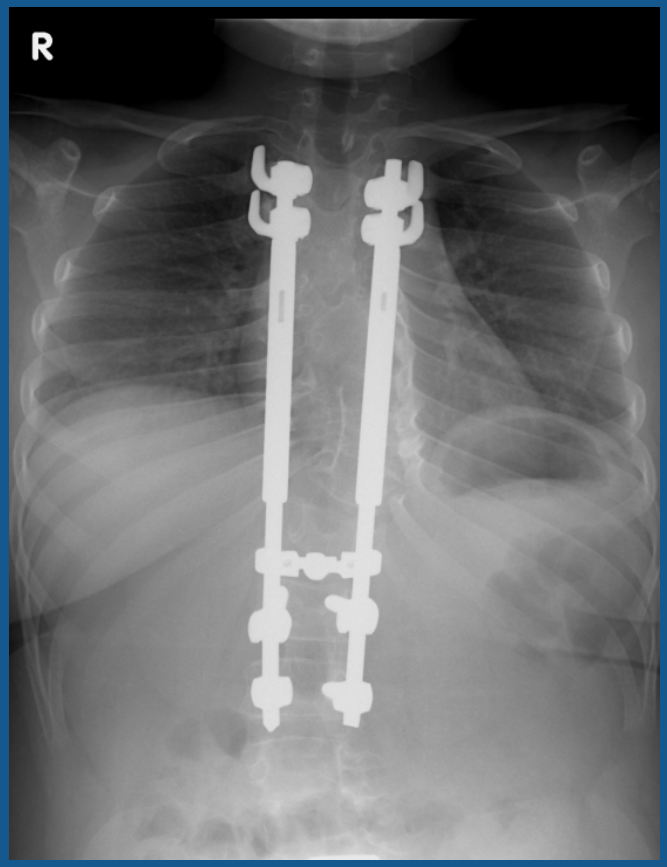
Hybrid Growth Rods
RIB BASED GROWING RODS



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

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Growth Friendly Implant Classification

1. Distraction based
   - Growing Rods
   - VEPTR
   - Self-Lengthening (Magec, Phenix)
2. Guided Growth
   - Luque-Trolley
   - Shilla
3. Compression Based
   - Tether
   - Staple

Growth Friendly Implant Classification

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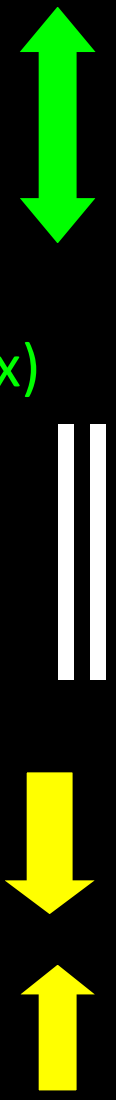
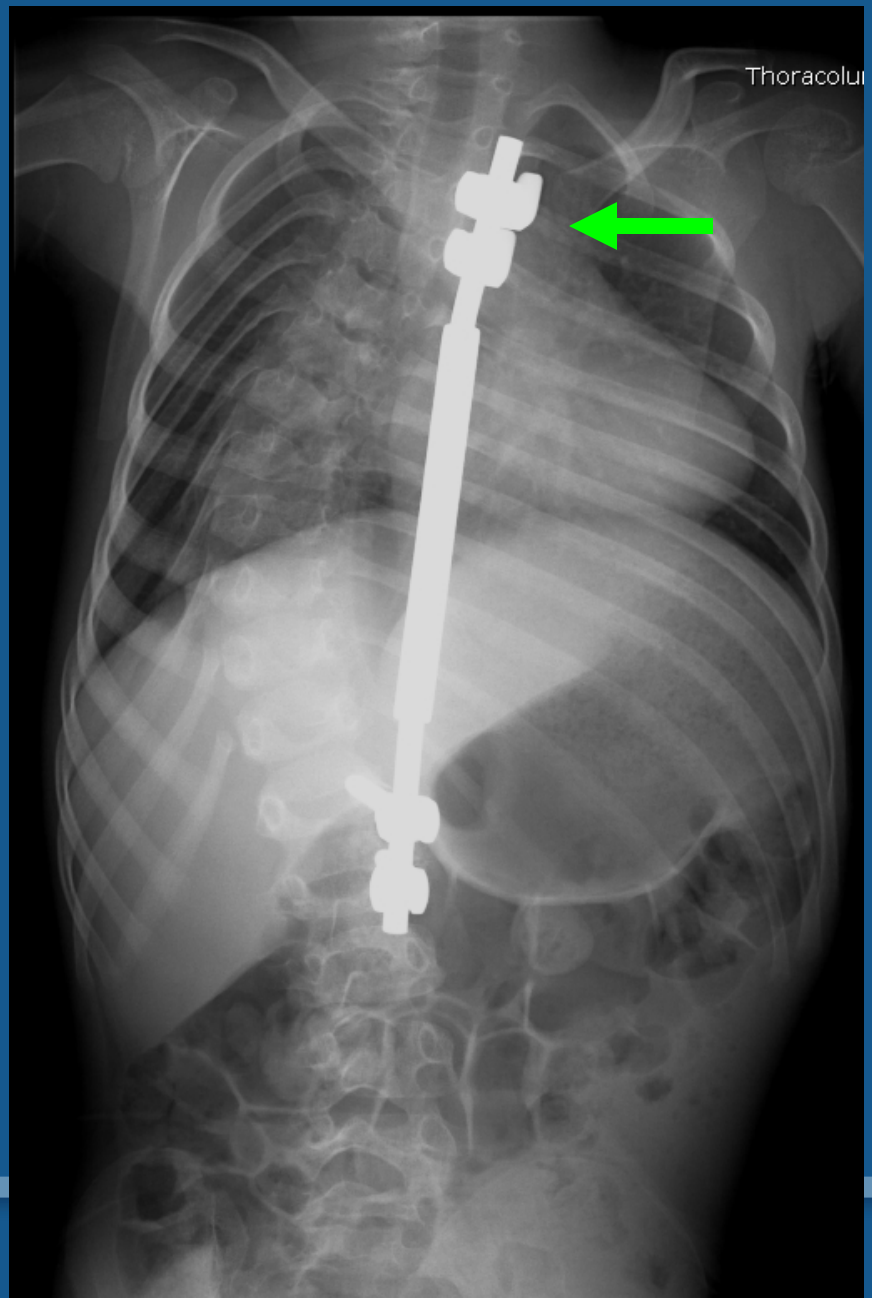
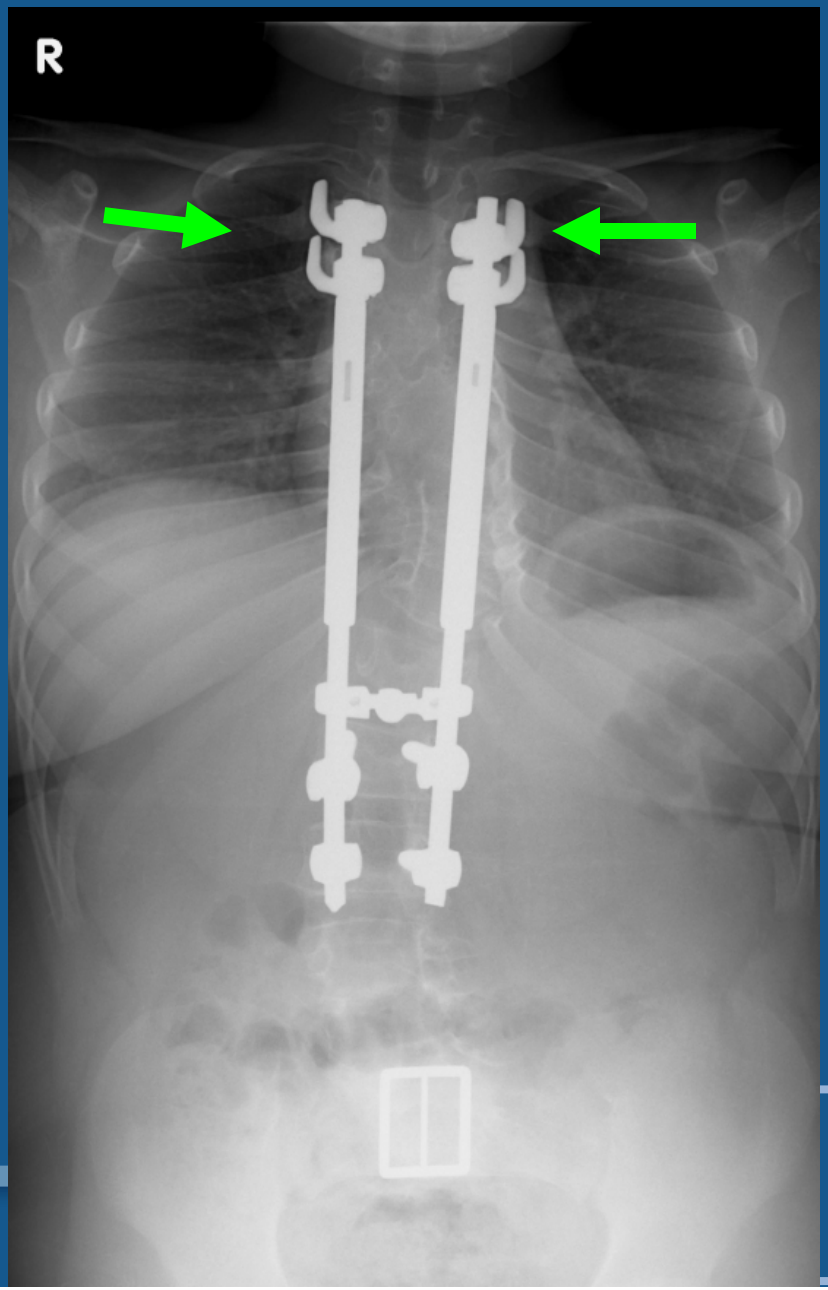


Hooks on Ribs





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1. Theoretical Advantages

2. Technique

3. Clinical Results

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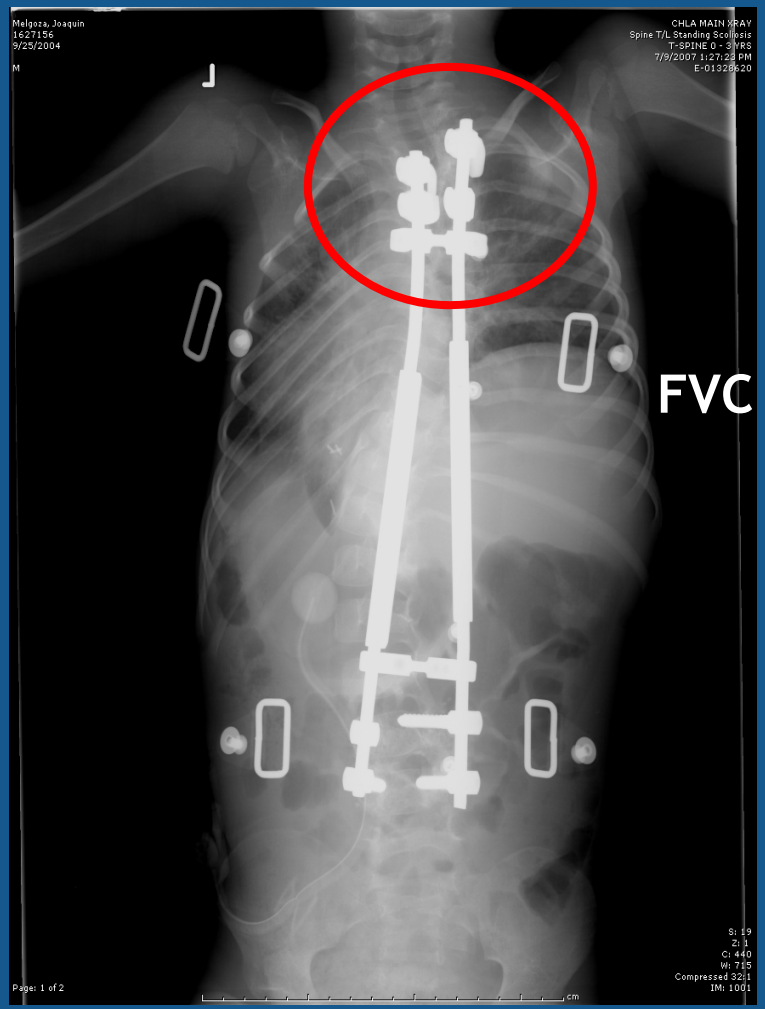
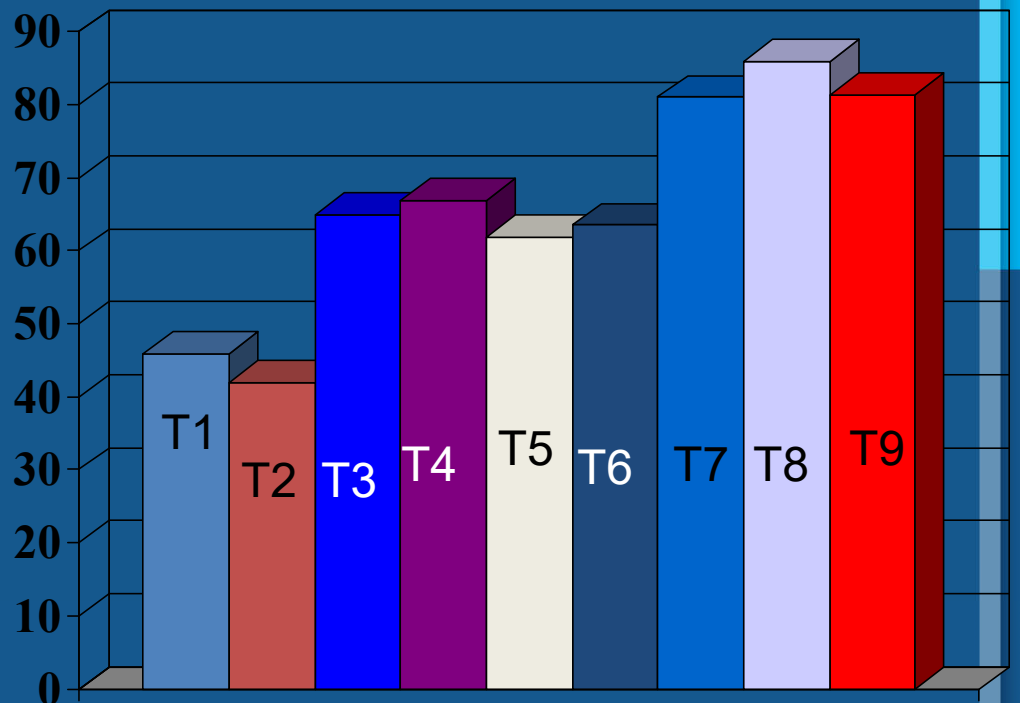
Part 1: Theoretical Advantages

