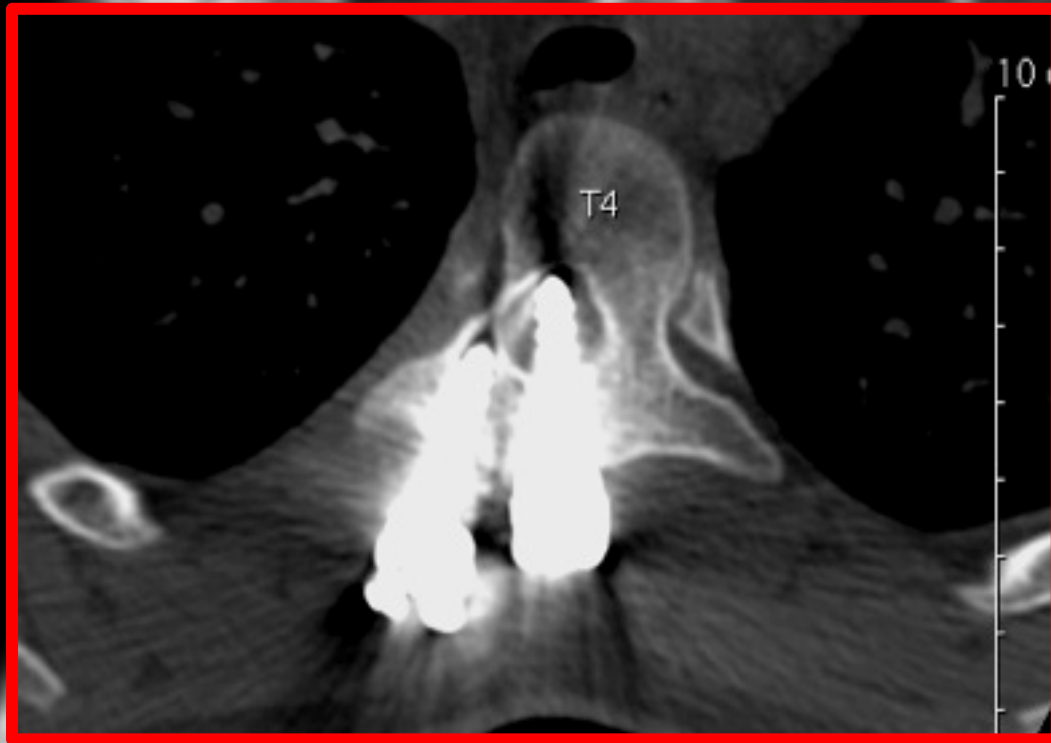


# Don't use first rib





# Fails Posterior



©Behrang Amini, MD/PhD

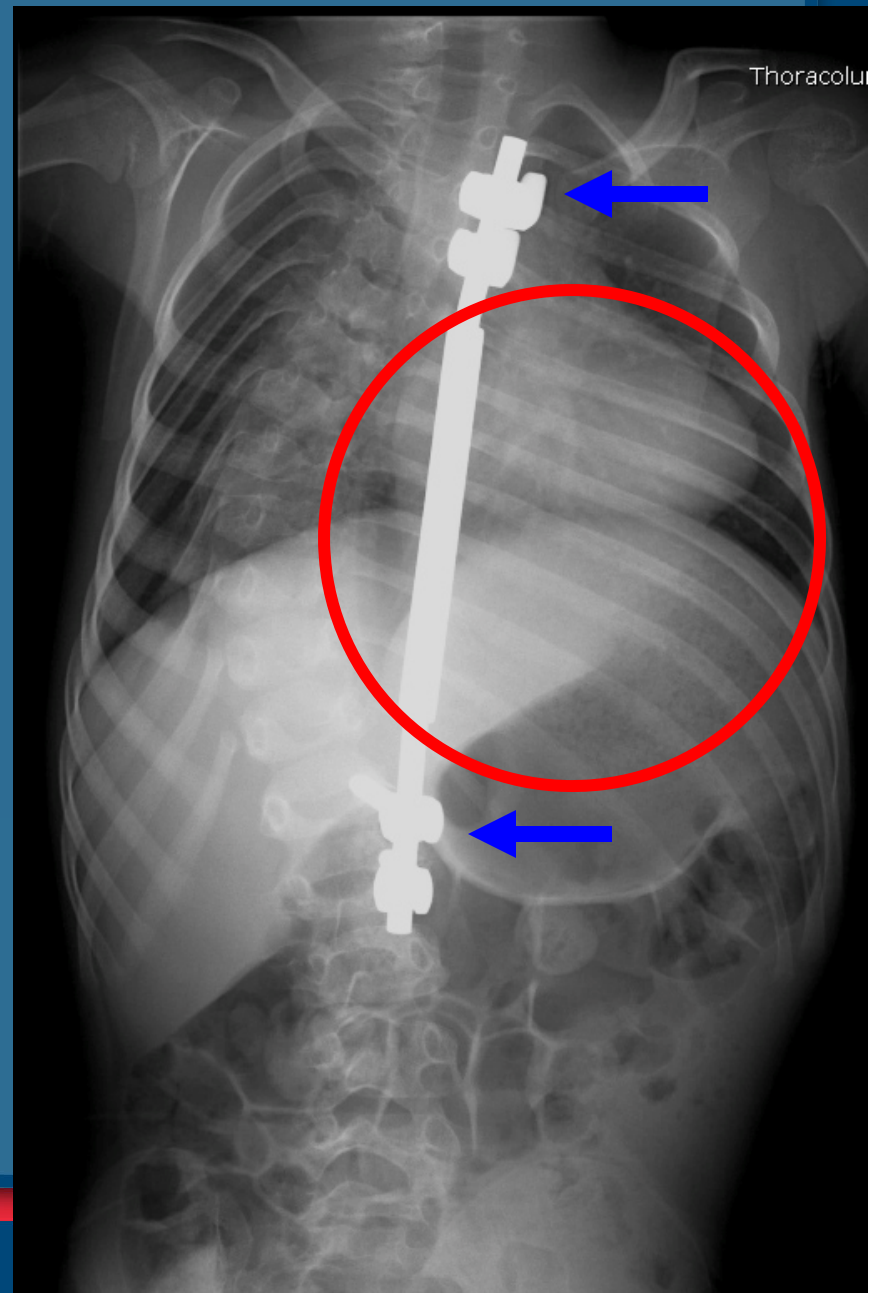
## Case Example 5yo boy

- Ambulatory
- neuromuscular
- 91° Scoliosis -progressive
- Extremely thin





# Portable Traction



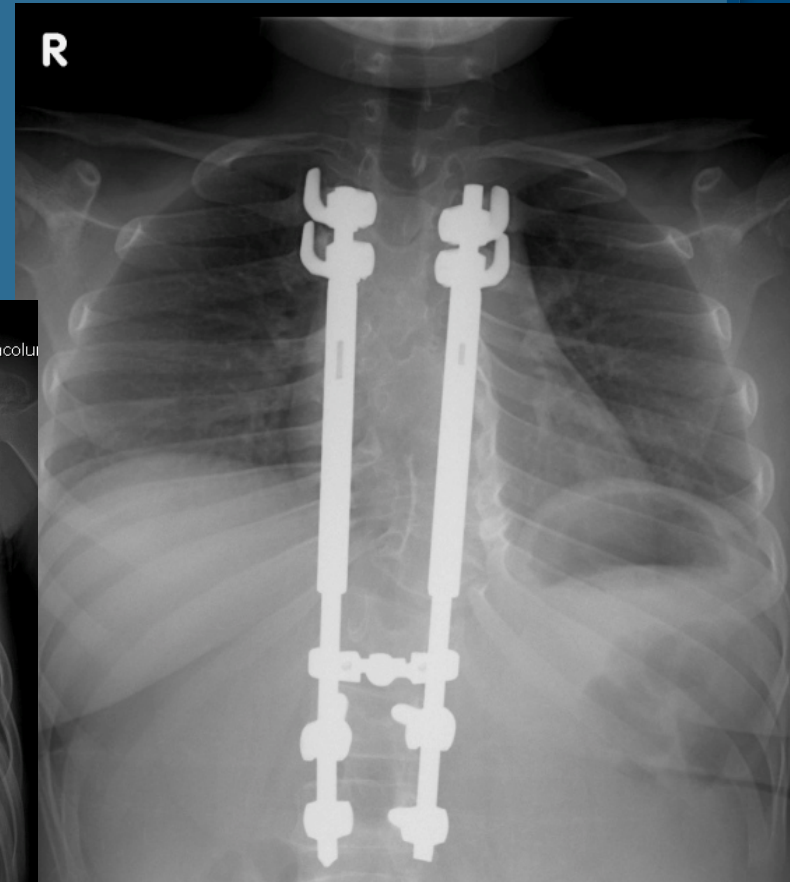
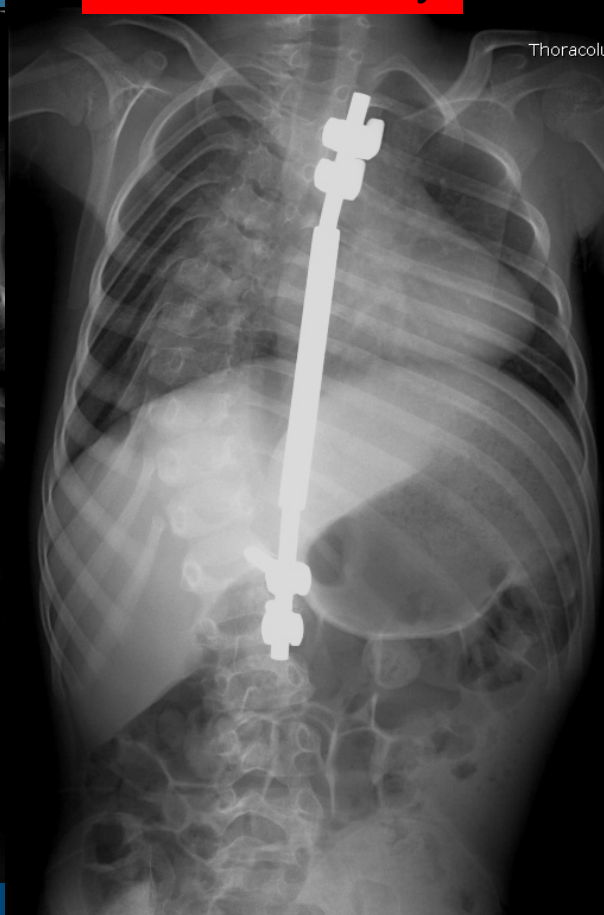
## Current Preference

- Dual-sided constructs
- $\geq 3$  up-going hooks

REALLY thin kids



NO Thorcotomy



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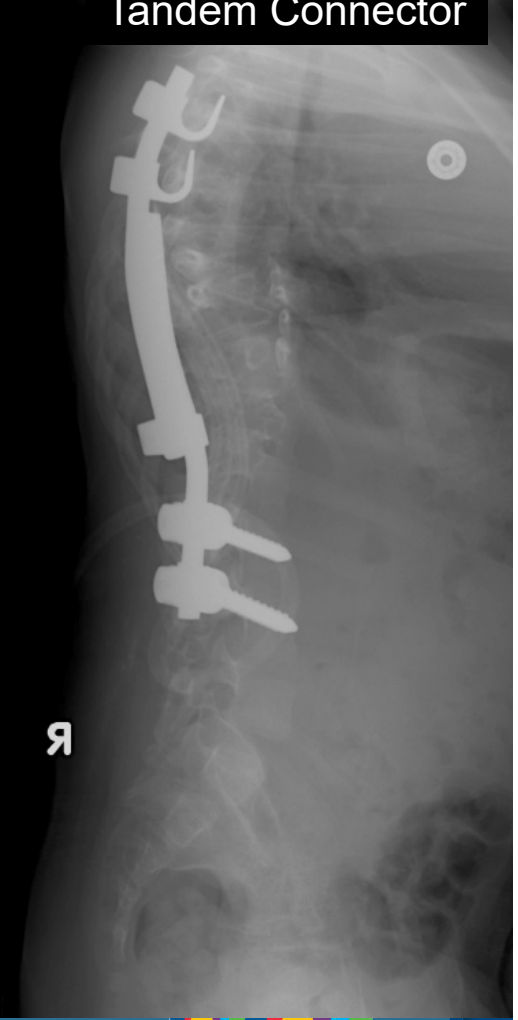
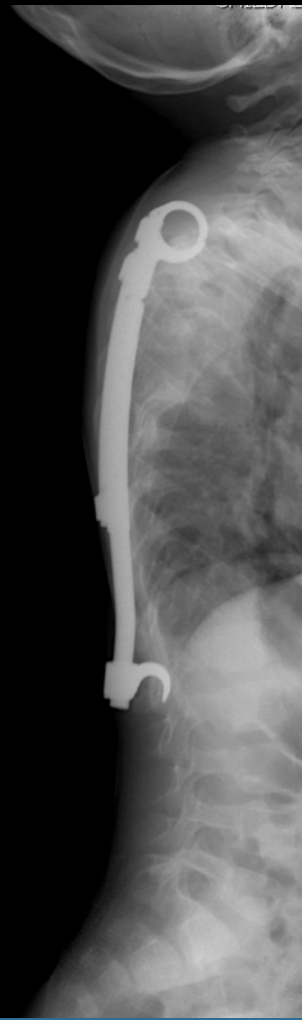
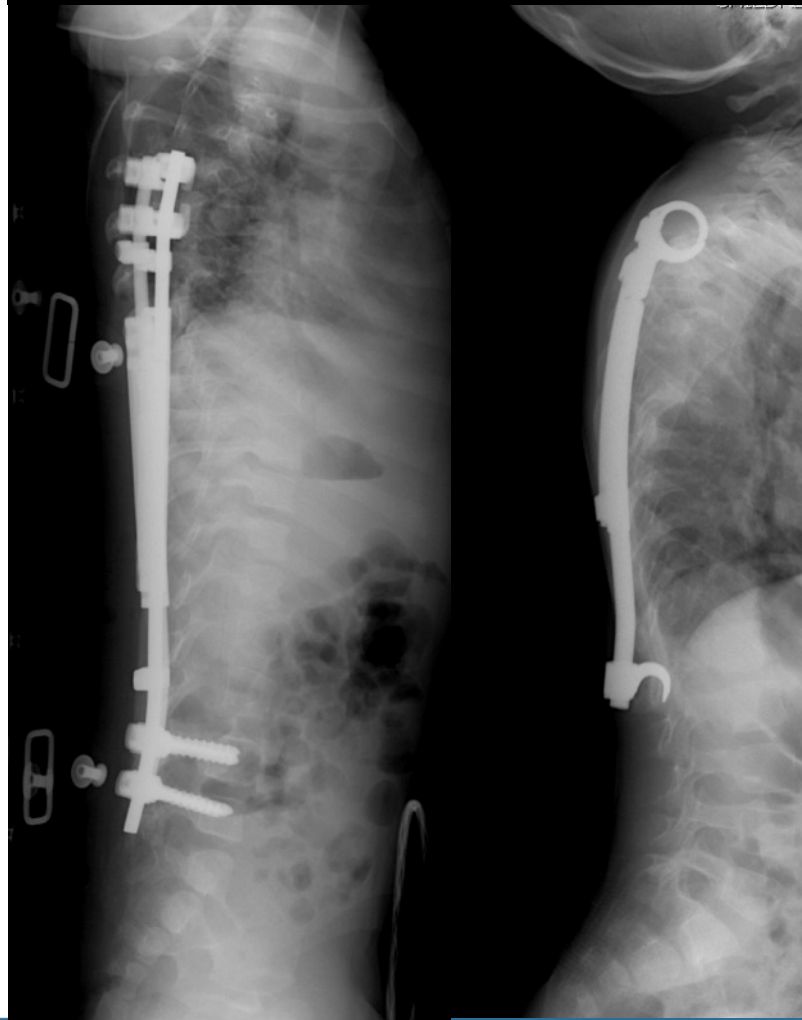
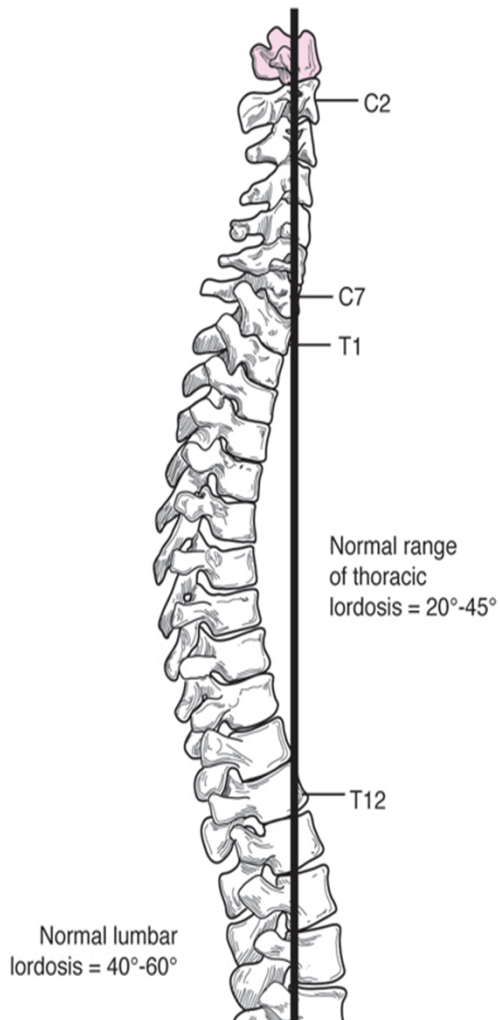
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# Sagittal Contouring

Straight Connector

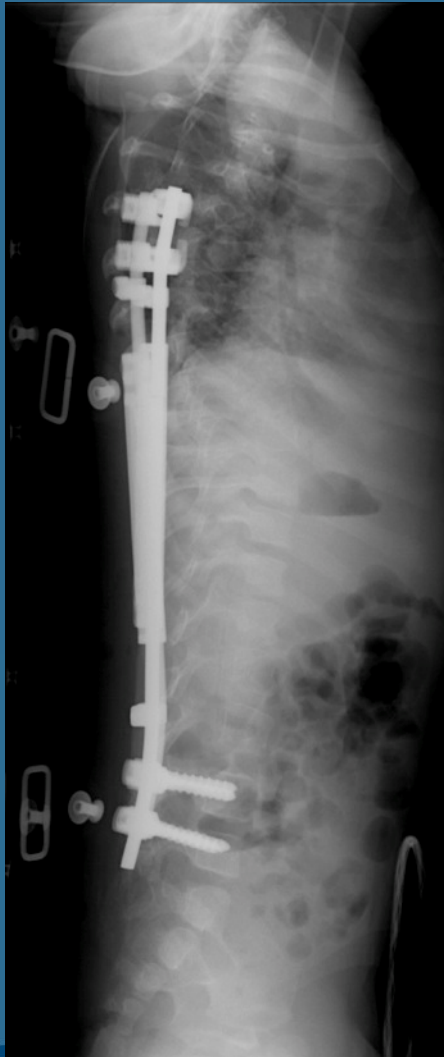
Curved Connector

Curved Rod  
Tandem Connector

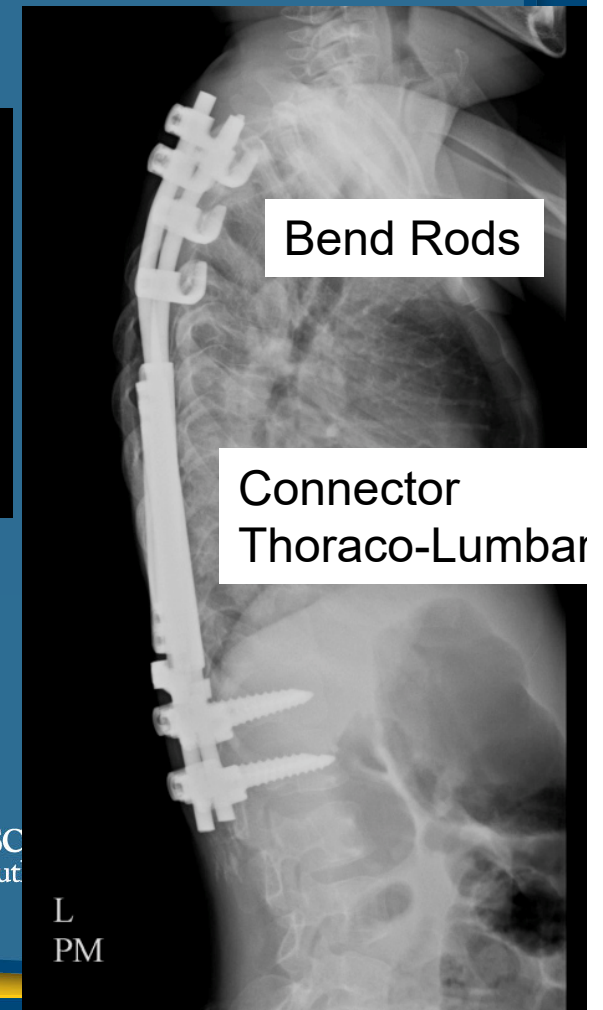




# Straight Longitudinal Connector



Too Long (straight)  
Vs.  
Too Short  
(Few lengthenings)