FVC VS. PROXIMAL LEVEL OF FUSION





Karol et. al, JBJS 2008

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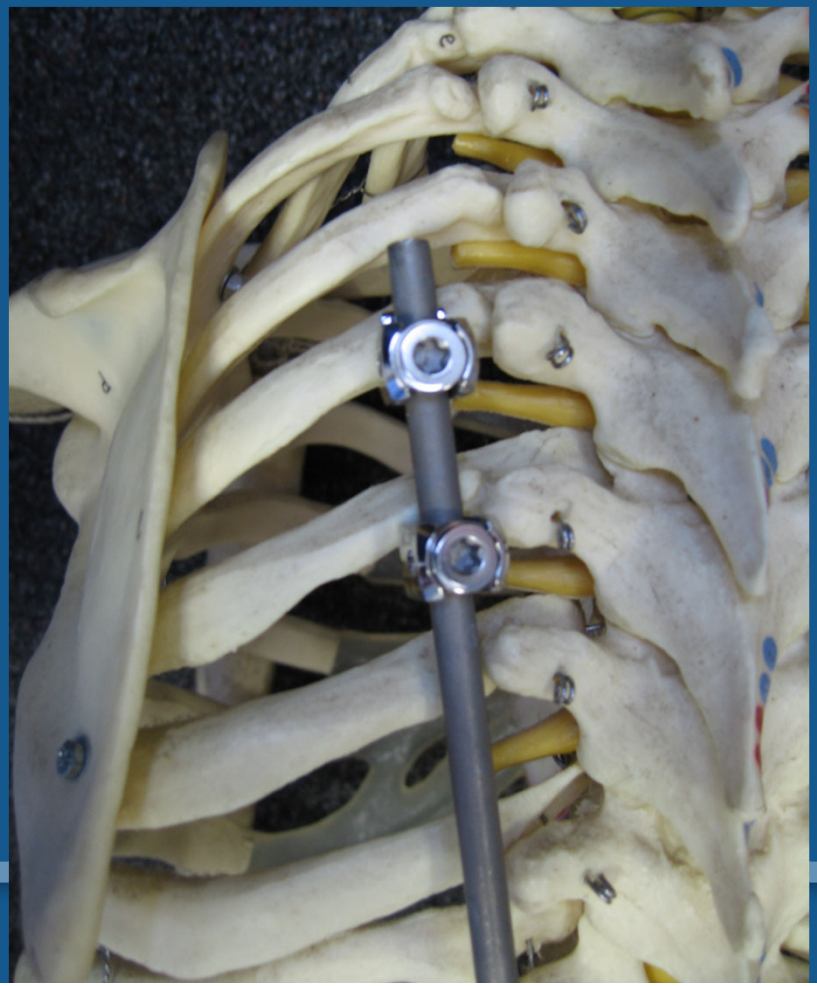
Dimeglio - Rabbit Model

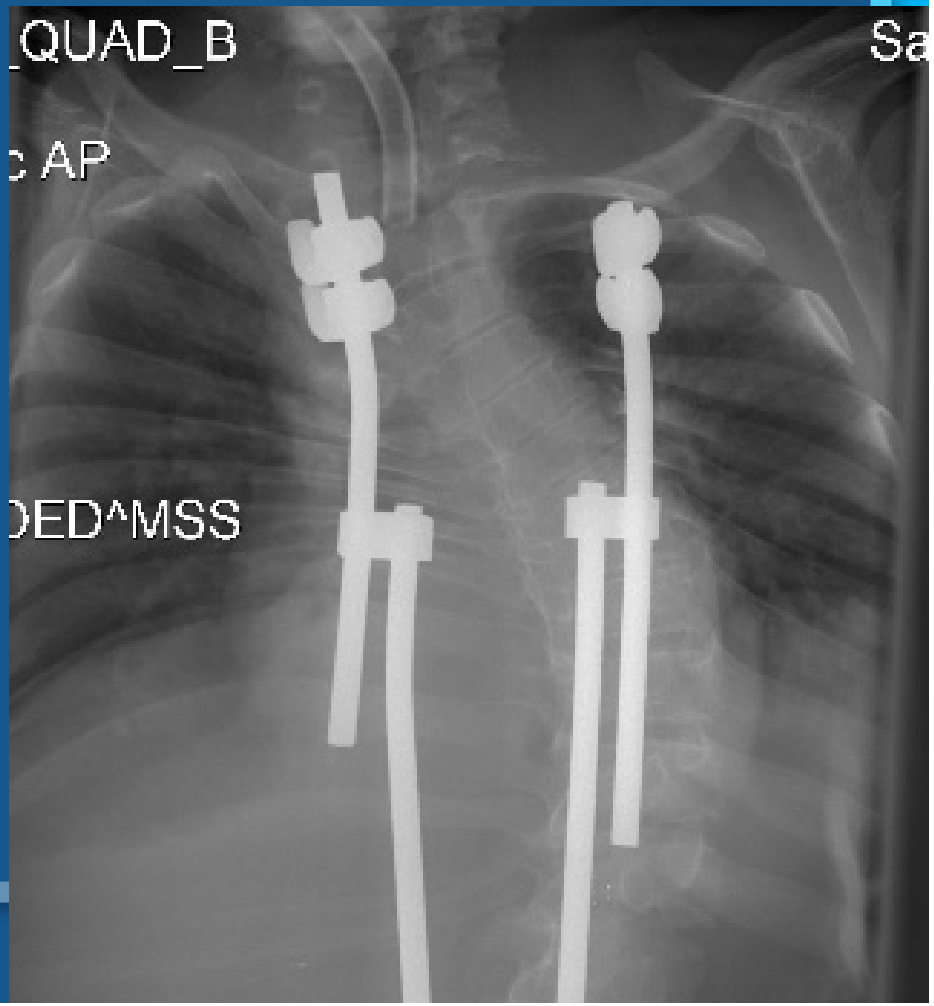
- Posteior spine fusion in growing rabbits
- T1-T6 fusion decreases thoracic volume > T7-T12 fusion

- hypothesis
  - T1-T6 ribs articulate with the sternum
  - T7-T12 ribs do not

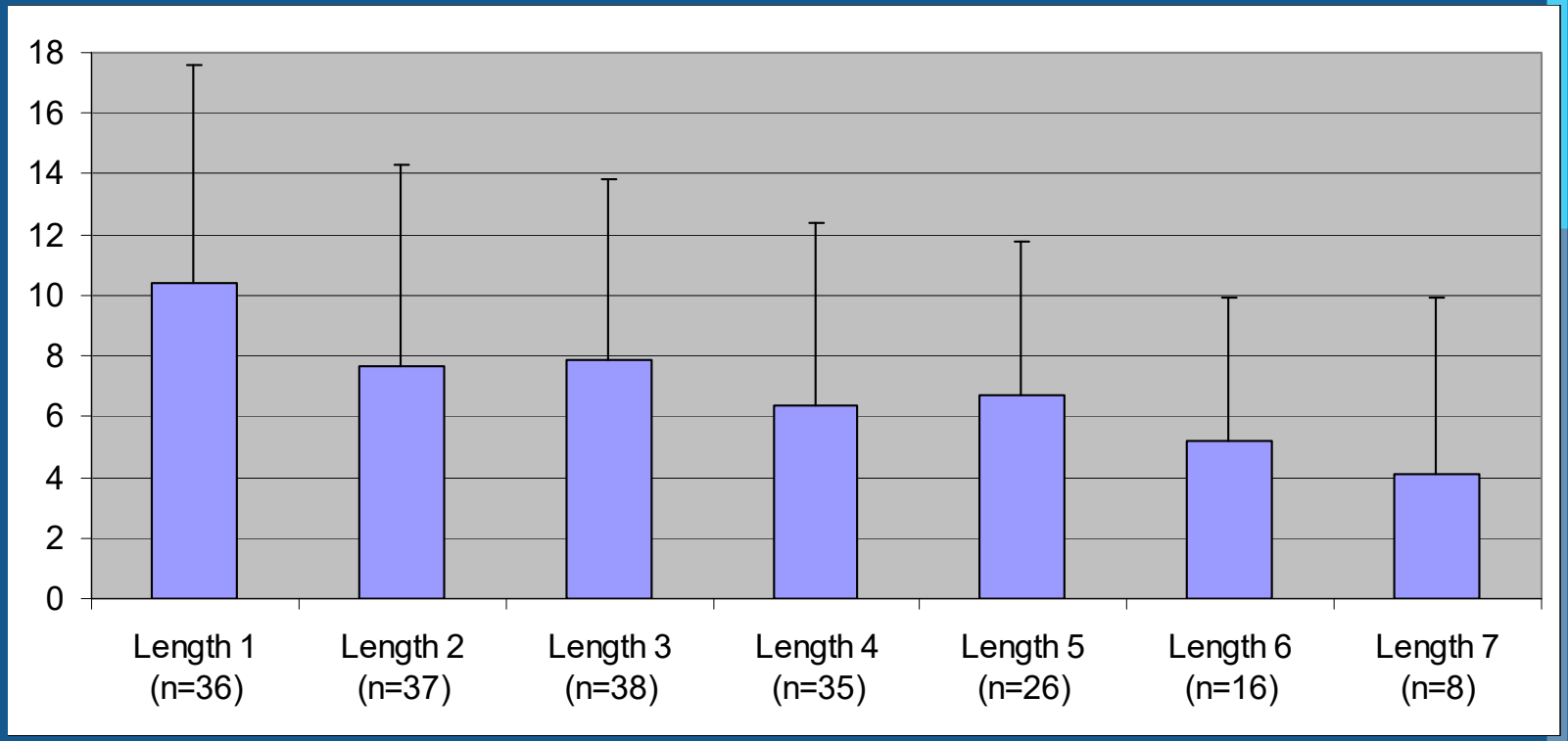
Hooks on Ribs: No intentional fusion
Do not expose or fuse upper spine

No thorocotomy!





Growing Rods
Law of Diminishing Returns
T1-S1Gain Vs. # of Lengthenings



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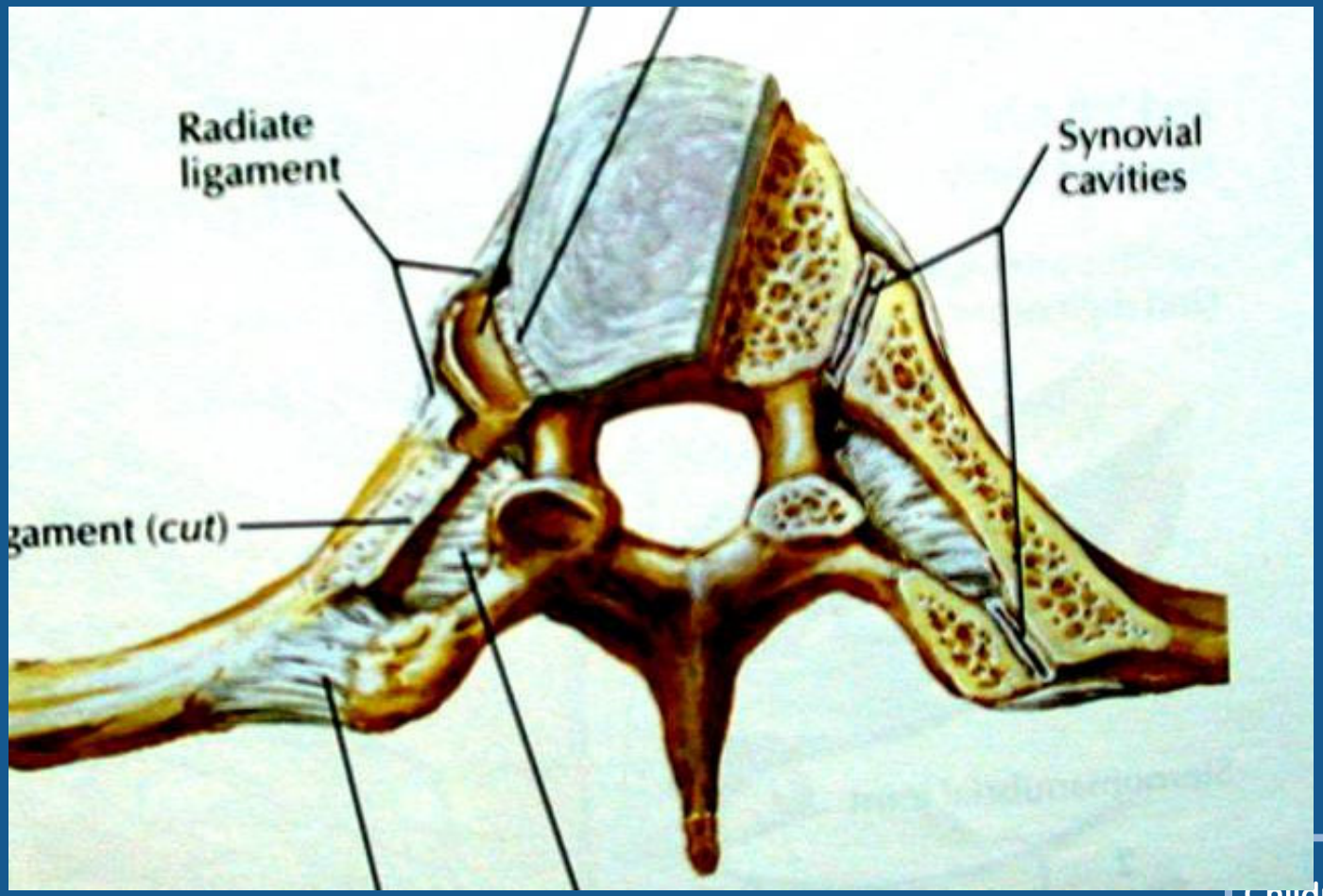
Growing Rods Autofuse
Cahil, et. Al, Spine 2010

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

Motion - Slower to autofuse???



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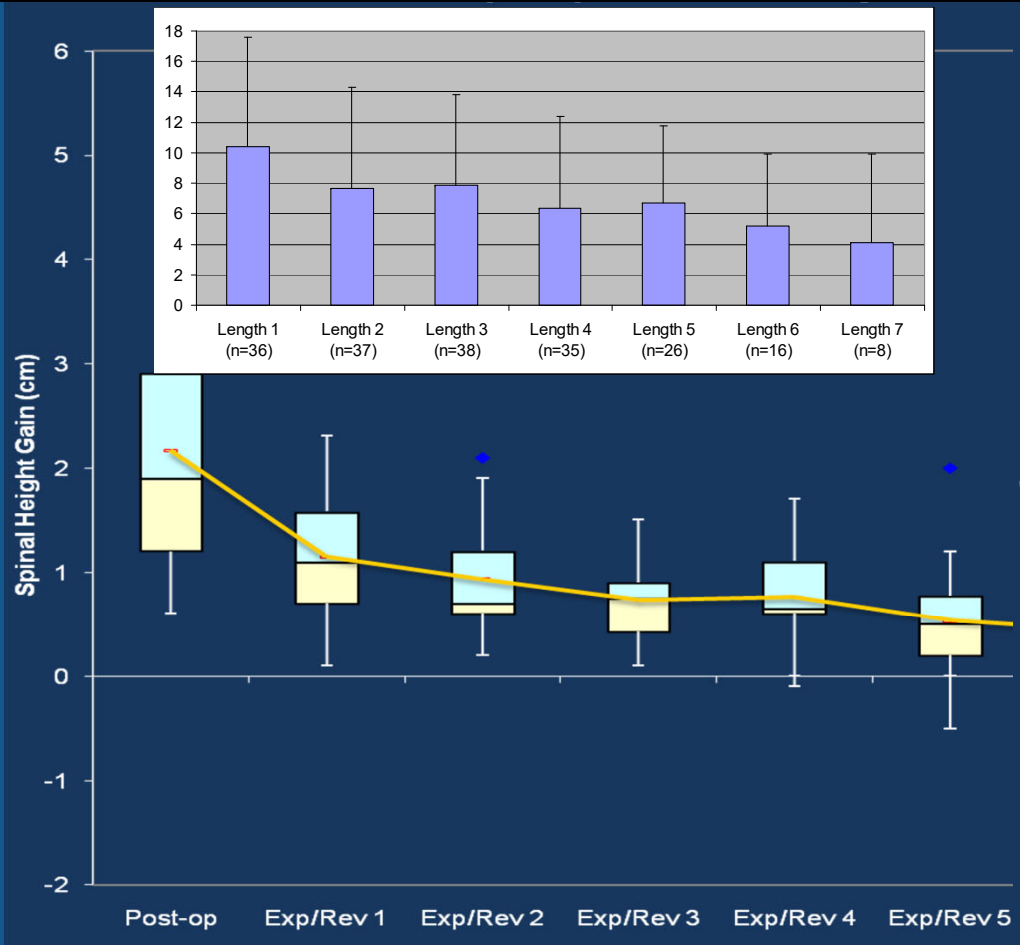
T1-S1 Gain (cm) in Rib Based distraction implants



27% of first lengthening

John Smith – unpublished

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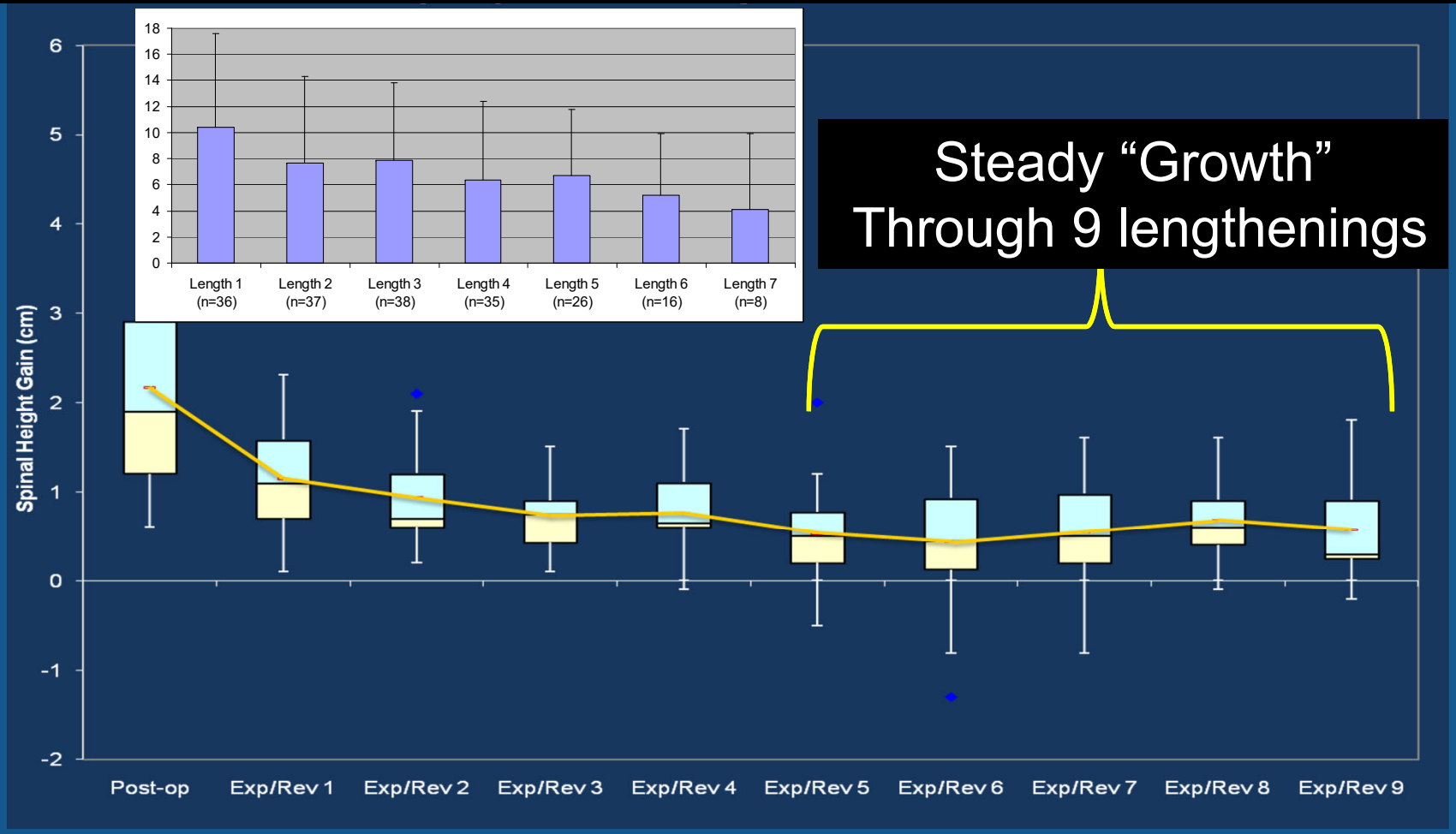
T1-S1 Gain (cm) in Rib Based distraction implants



Steady "Growth"
Through 9 lengthenings

John Smith – unpublished

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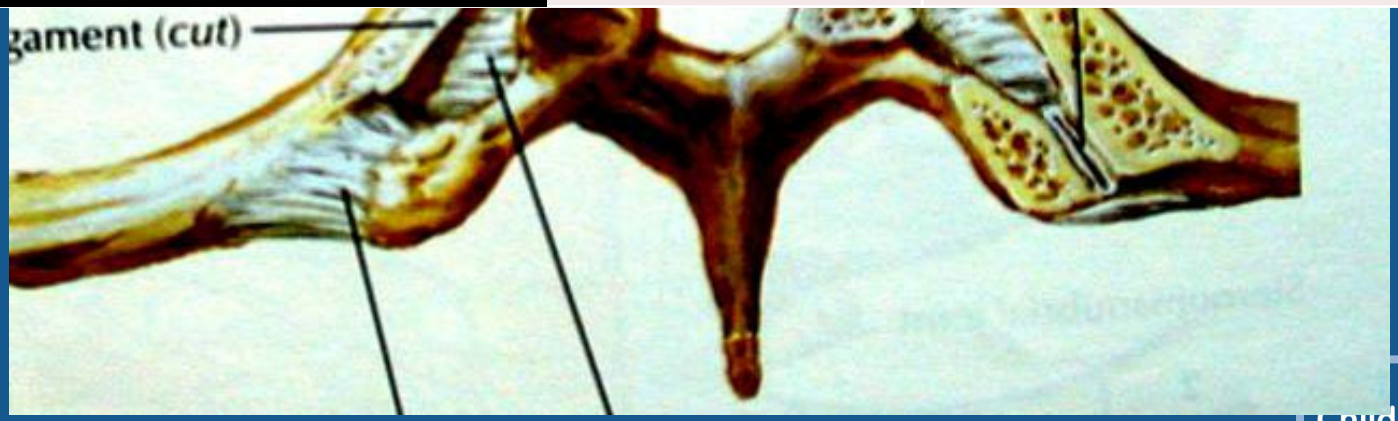
“give” Less likely to break rods?

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

Wudbhav, Spine, 2010



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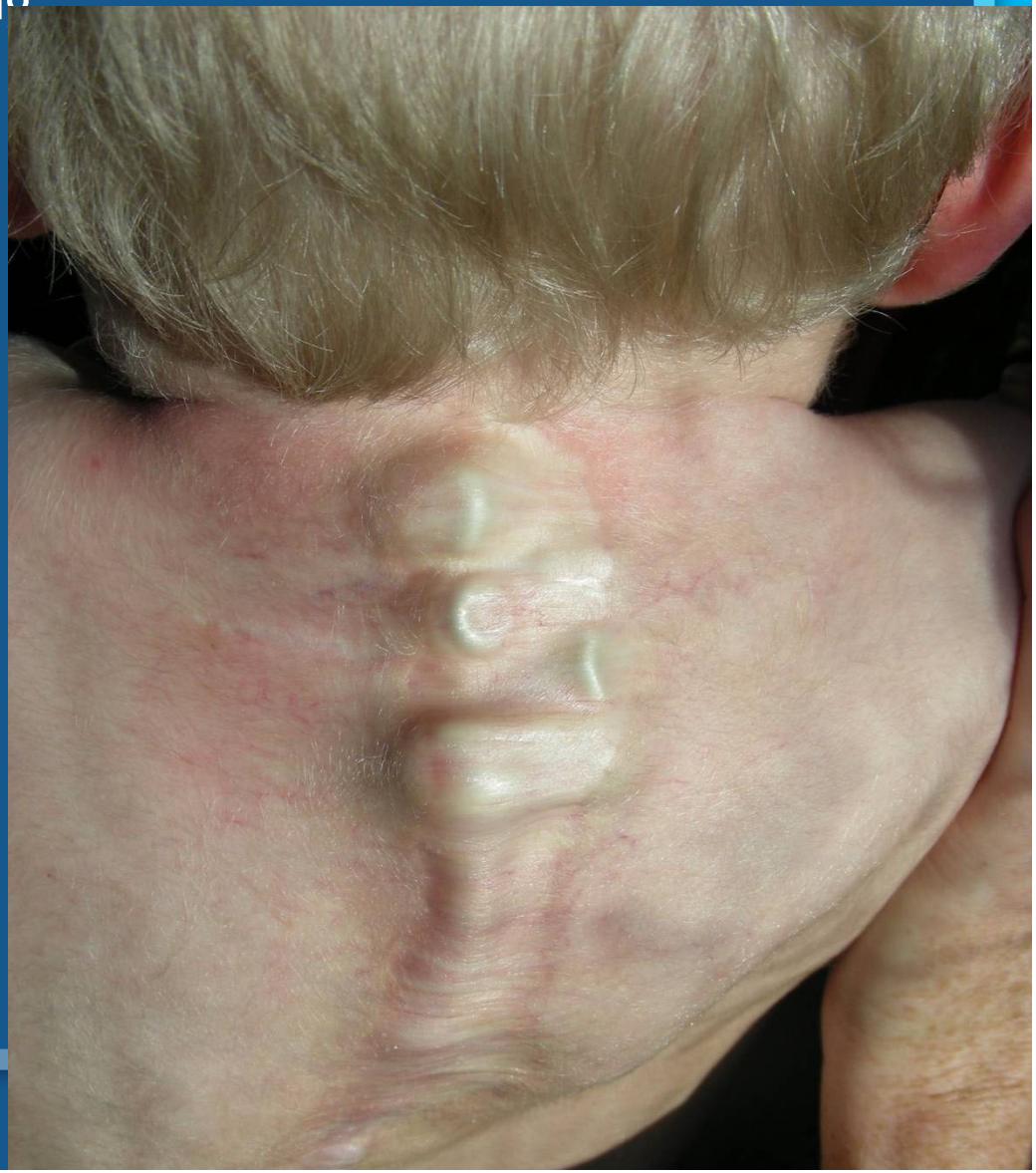
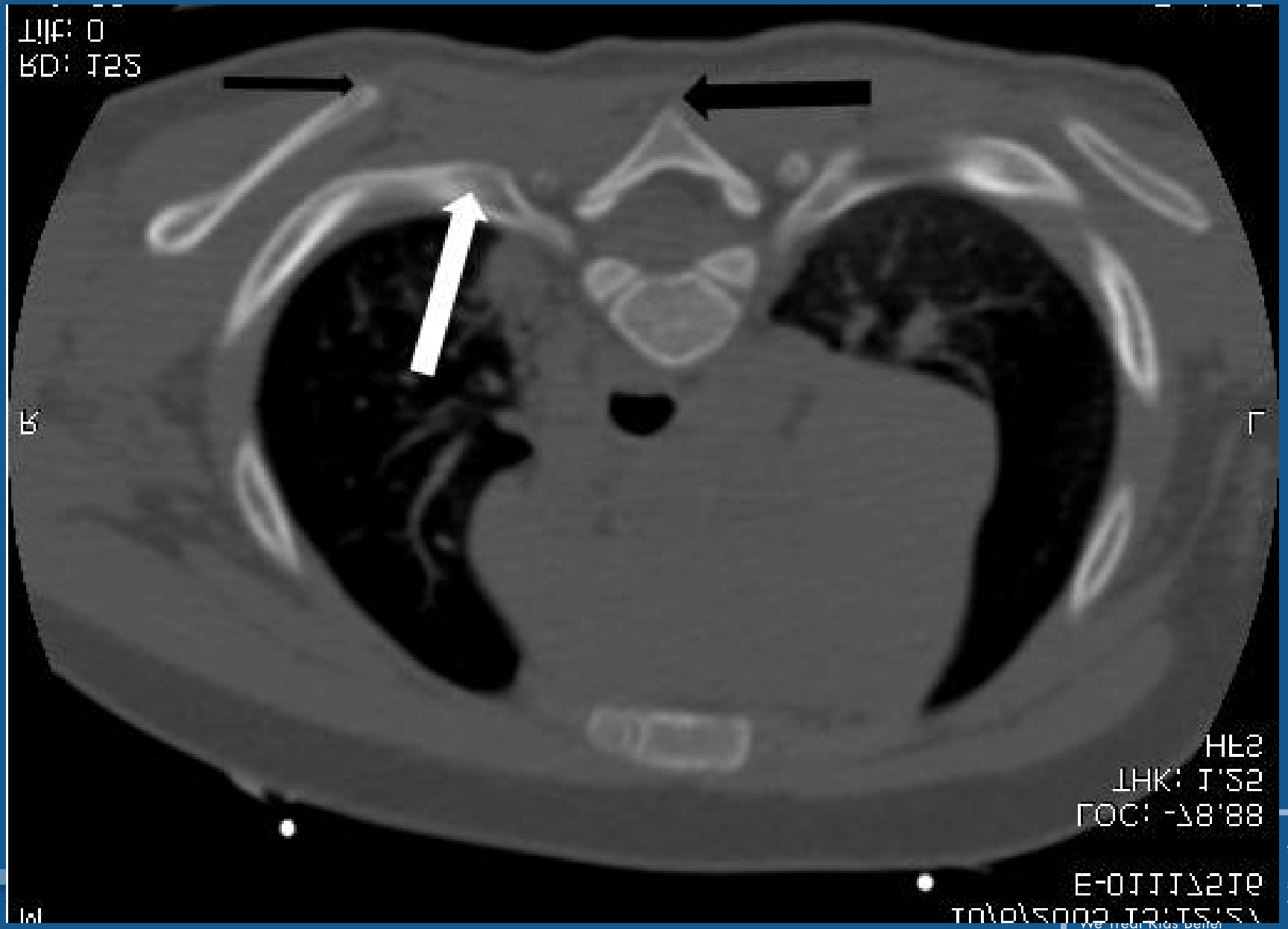
Nutrionally Depleted Population

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



Myung, 2009

Low Profile



PJK ??