# Lengthening Through Curved Rods

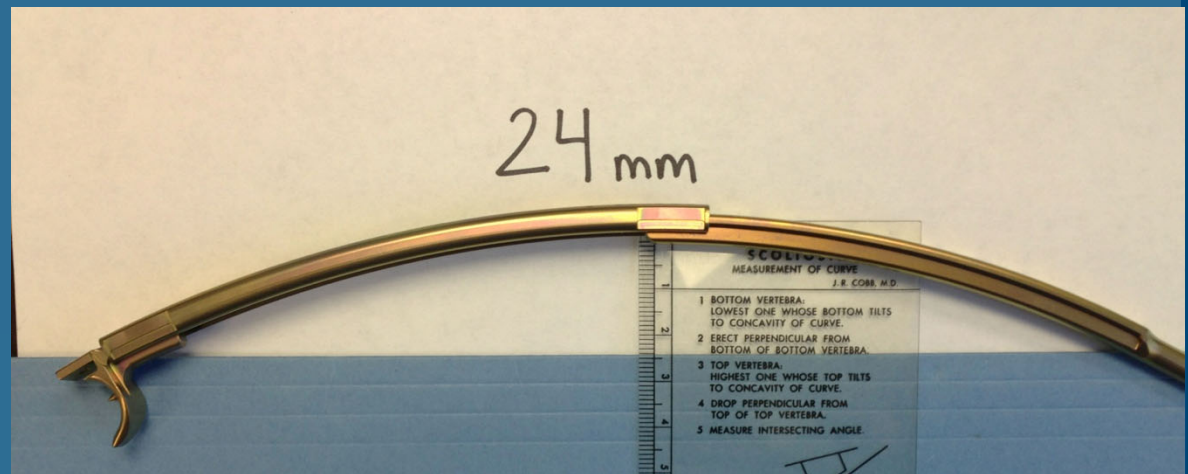
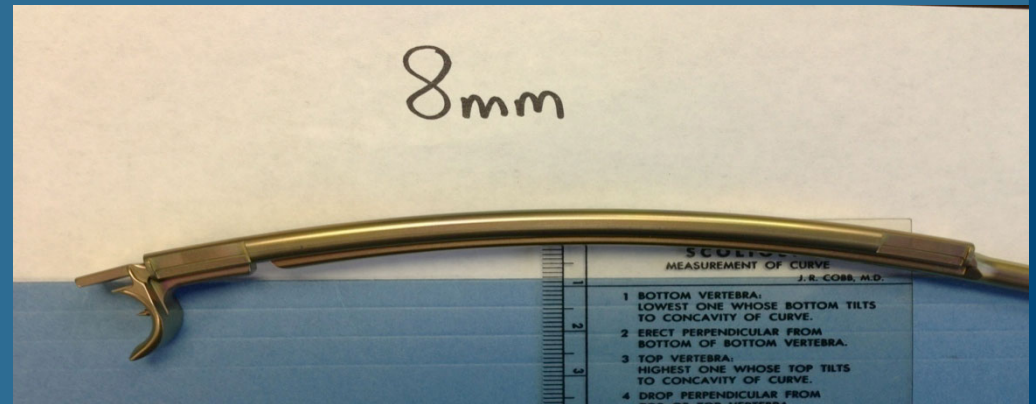
- More Posterior Prominence
- More Kyphosis

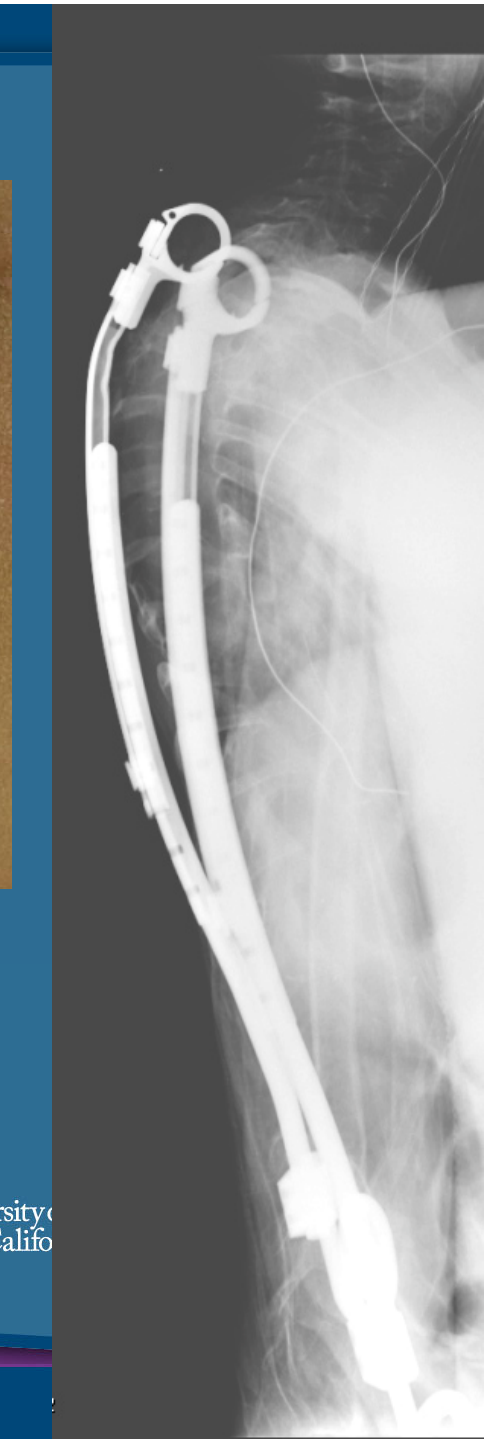
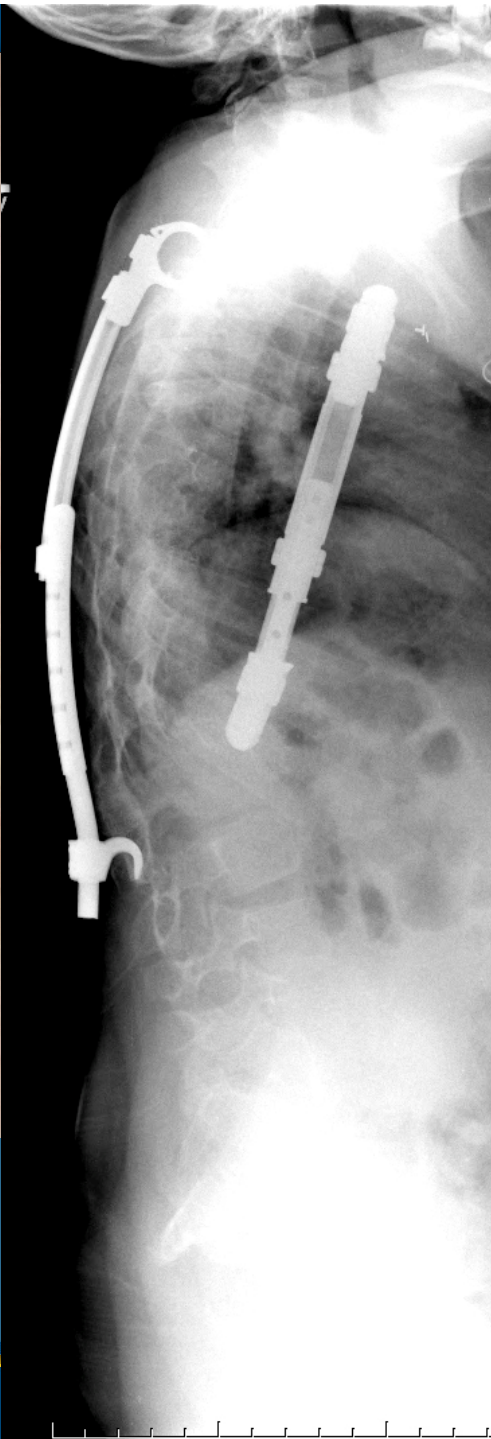




# Lengthening Through Curved Rods

- More Posterior Prominence
- More Kyphosis





From  
Charlie Johnston

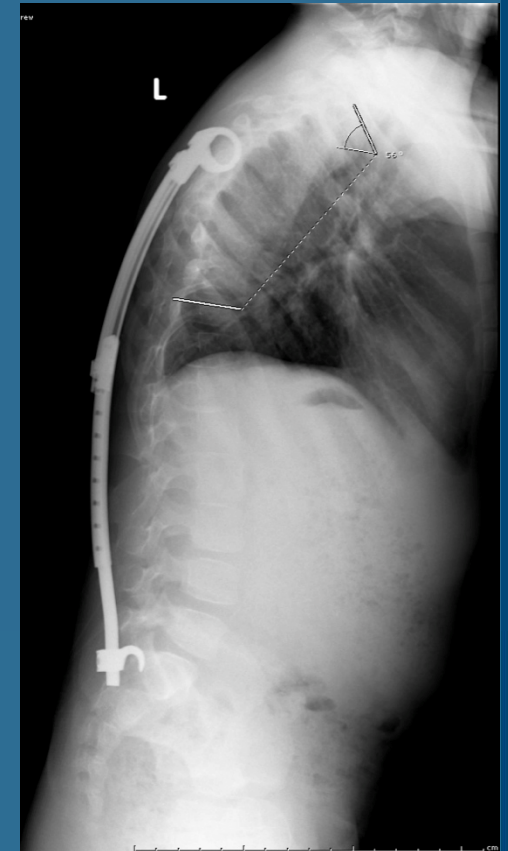
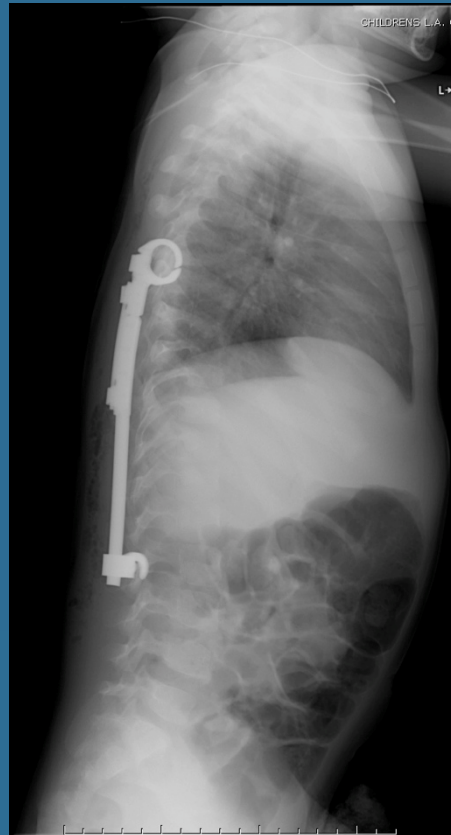
# Lengthening Through Curved Rods