- Hybrids 42% (5/12) Vs. Growing rods 62% (10/17)
  - P=0.59

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

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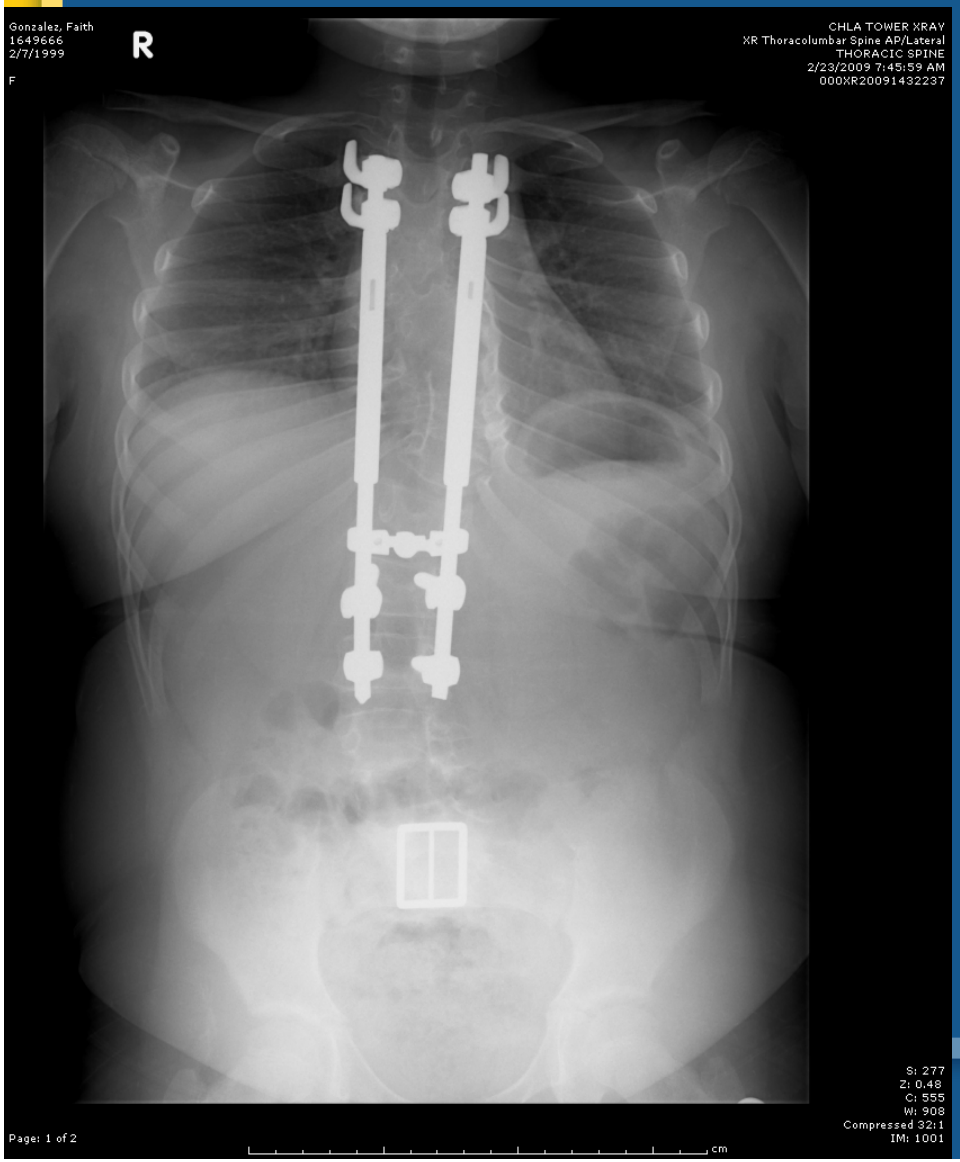
Theoretical Advantages of rib fixation thus far…



- Avoid proximal fusion
- Less rigid system
  - Minimize autofusion?
  - Less rod breakage
- Less Prominent

- Above true of VEPTR and laminar hooks…

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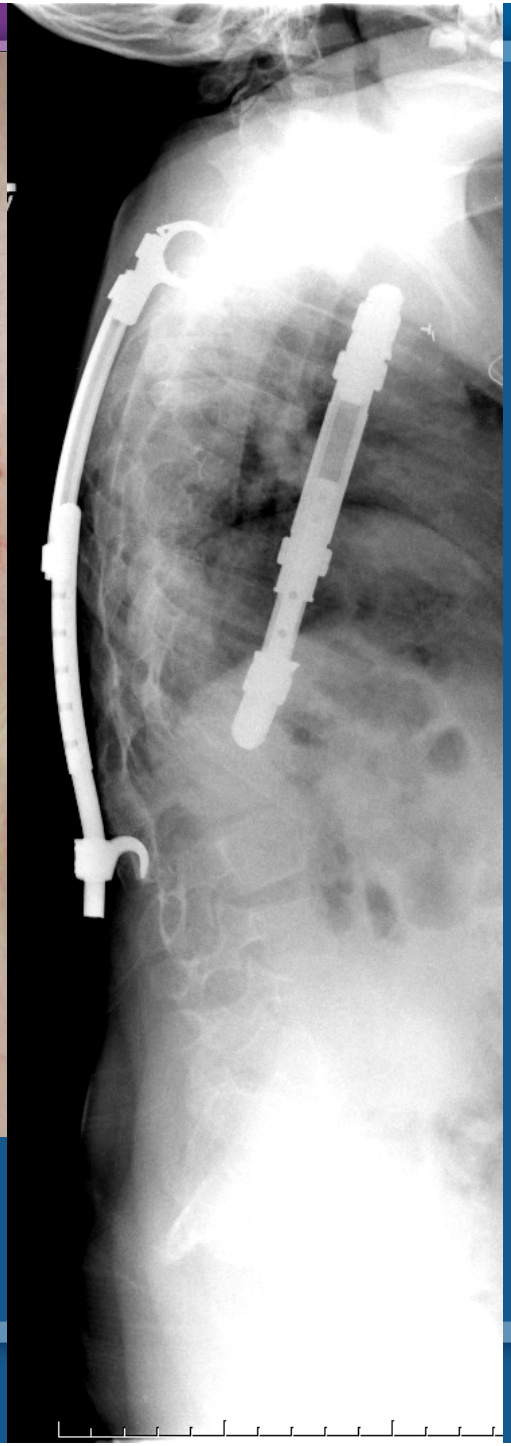
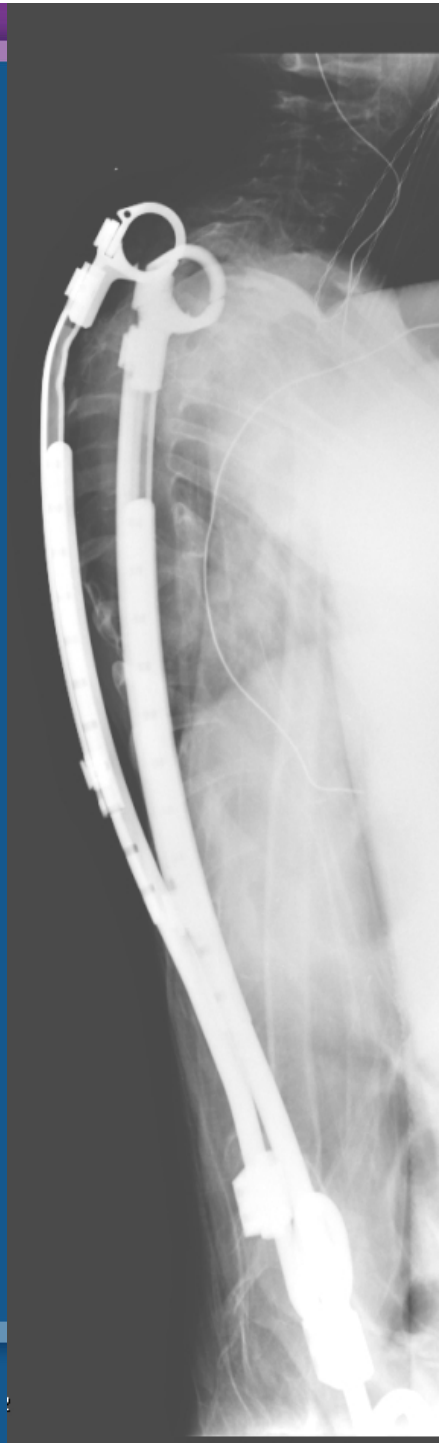
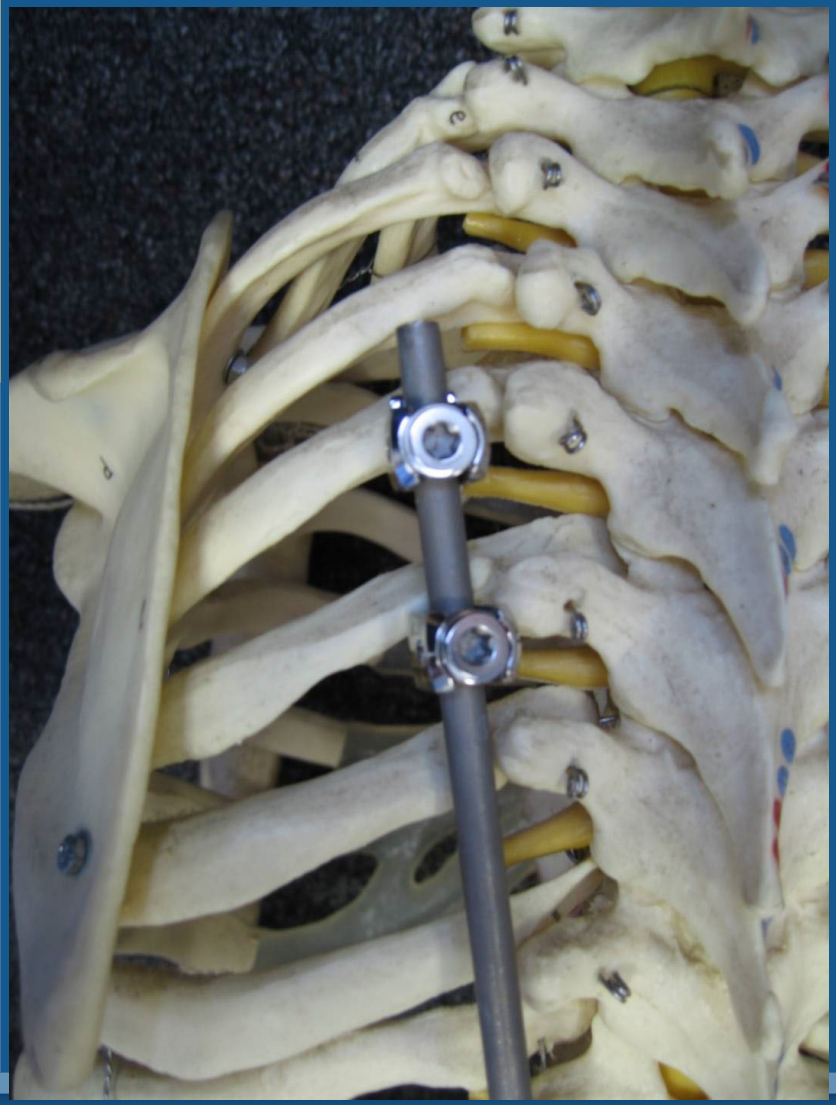


Courtesy of
Charlie Johnston

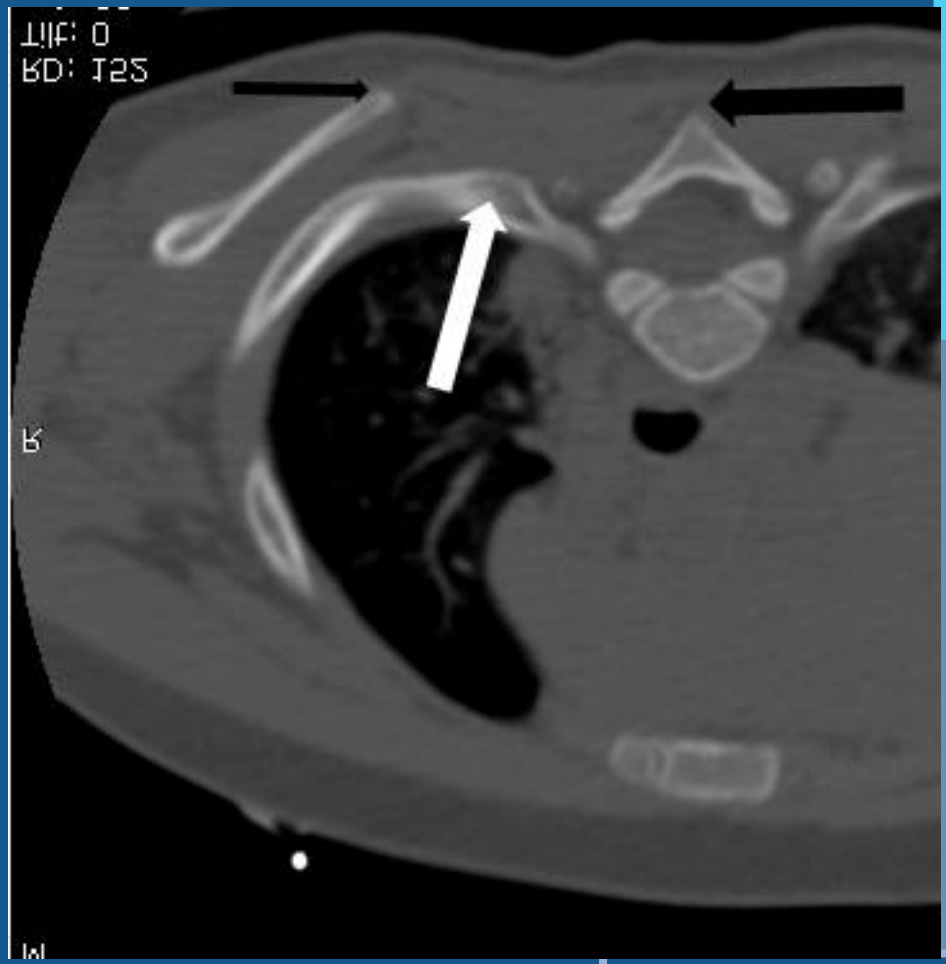


Part 2: Technique

Adjacent to TP



No Dissection of Proximal Spine



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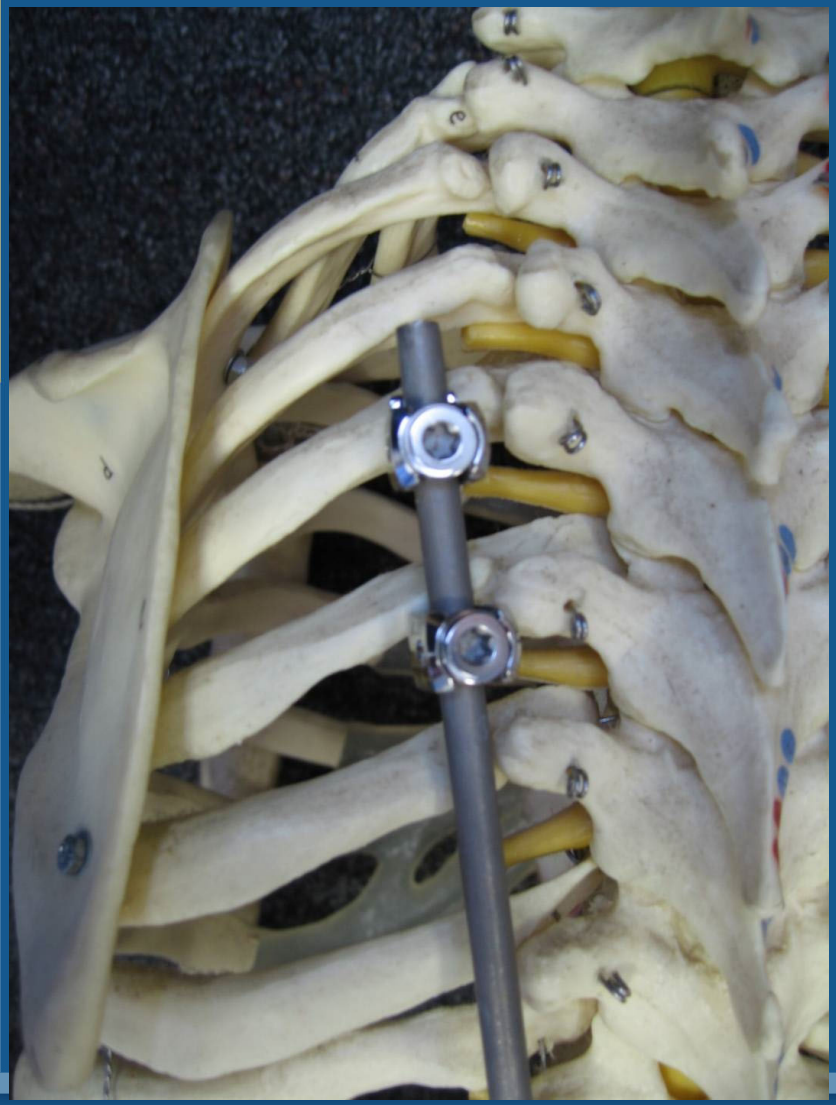
Adjacent to TP

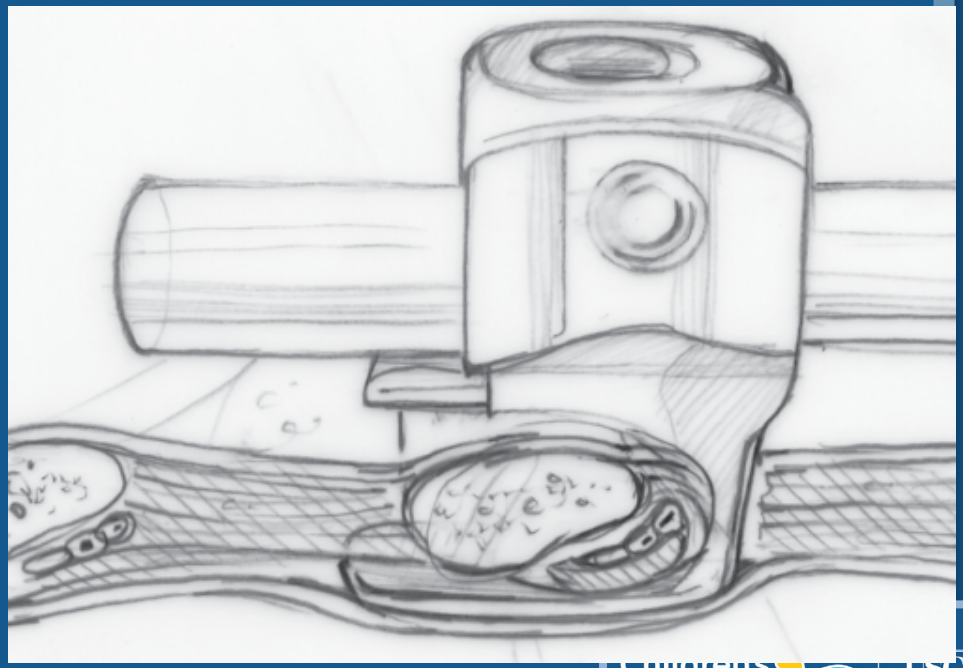


Extra-Periosteal

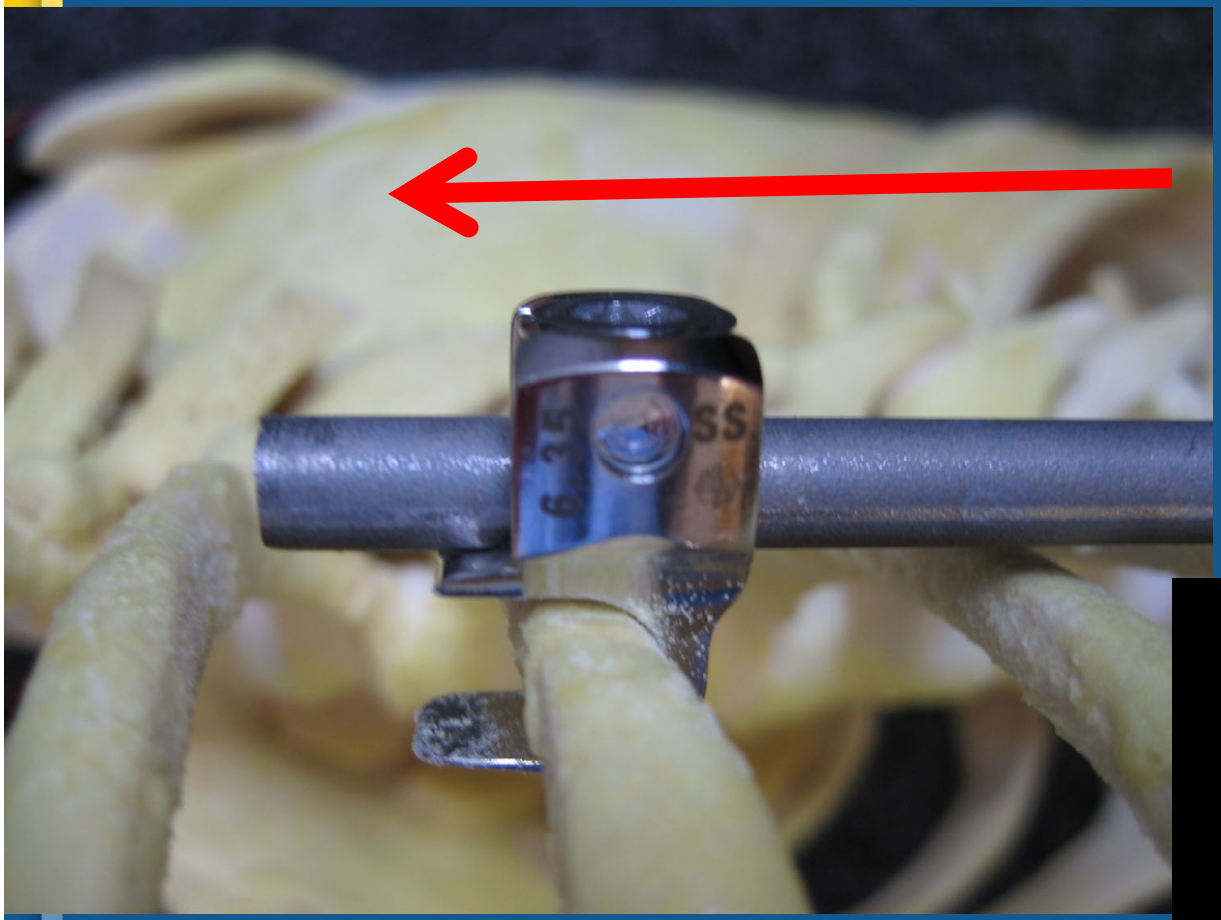
Want ribs to hypertrophy

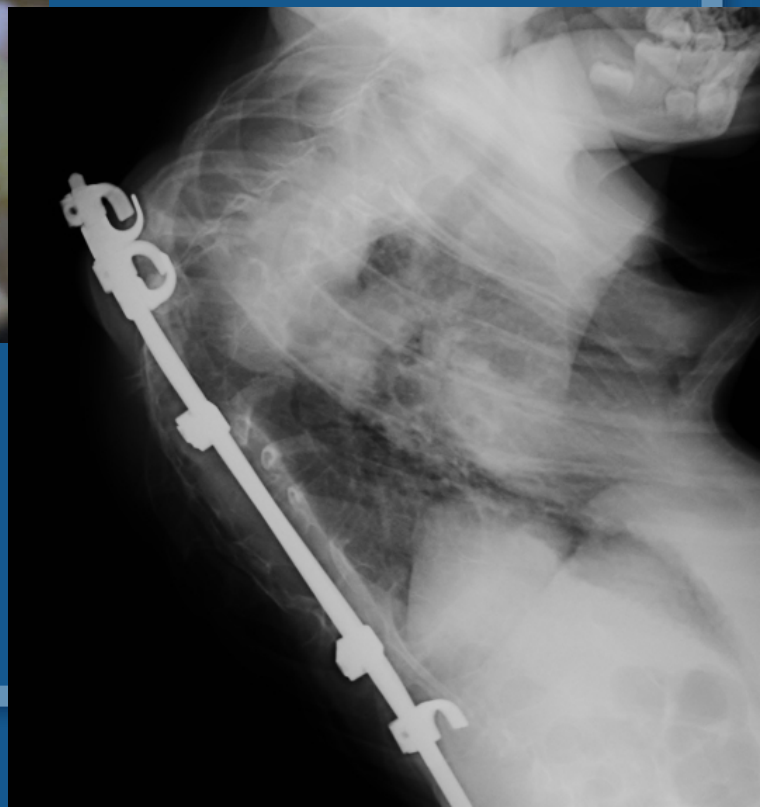
NOT in chest

No chest tube

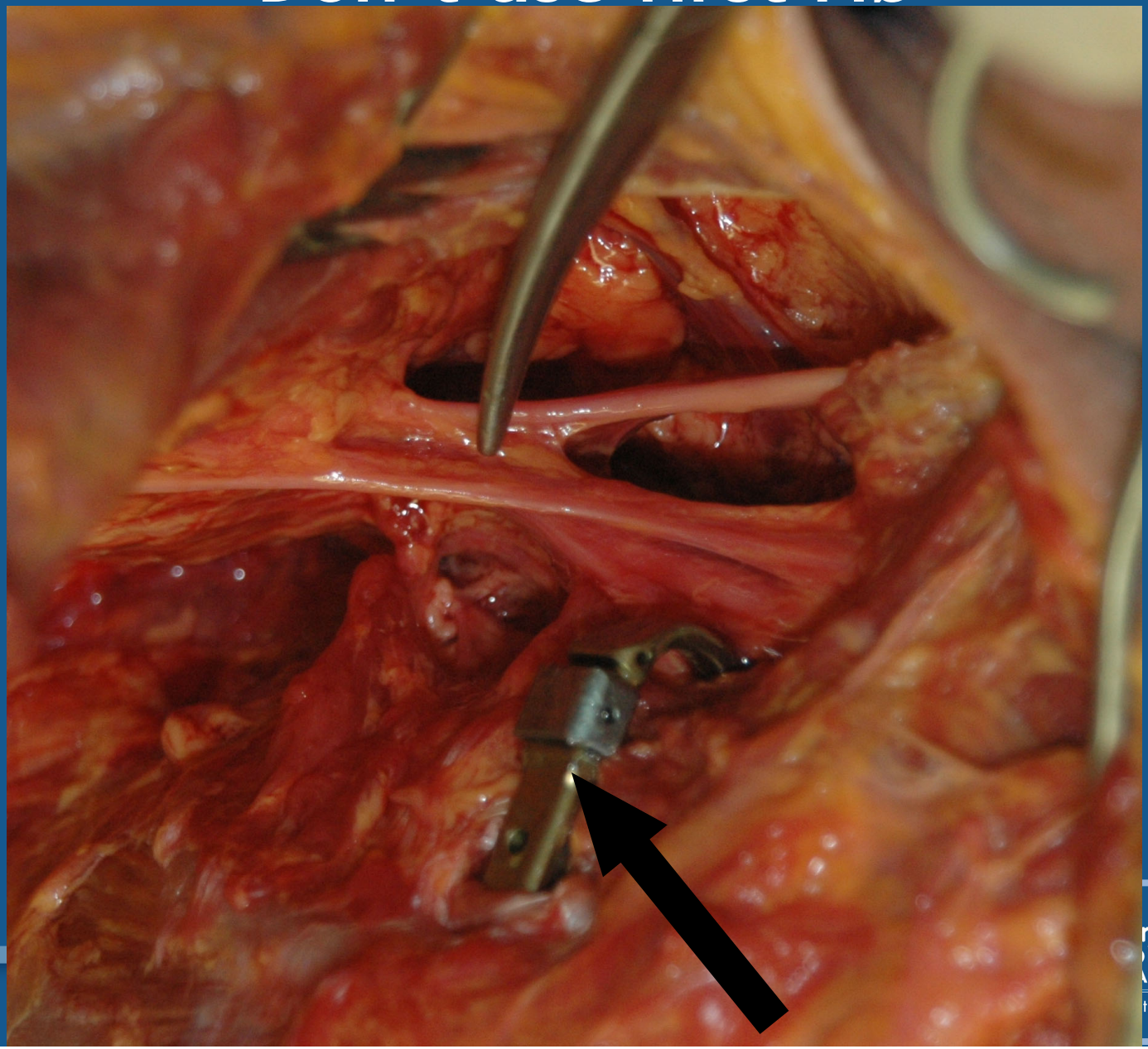


No Advantage to "Claw"