- More Kyphosis
- + Sagittal Balance

4 yo

Same Patient

7 yo



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# Rib Anchored

Scoliosis

BAILOUT-Previous infection

Previous

laminectomies/scarring

Multiple rib

fusions/thoracostomy

# Spine Anchored

Kyphosis



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# Thank You

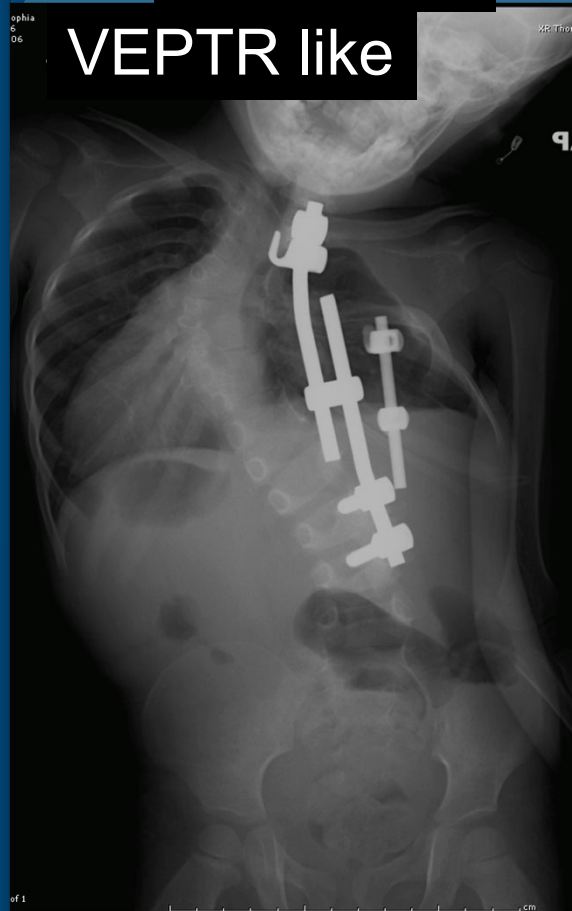


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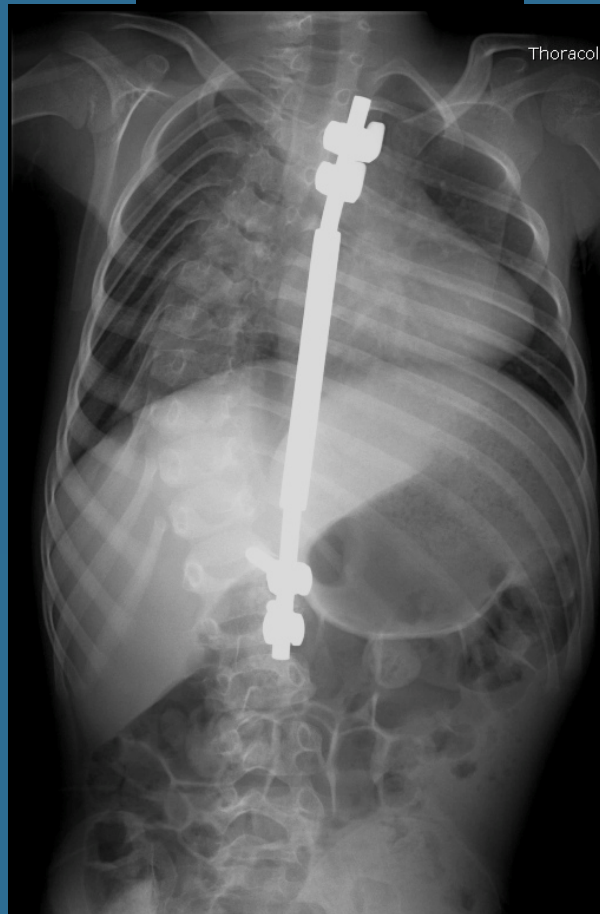


# Many Options

Unilateral  
Dual Rods

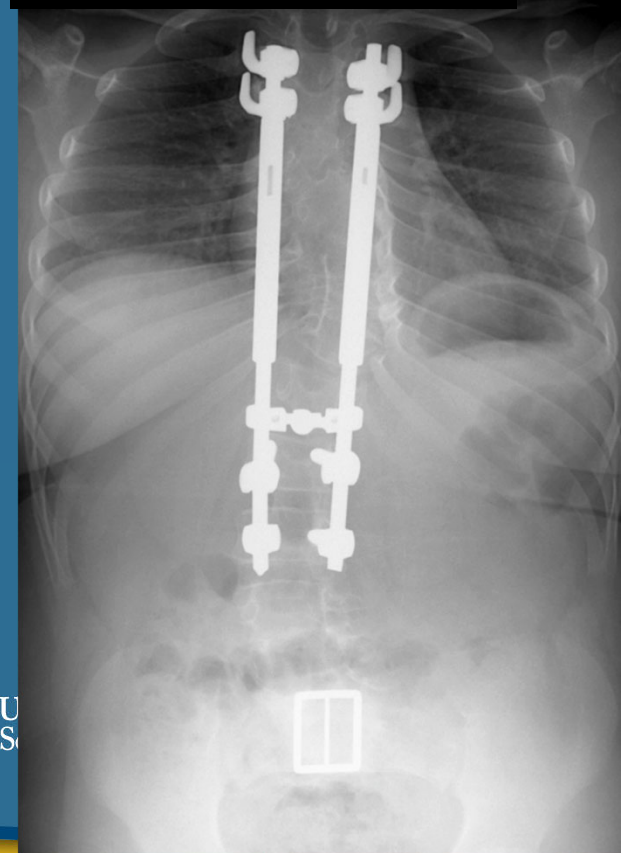


Unilateral  
Single Rods



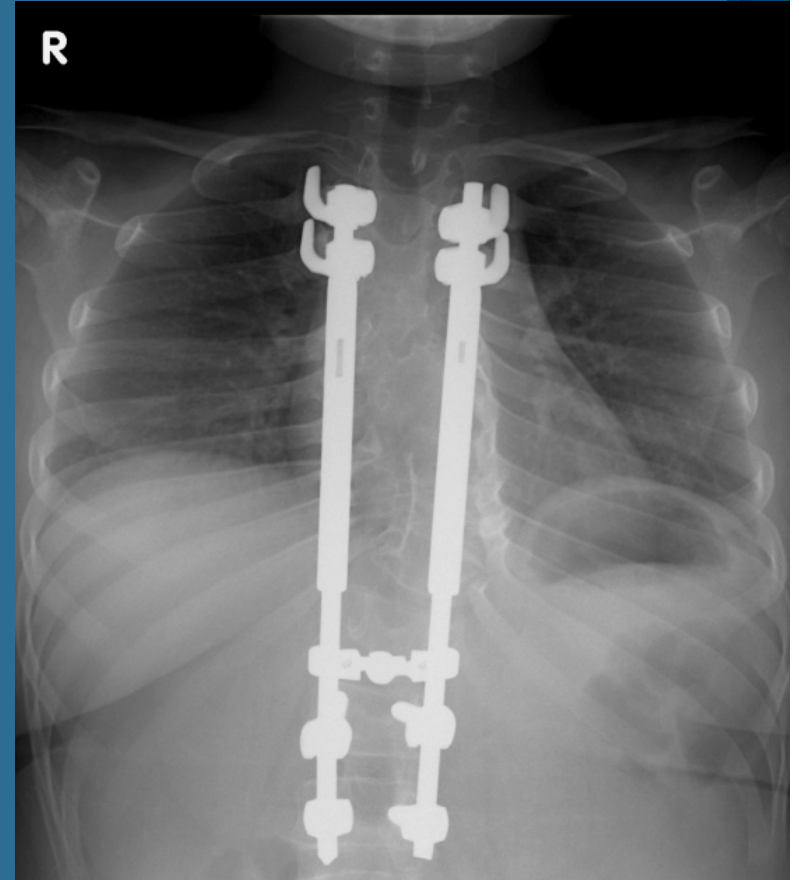
Bilateral  
Dual Rods

Growing rod like



## Current Preference

- Dual-sided constructs
- $\geq 3$  up-going hooks



# T1-S1 Growth

## Normal Growth

0-5 yrs

2.0 cm/yr

5-10 yrs

1.2 cm/yr

Dual Growing Rods,  
2005,2008, 2009

5 + 6 yrs  
39 mo f/u

1.1 -1.8 cm/yr

VEPTR, Congenital  
JBJS, 2003

3 + 3yrs  
50 mo f/u

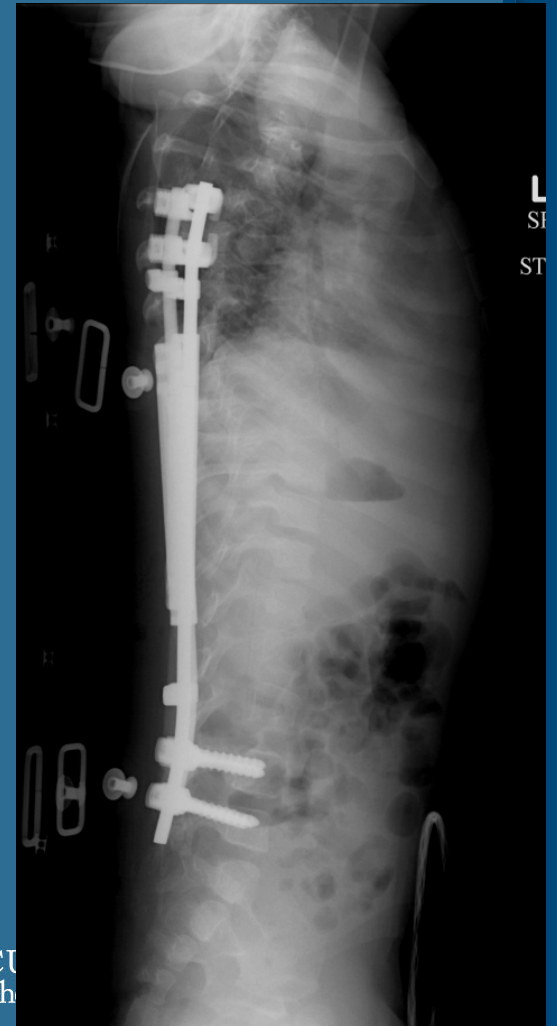
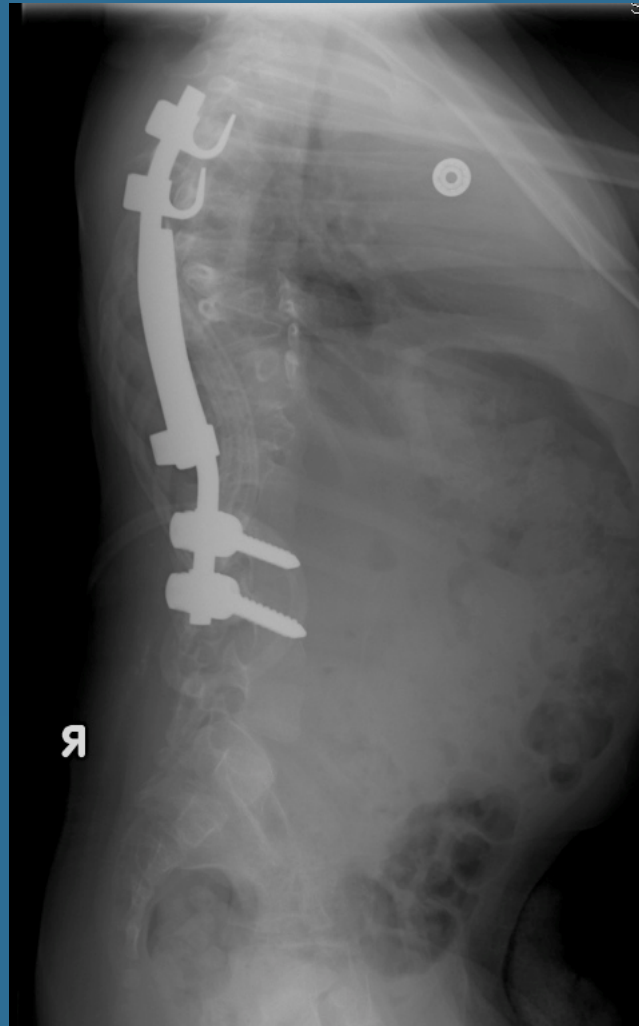
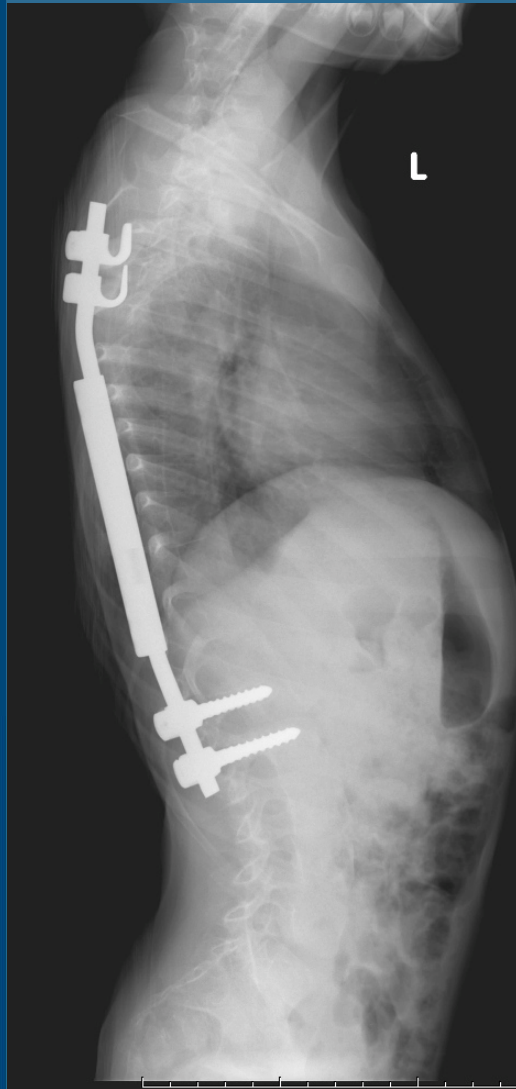
0.83 cm/yr  
Thoracic only

Hybrid Implants  
85% congenital

3 + 1 yrs  
37mo f/u

**Unilat -0.65 cm/yr**  
***Bilat-1.2 cm/yr***

# Sagittal Contouring



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Thank You



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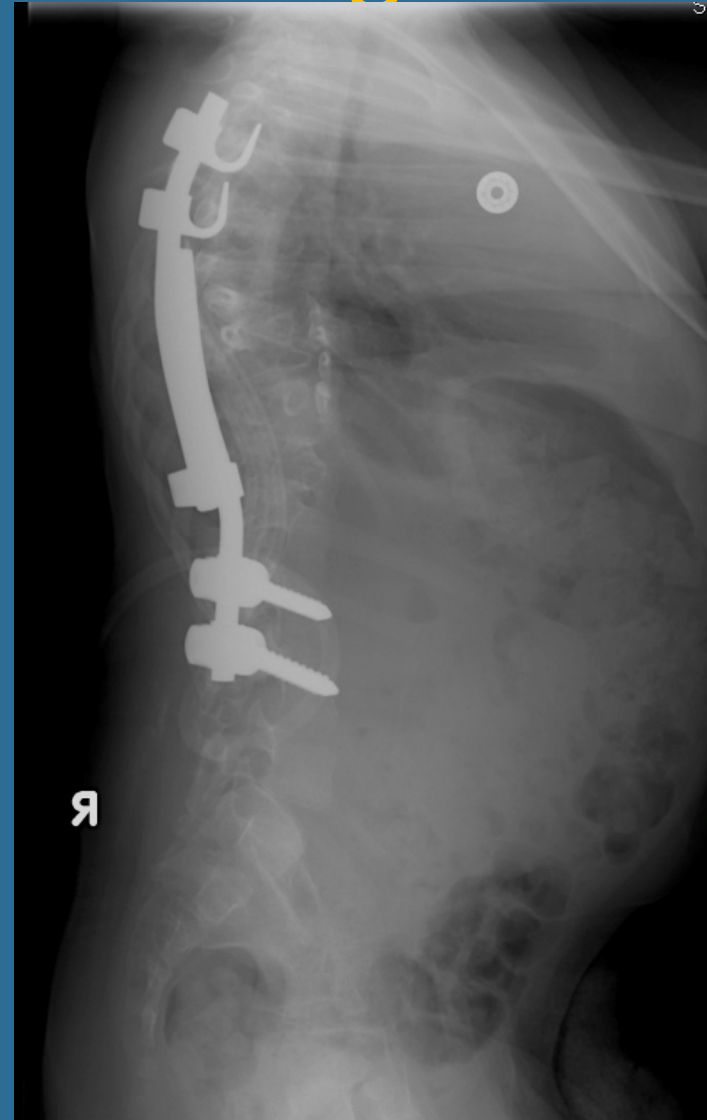
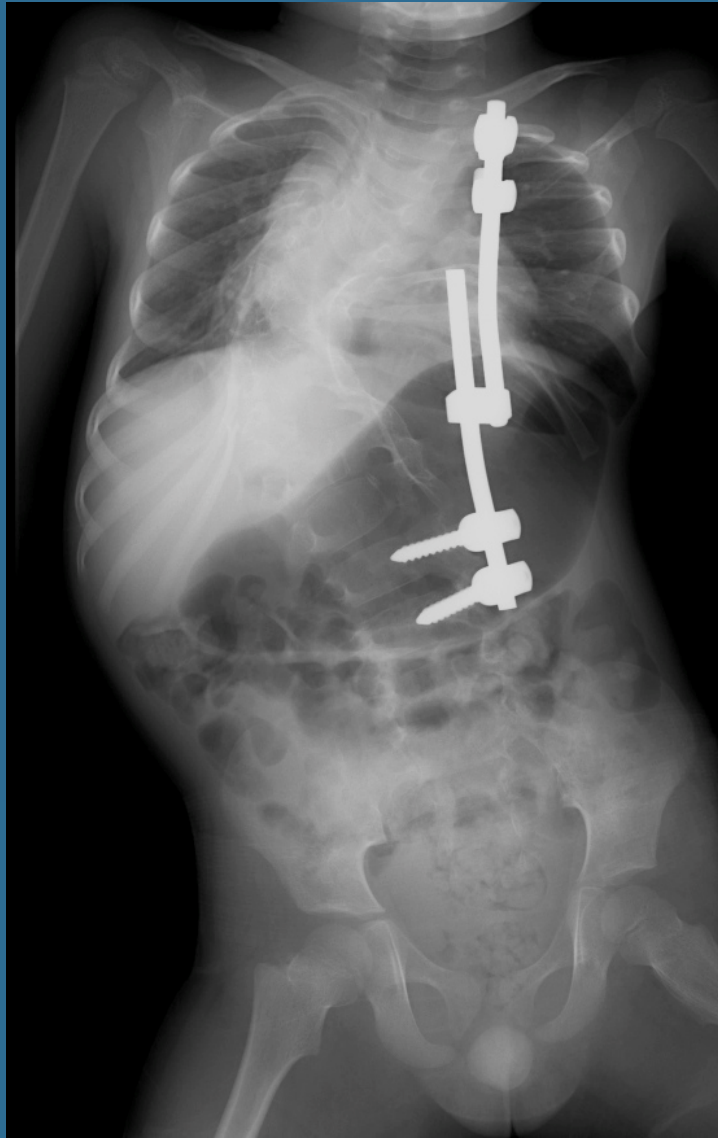
# Video



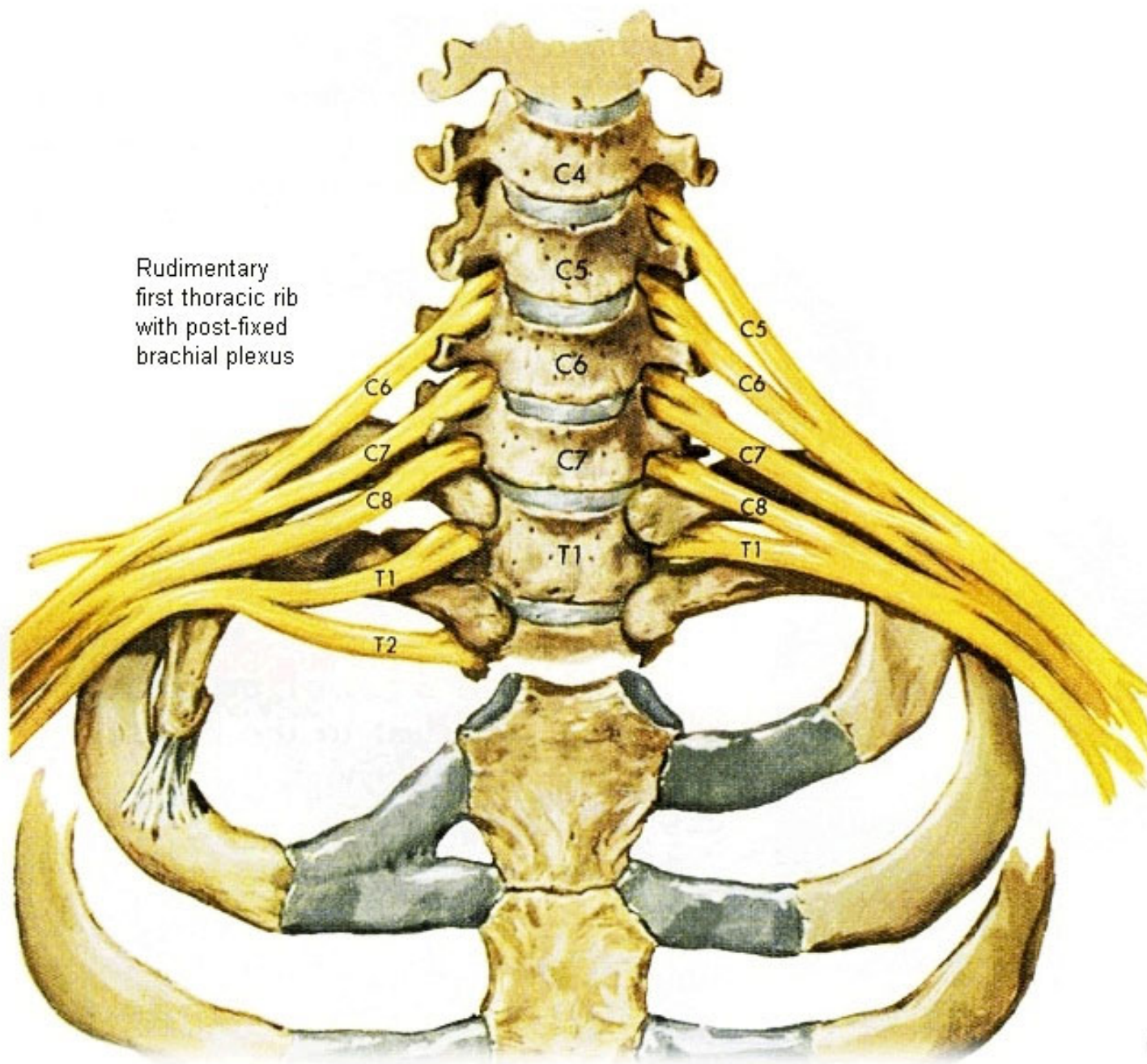
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ORTHOPAEDIC CENTER