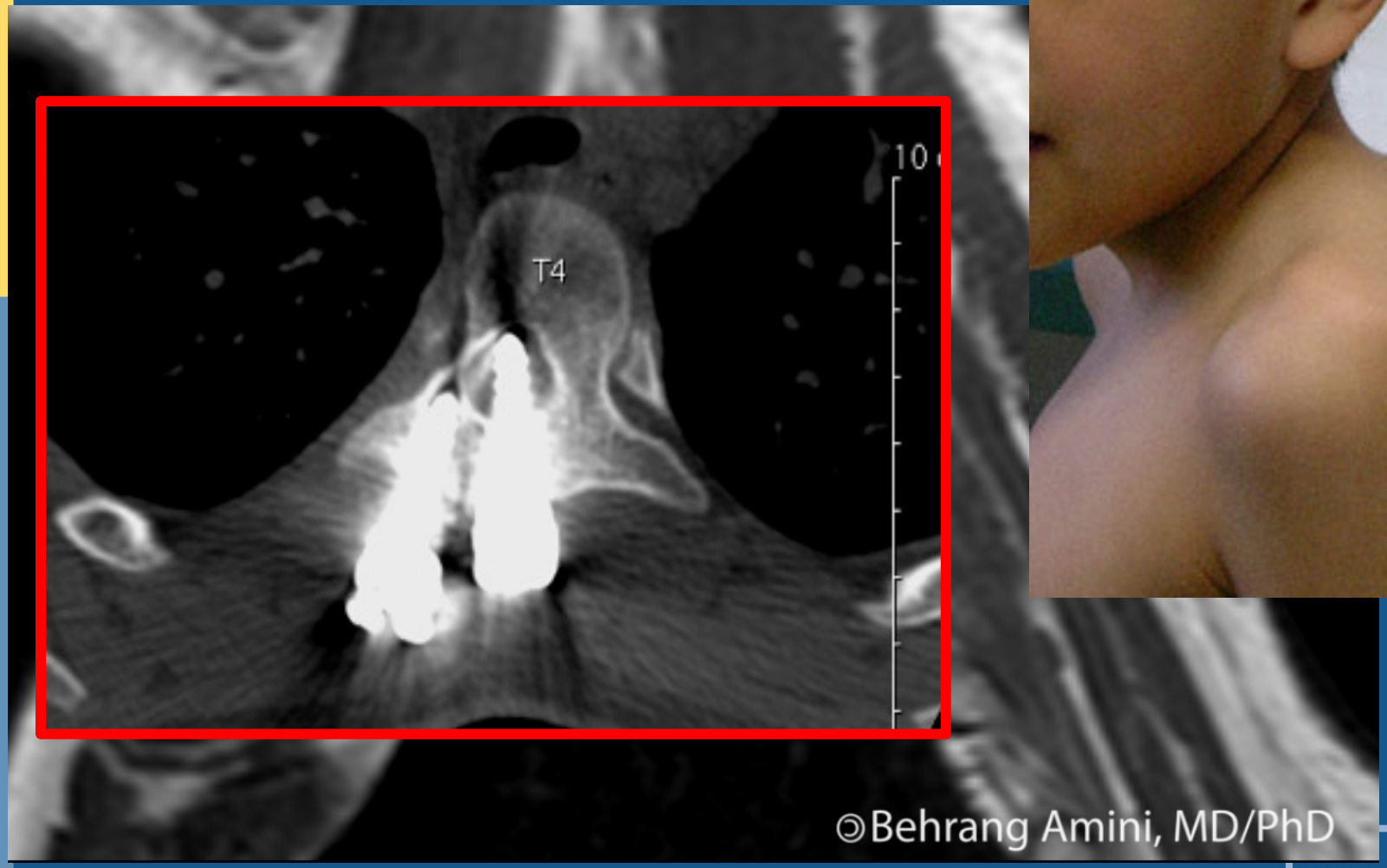




Don’t use first rib



Fails Posterior



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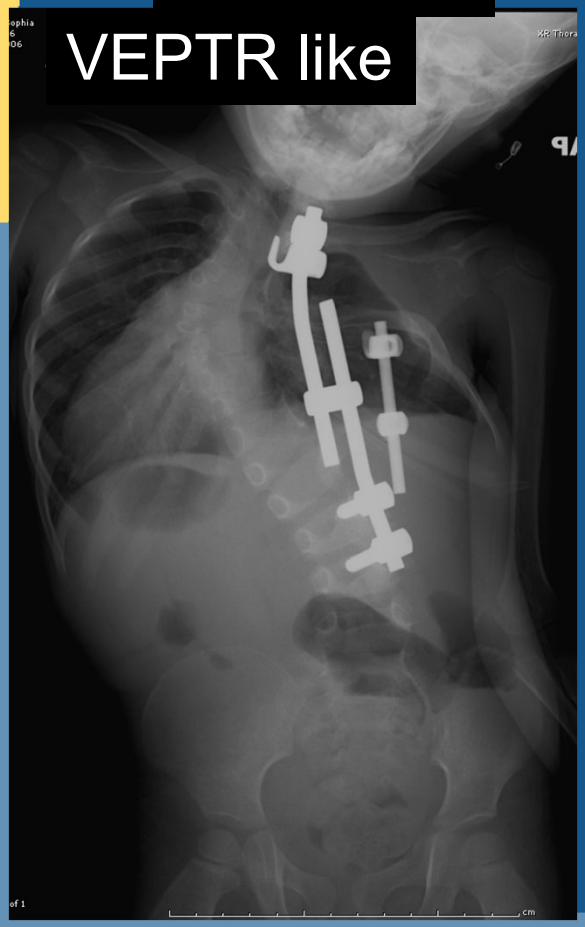
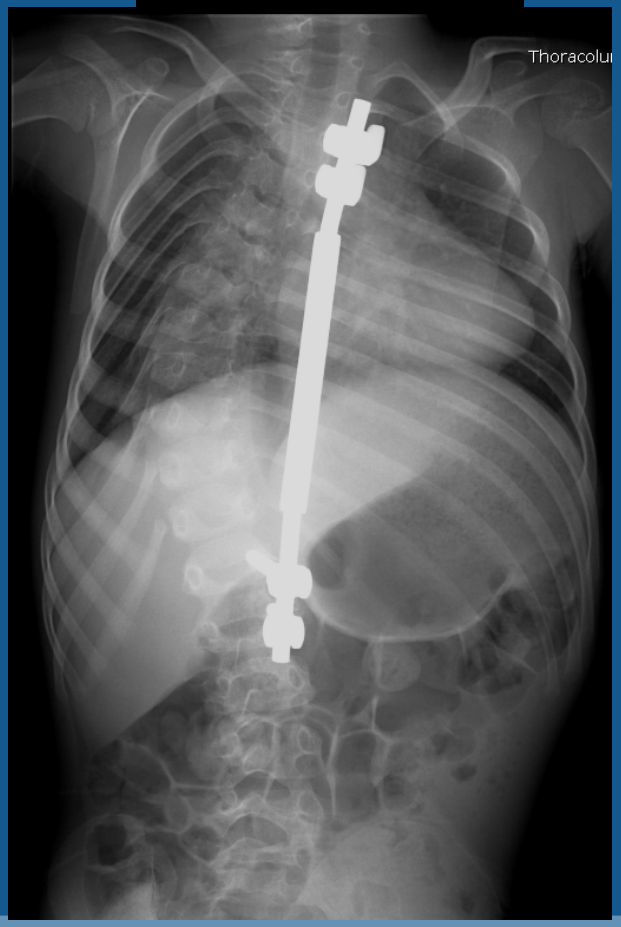
Many Options

Unilateral
Dual Rods

VEPTR like

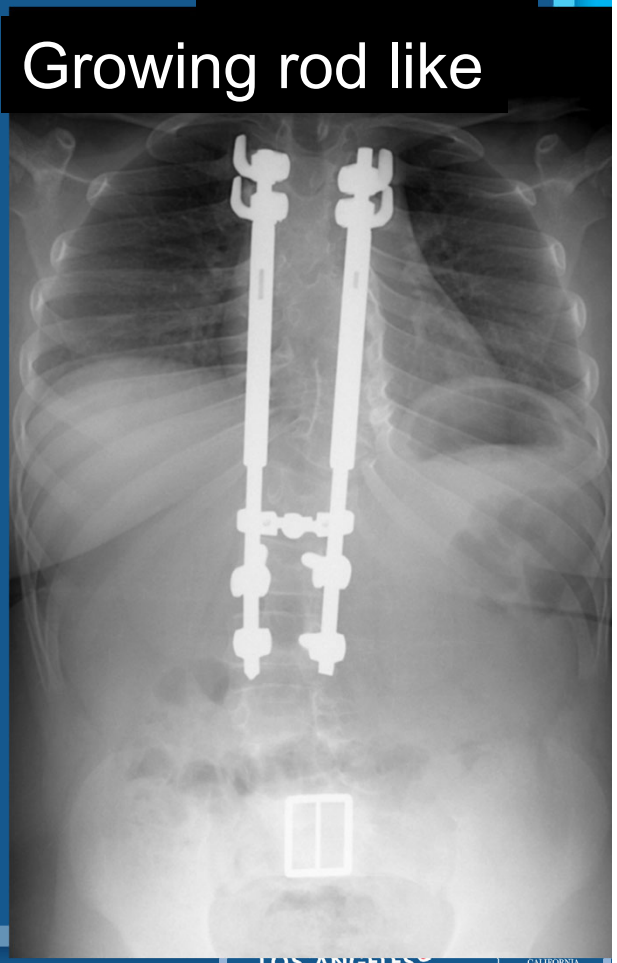


Unilateral
Single Rods



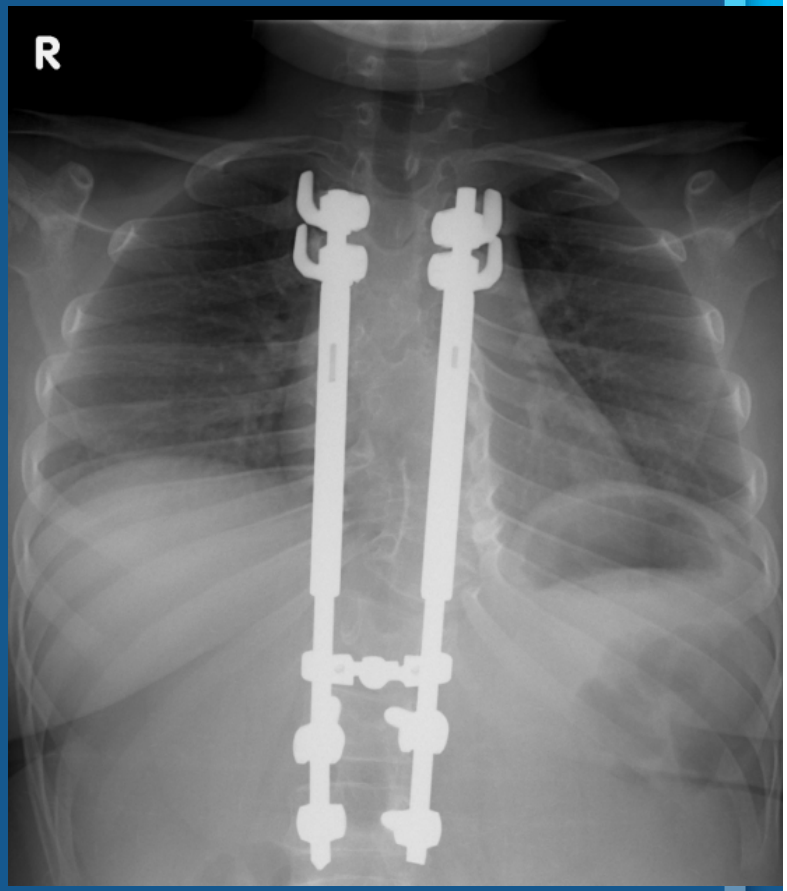
Bilateral
Dual Rods

Growing rod like



Current Preference

- Dual-sided constructs
- ≥3 up-going hooks



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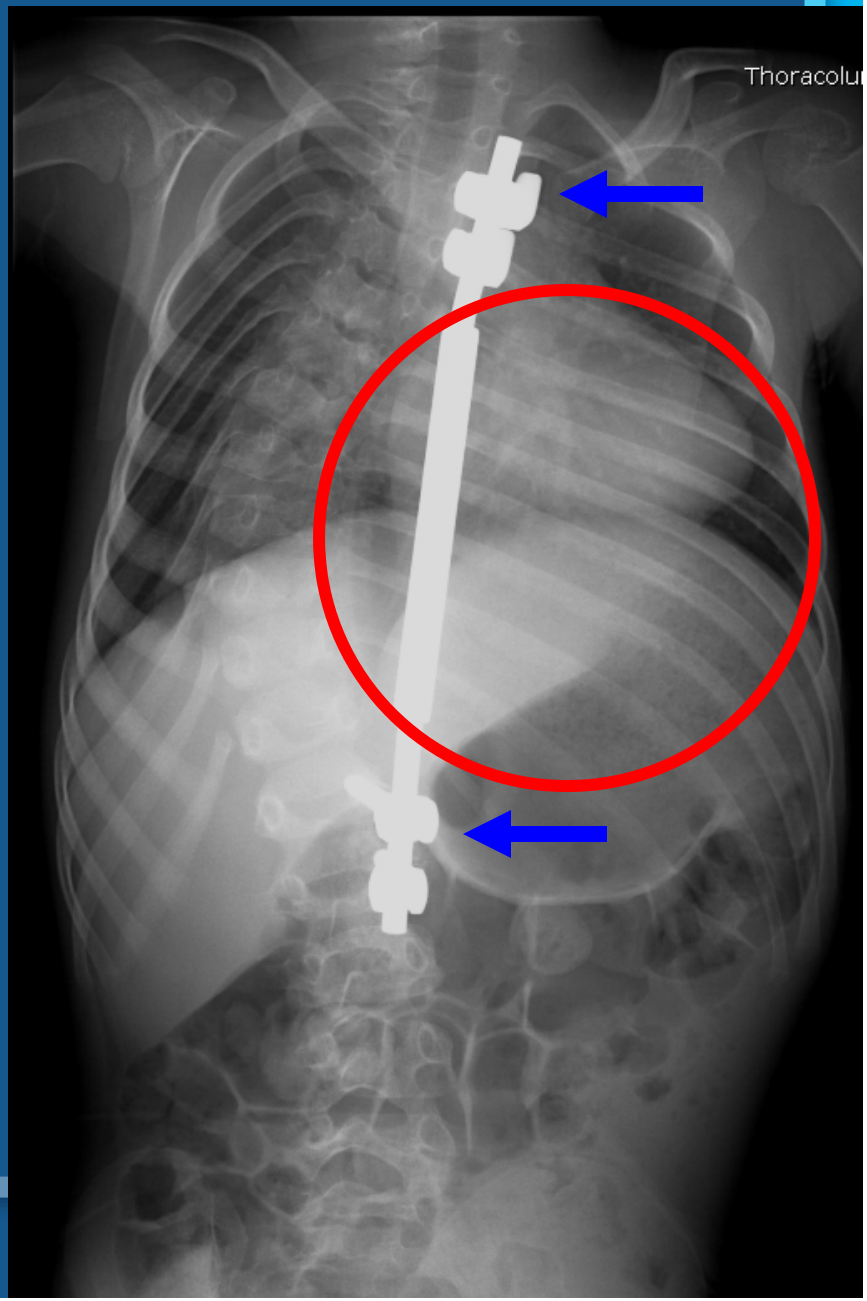
Case Example
5yo boy

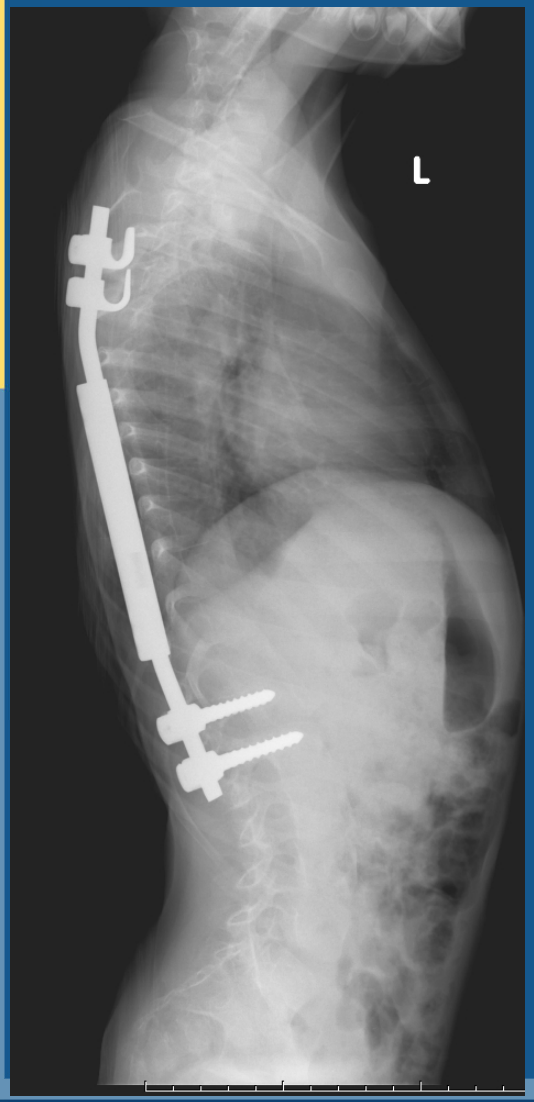
- Ambulatory
- neuromuscular
- 91º Scoliosis –progressive
- Extremely thin