# Sagittal Contouring



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No  
pl



Thank You



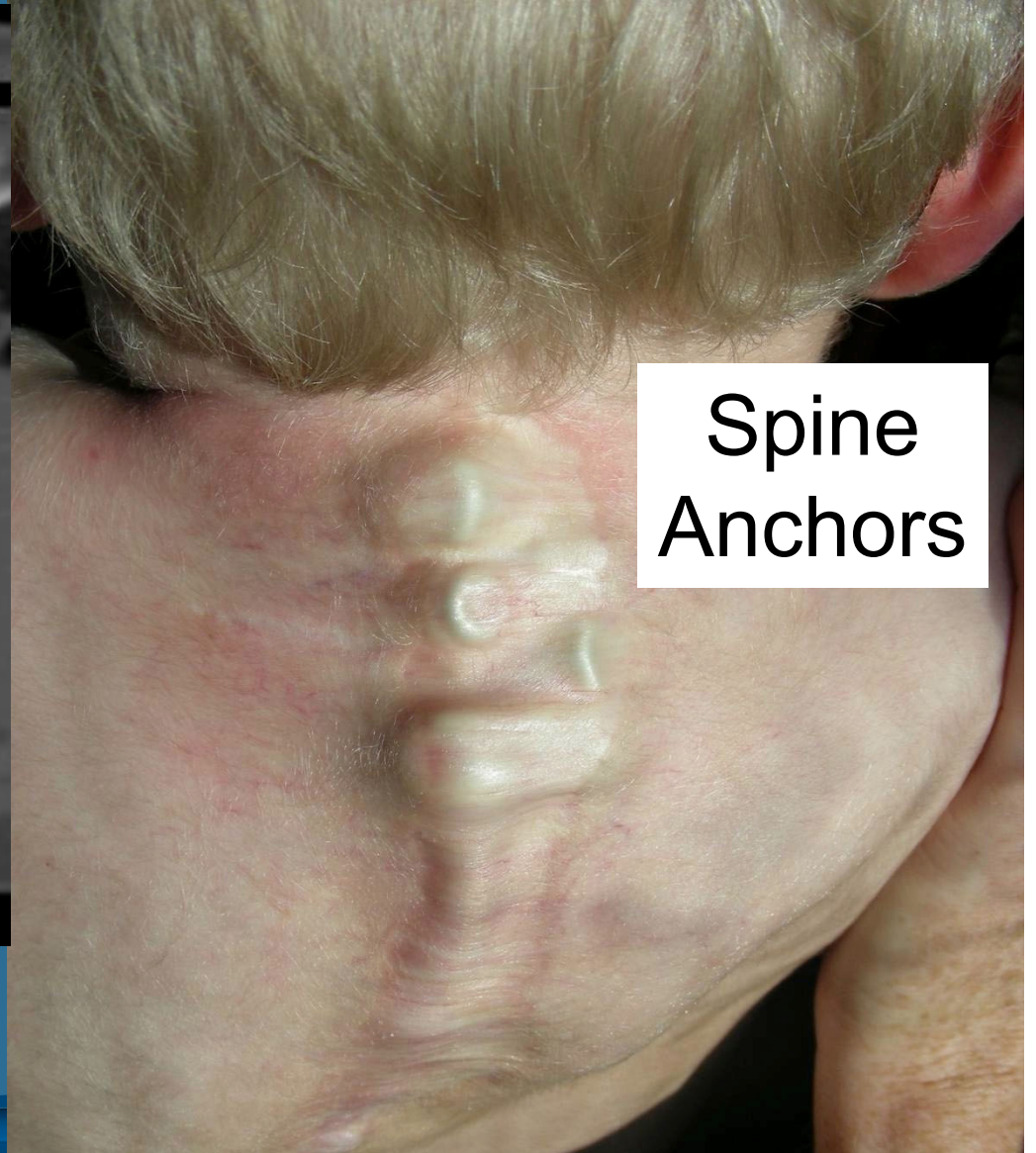
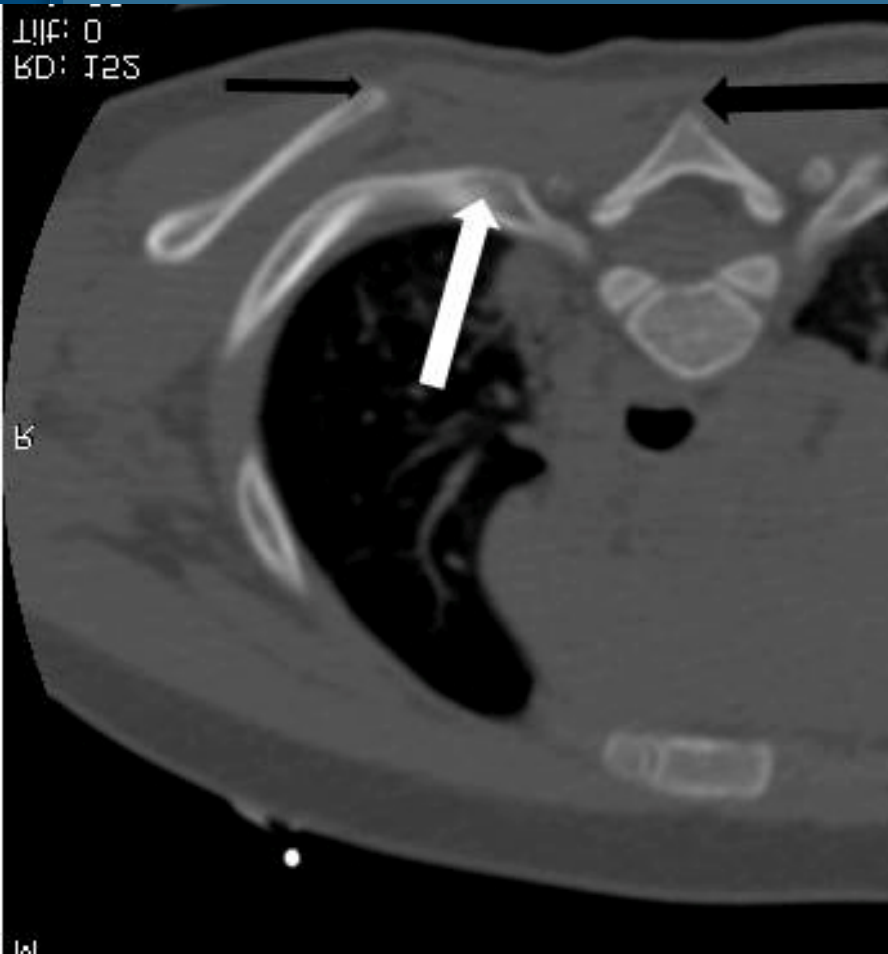


Growing Rod  
Surgery is Like ..





## Hooks on Ribs: Lower Profile than Spine



# References

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- Karol, L. A., C. Johnston, et al. (2008). "Pulmonary function following early thoracic fusion in non-neuromuscular scoliosis." Journal of Bone and Joint Surgery Am **90**(6): 1272-1281.
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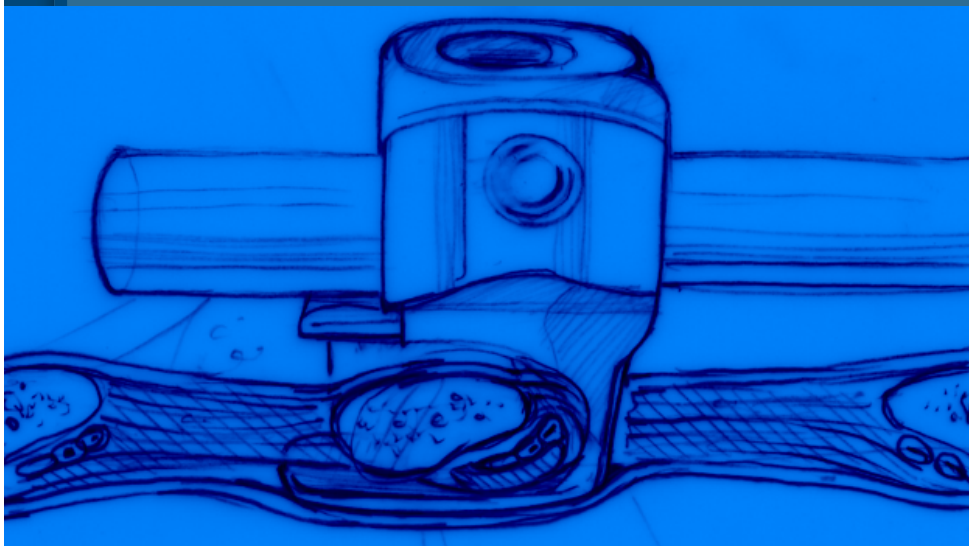


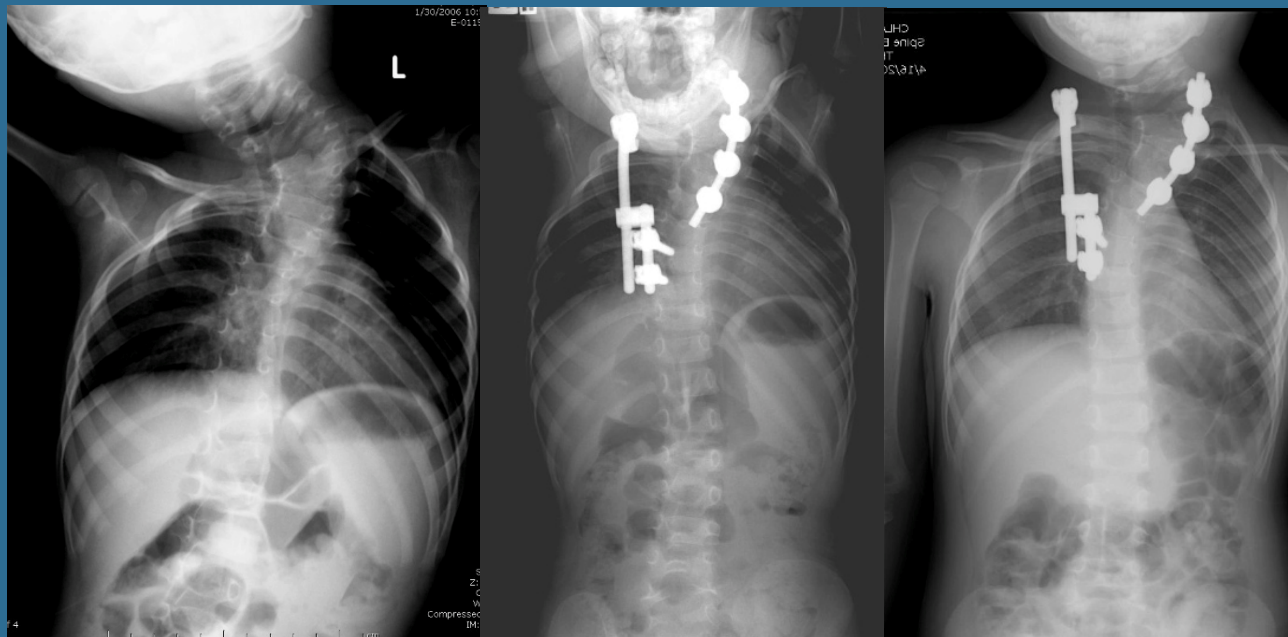
University of  
Southern California



# Purpose

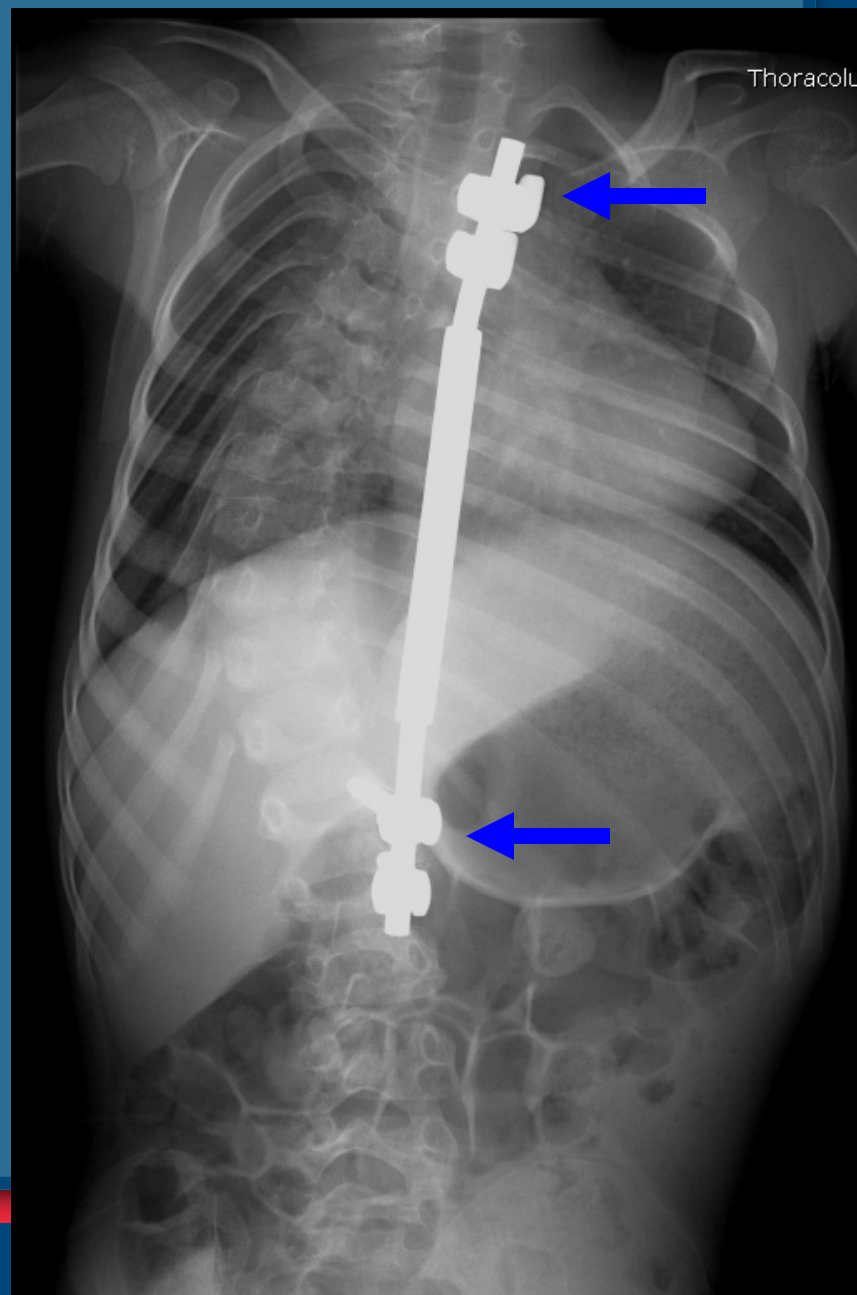
- To report the early results of this technique.







# Portable Traction





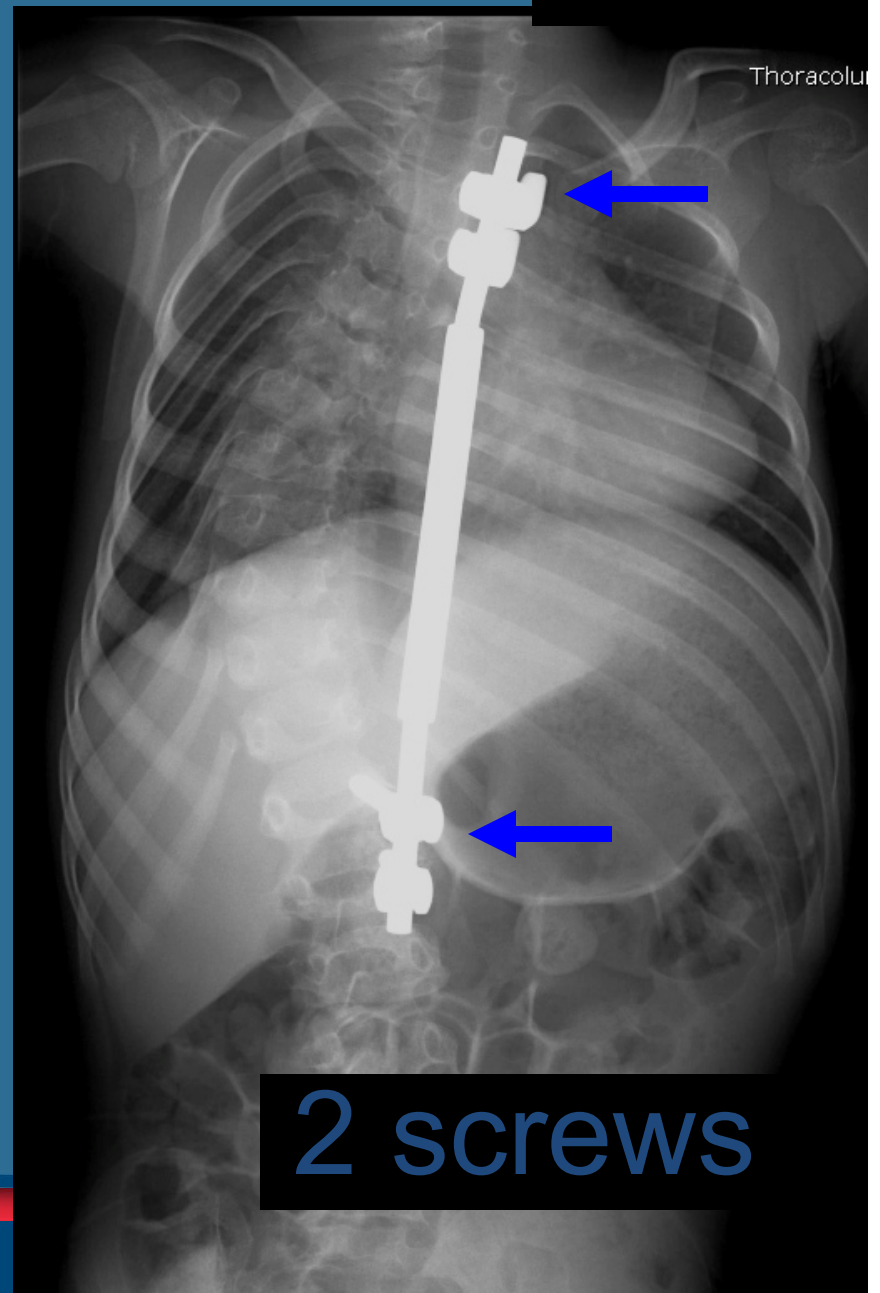
3.5 mm





# No Thoracotomy

2 ribs



# Complications

- Risk factors:
  - Younger age at index surgery ( $p=0.12$ )
  - Larger initial Cobb angle ( $p=0.12$ )



	% rod breakage
Traditional Growing Rods	120% (12 /10)
Hybrid growing rods	0% (0/6)
Veptr	31% (6/19)



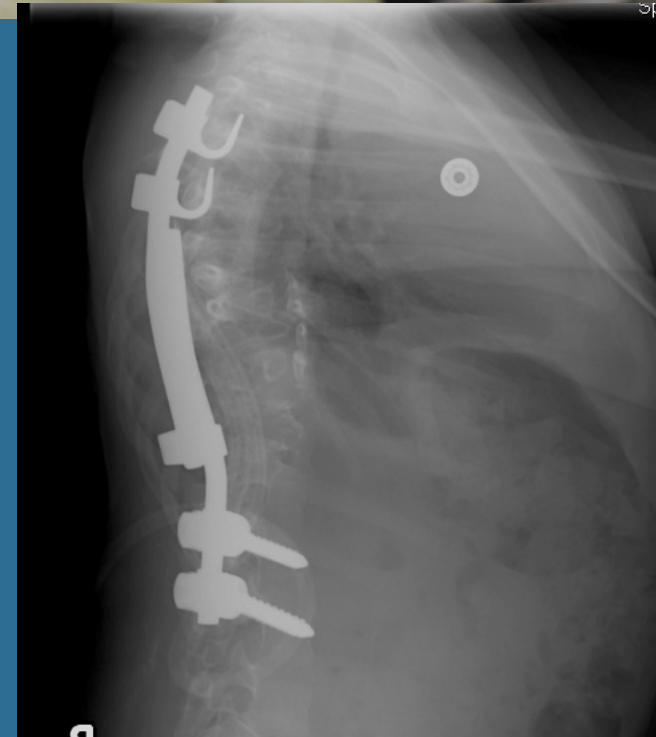


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- FDA Off label
- No IRB approval
- \$ < VEPTR
- Allows precise hook placements - non-constrained
  - Sagittal contouring