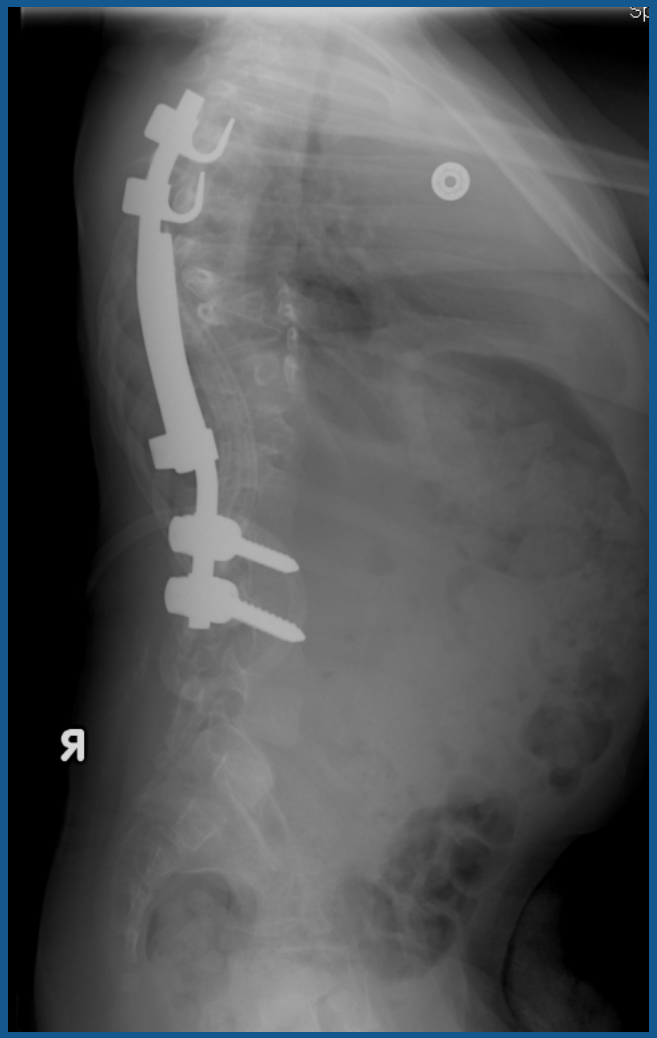
Portable Traction

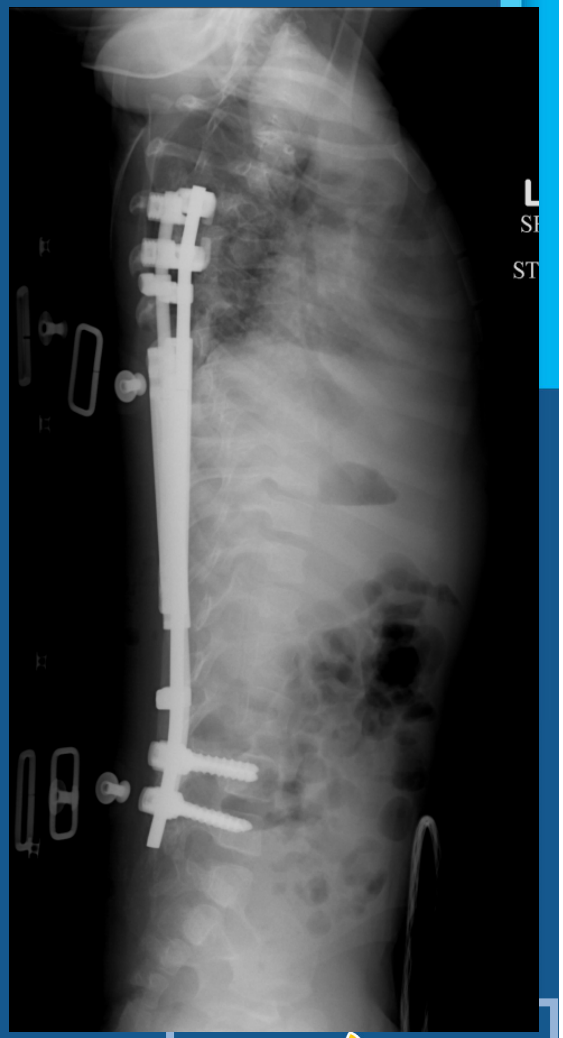


3 and 5 cm incisions no thorocotomy

Sagittal Contouring







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Hybrid Indications

Growing Implants

Previous mid-line implant infection - BAILOUT

Previous laminectomies/scarring

Any time you think of VEPTR

Contraindications

Fusion wanted

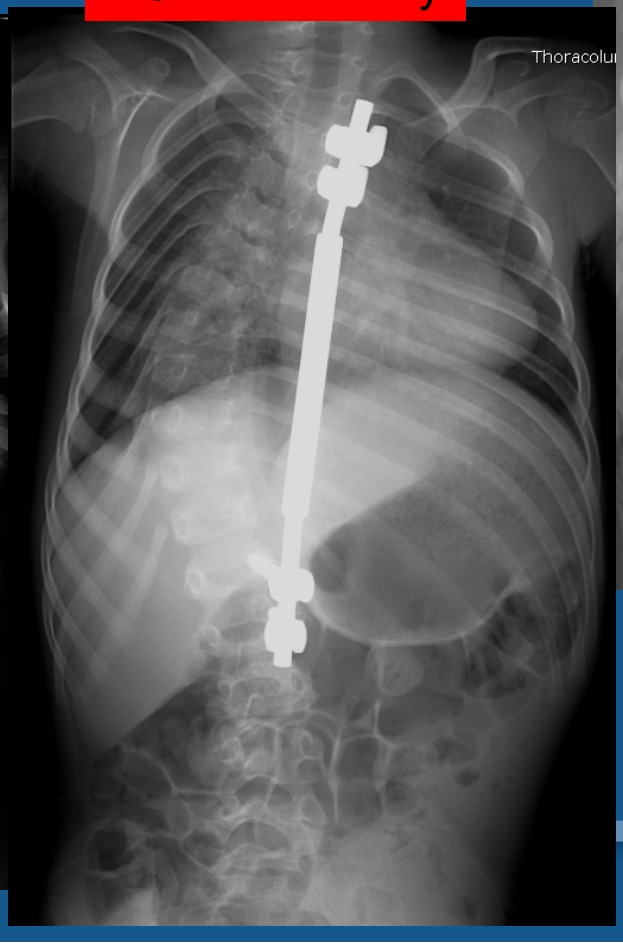
Beware of Kyphosis (screws up top, bend rods over time)

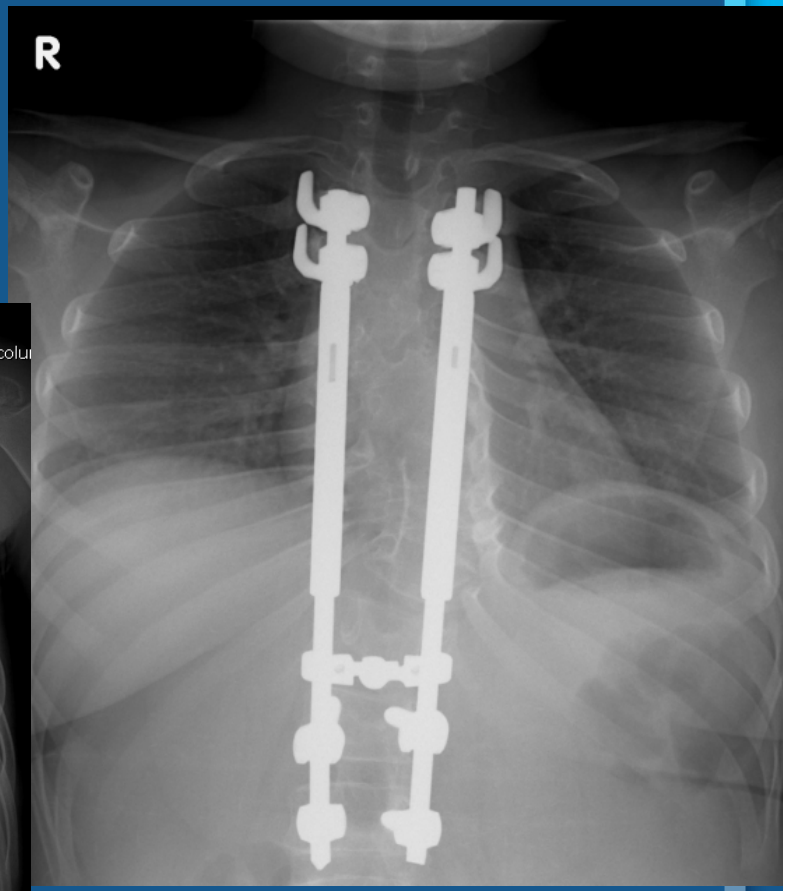
Current Preference

- Dual-sided constructs
- ≥3 up-going hooks

REALLY thin kids

NO Thorcotomy





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Thank You

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Part 3: Clinical Results

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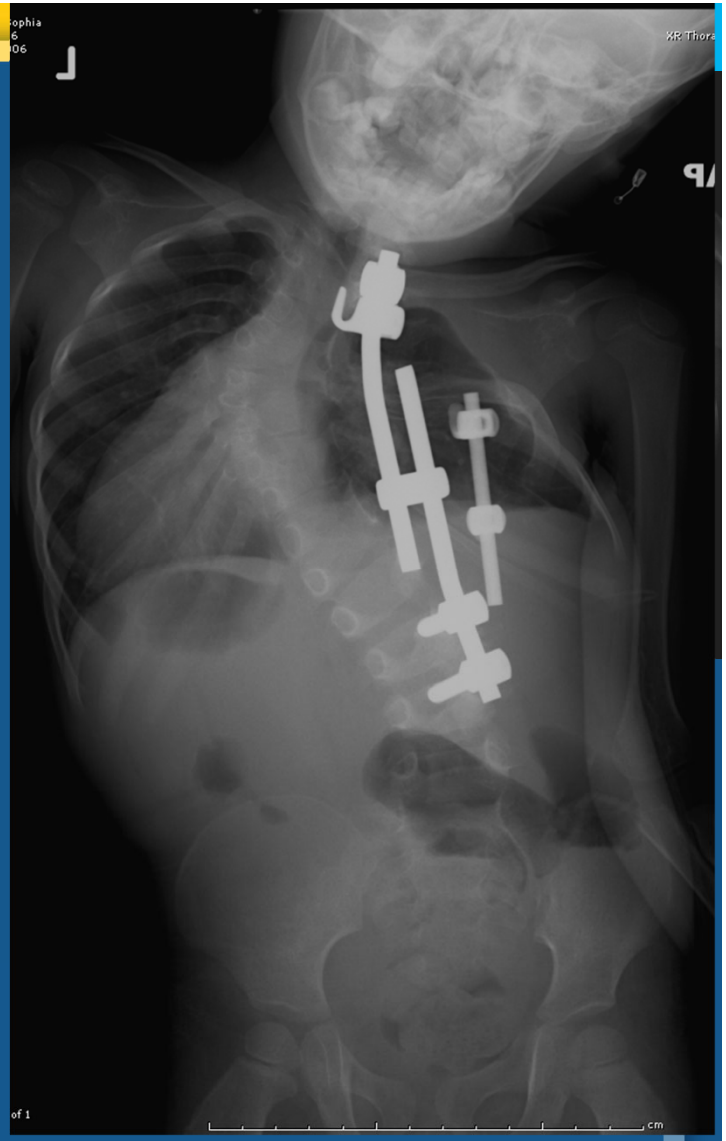
Myung, et al, SRS,2010

- Retrospective study
- 28 patients, 6 institutions
- Age at index surgery = 3.7 yrs
- Mean Cobb angle = 69°
- Mean f/u = 37 months



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Complications

- 10 /28 pts (35%)
- Mean time to complication = 28 months
  - 7 loss of fixation
  - 2 wound issues
  - 1 rod breakage

No neurologic complications

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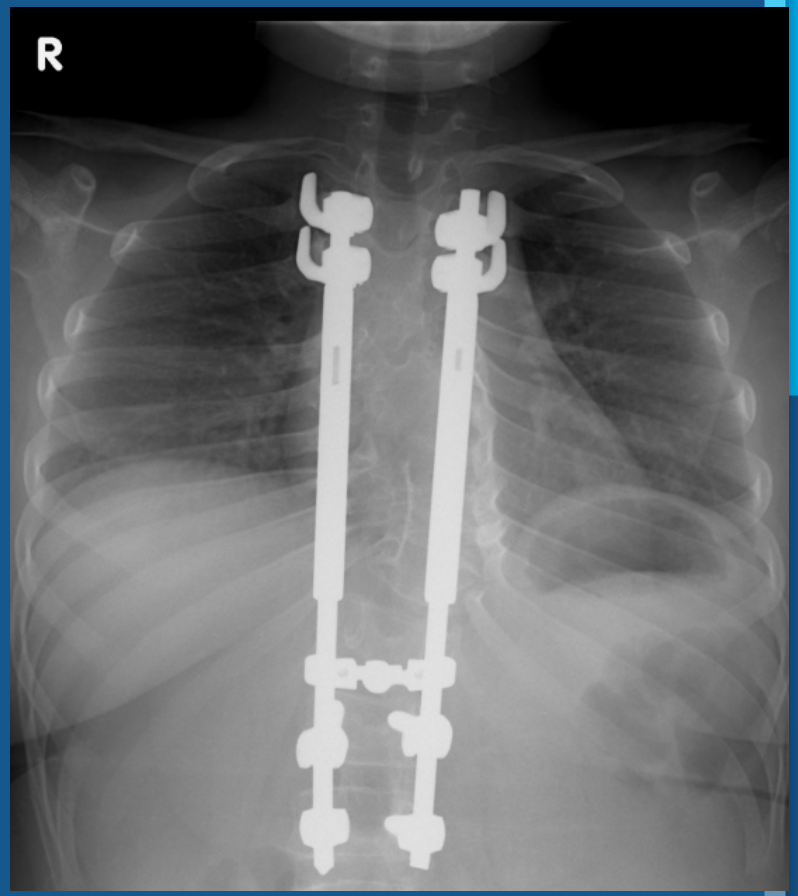
No implant related complications:

- in dual-sided constructs
- ≥3 up-going hooks



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Comparison of Complications Of Distraction Based Implants

VEPTR (Hassler, JPO 2007)	**119%**
Dual Growing Rods (Spine 2005)	57%
Hybrid (this study)	35%

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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***

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Laminar Hooks Vs. VEPTR

	Laminar Hooks	VEPTR
Cost	Less	More
Present in most hospitals	Yes	No
IRB approval needed?	No	Yes (USA)
Multiple Rib Fixation	Yes – Precise Adjustment	Yes (Constrained)
Saggital Profile	Fully Adjustable	Constrained