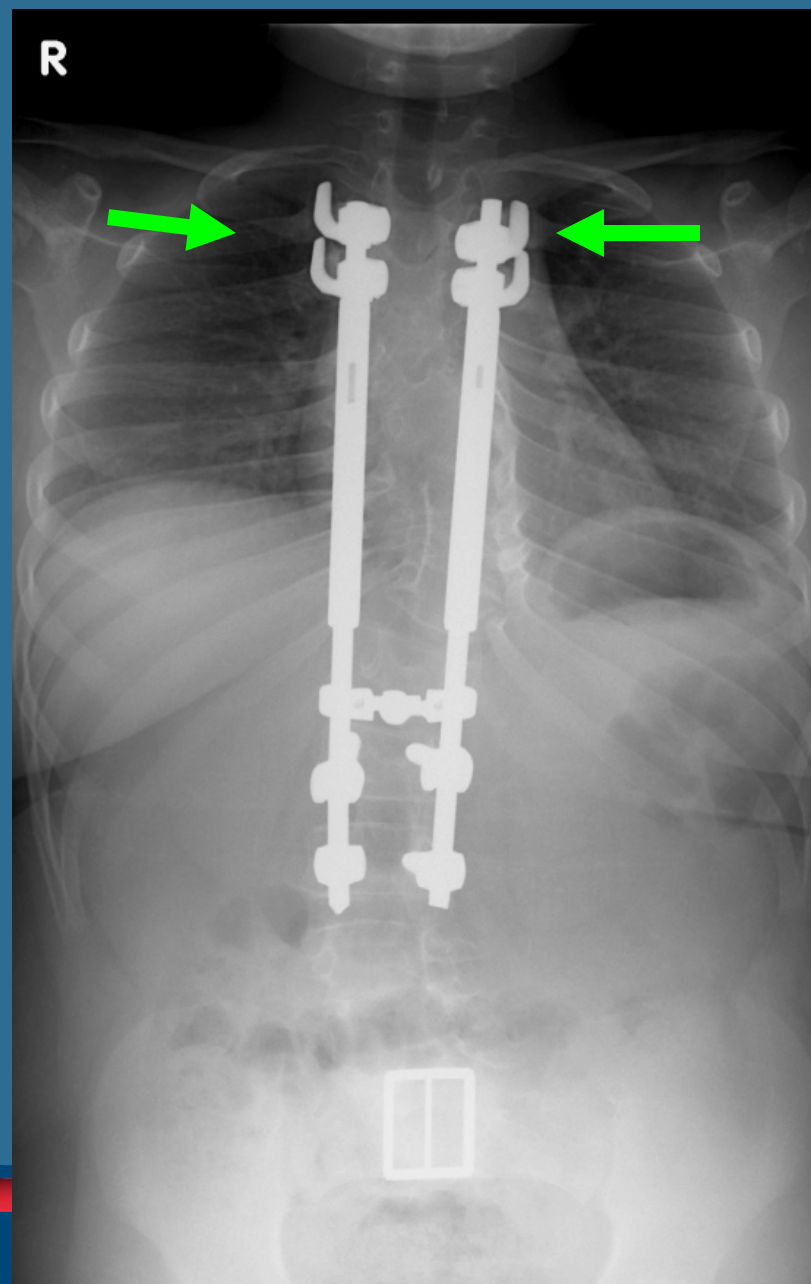
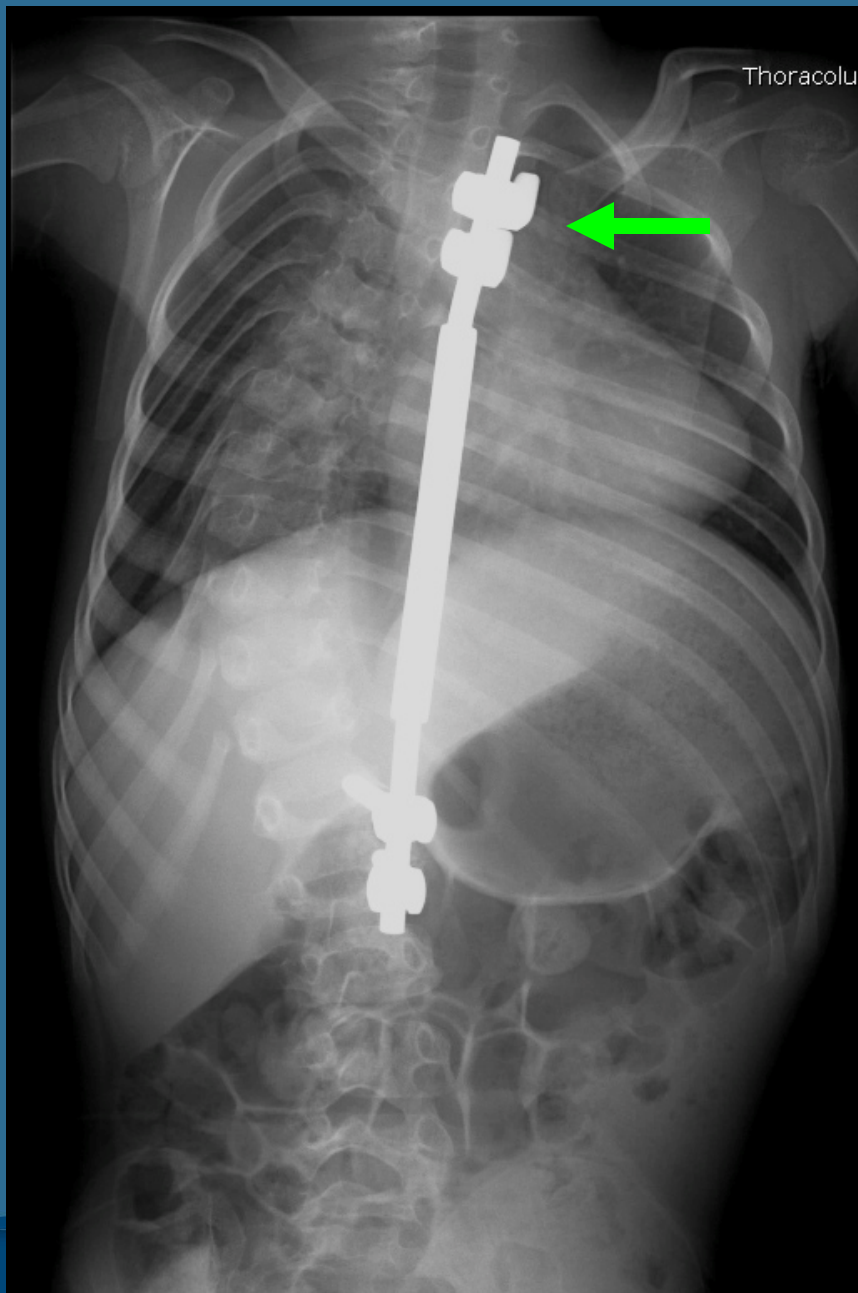


## Conclusions

- Complications in Hybrids is less common than other distraction based growth implants
  - Low profile
  - Multiple non-constrained load sharing anchors
  - Bend Sagittal profile to meet patients needs
  - Uses standard spine implants (no IRB approval needed)

**Avoids intentional fusion of upper thoracic spine**

# Rib Anchored Distraction Based Implants

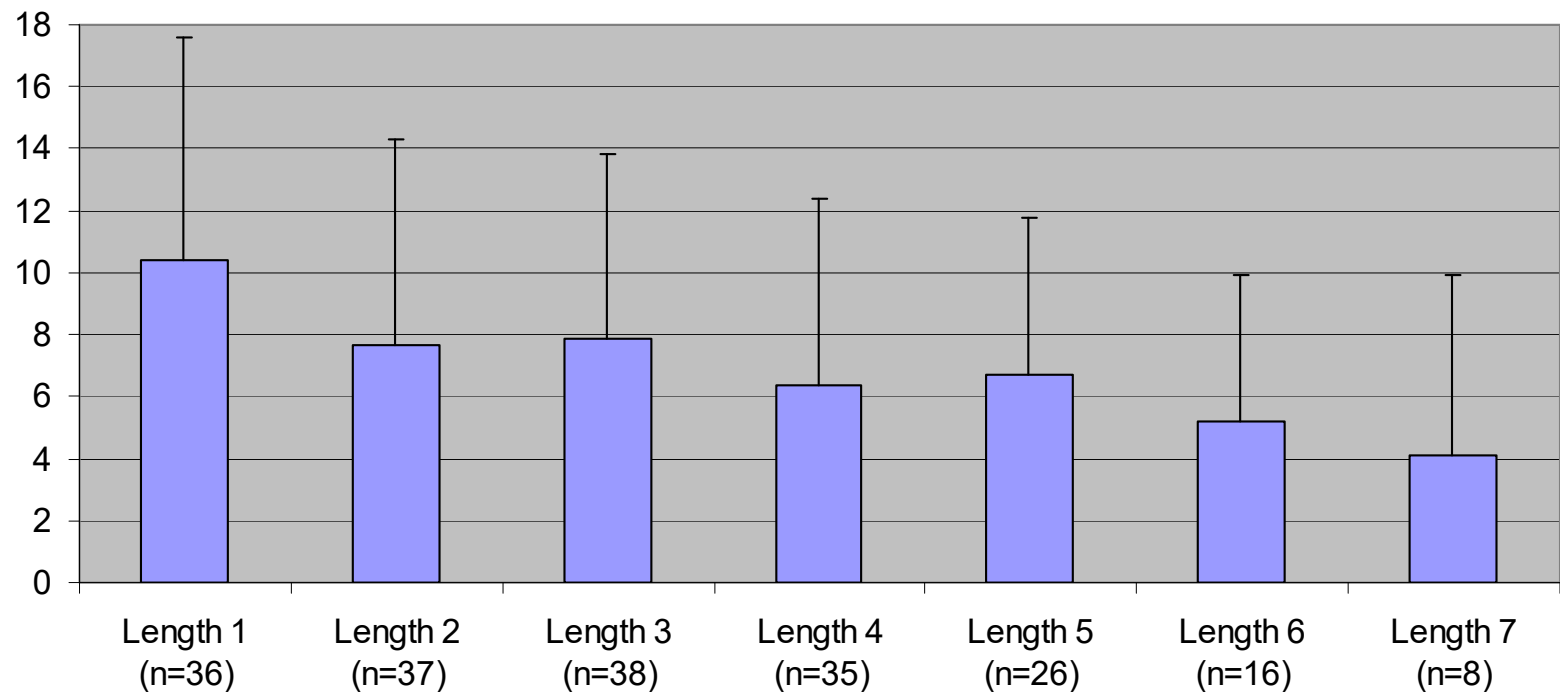


# Growing Rods

## Law of Diminishing Returns

### T1-S1Gain Vs. # of Lengthenings

Gain  
(mm)



# Lengthening

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