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Video

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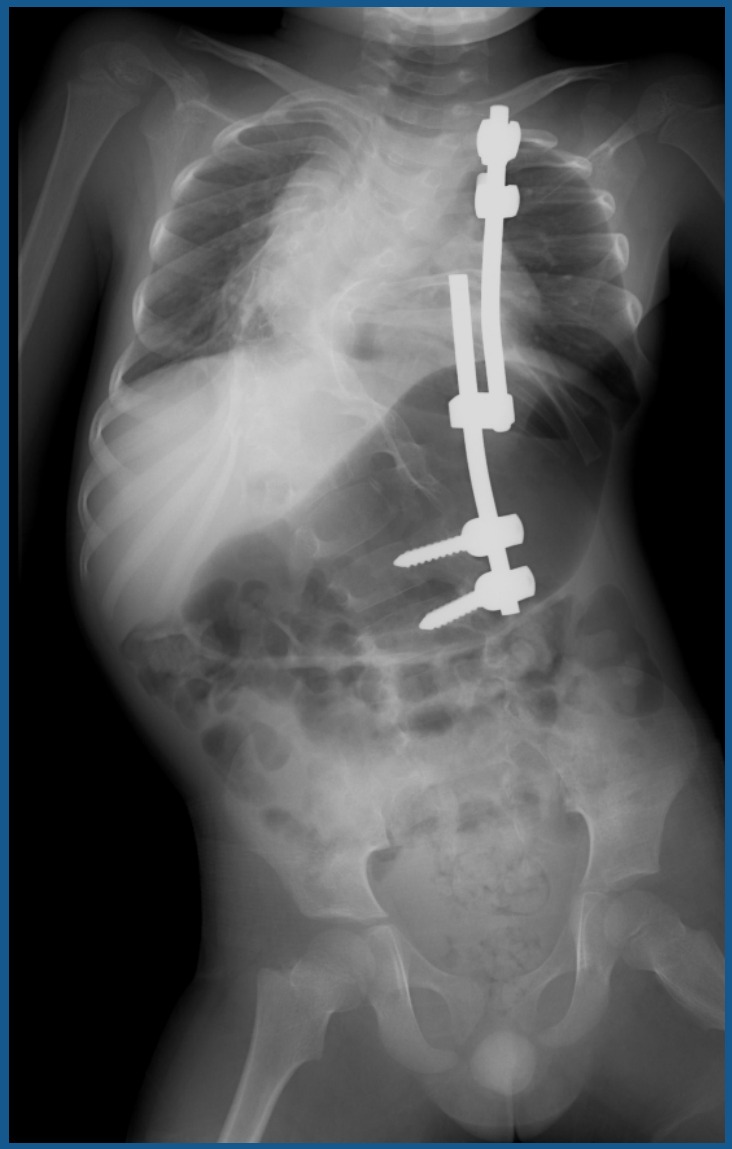
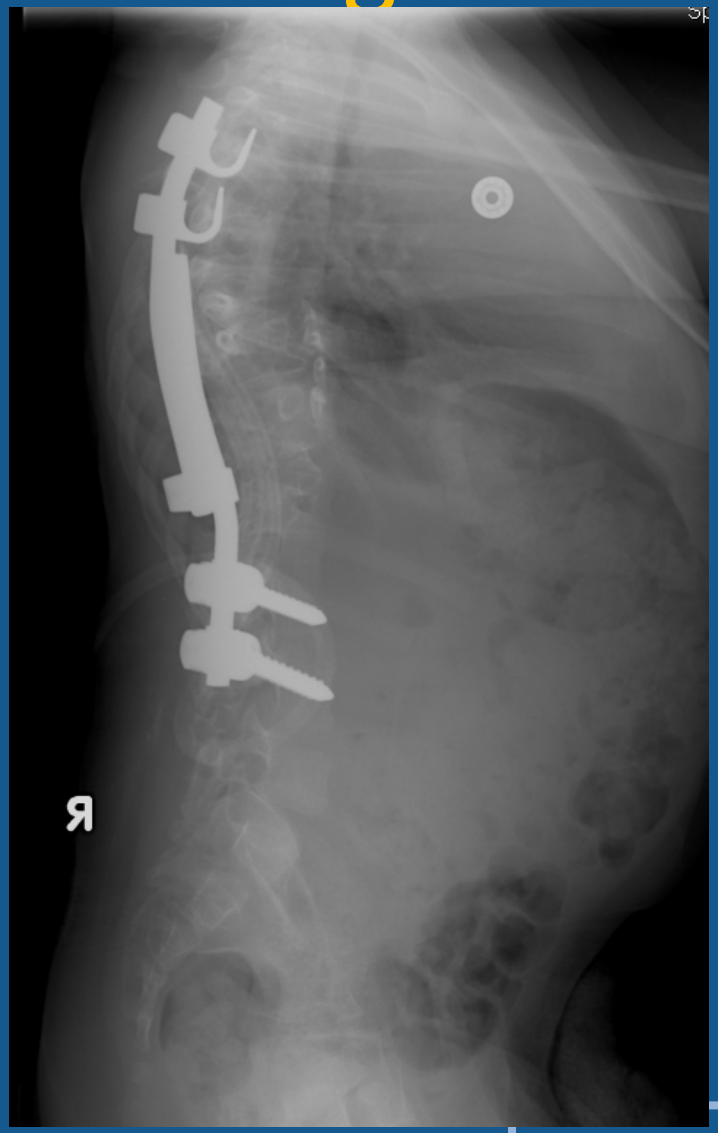
Sagittal Contouring





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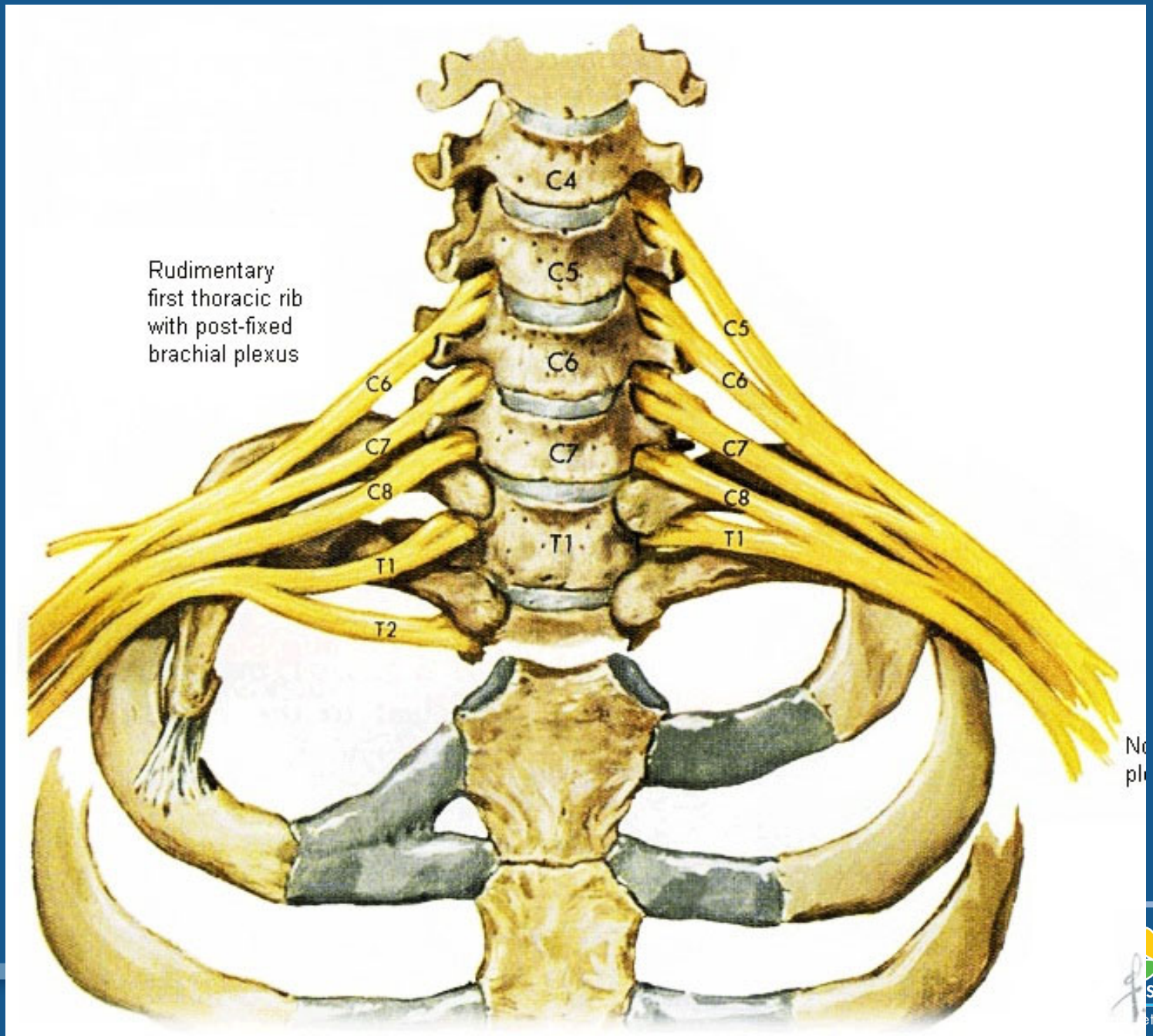
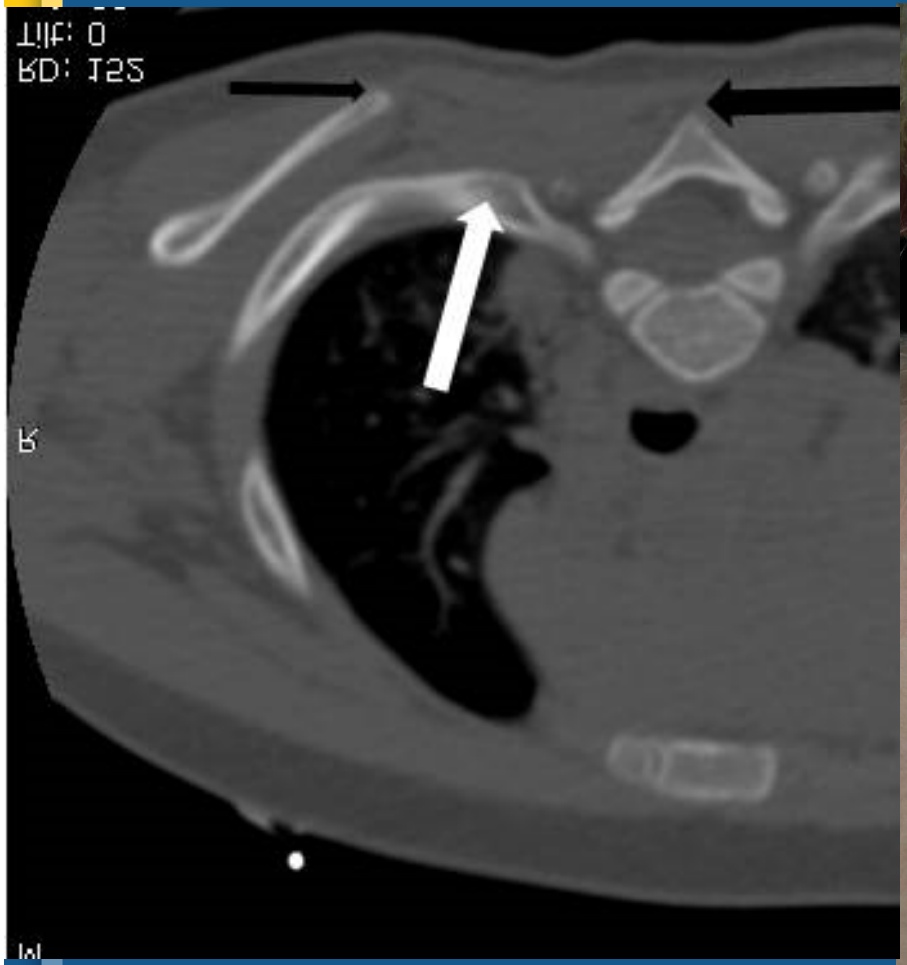
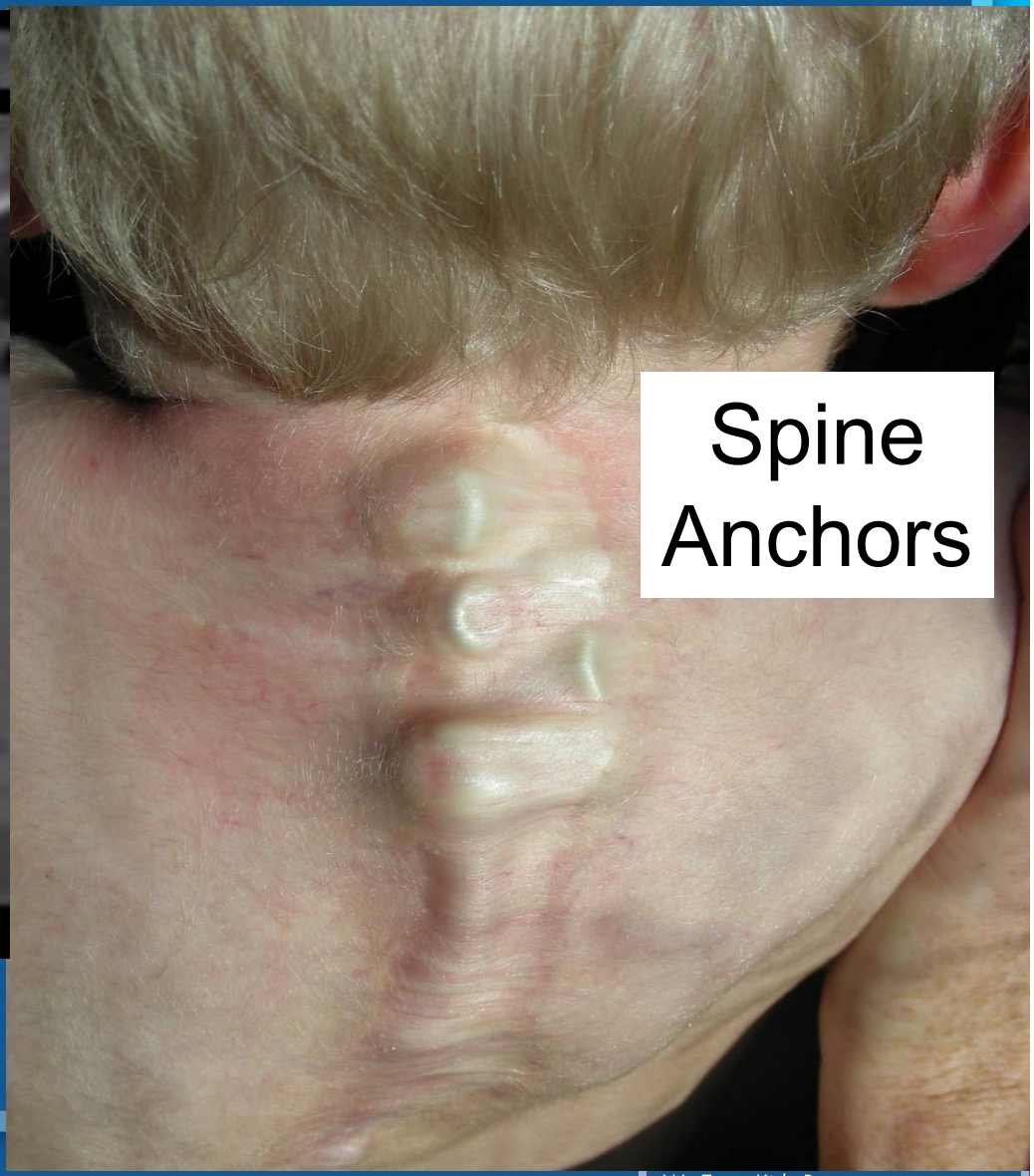

Rudimentary
first thoracic rib
with post-fixed
brachial plexus
C4
C5
C6
C7
C8
T1
T2
C5
C6
C7
C8
T1

Thank You

Growing Rod Surgery is Like ..

Hooks on Ribs: Lower Profile than Spine





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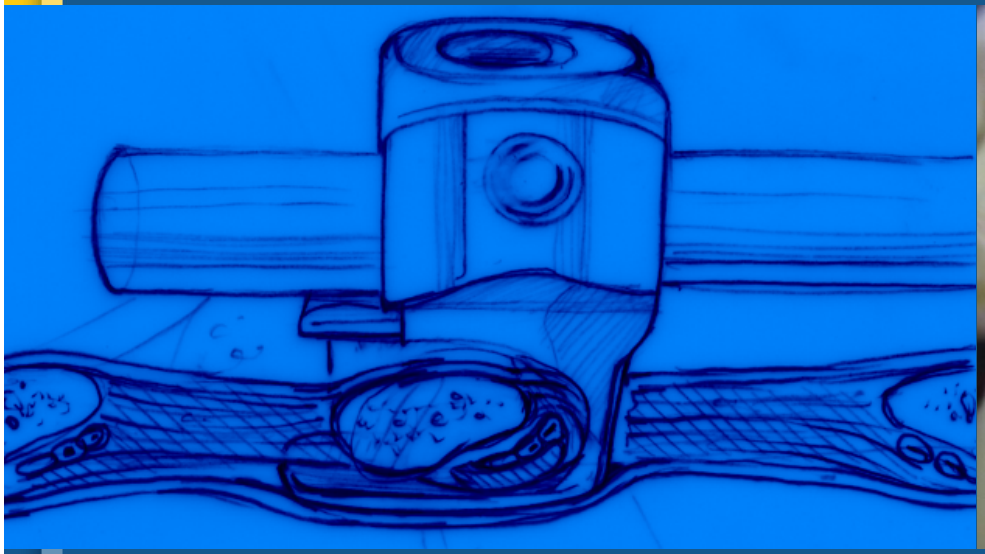
Purpose

- To report the early results of this technique.



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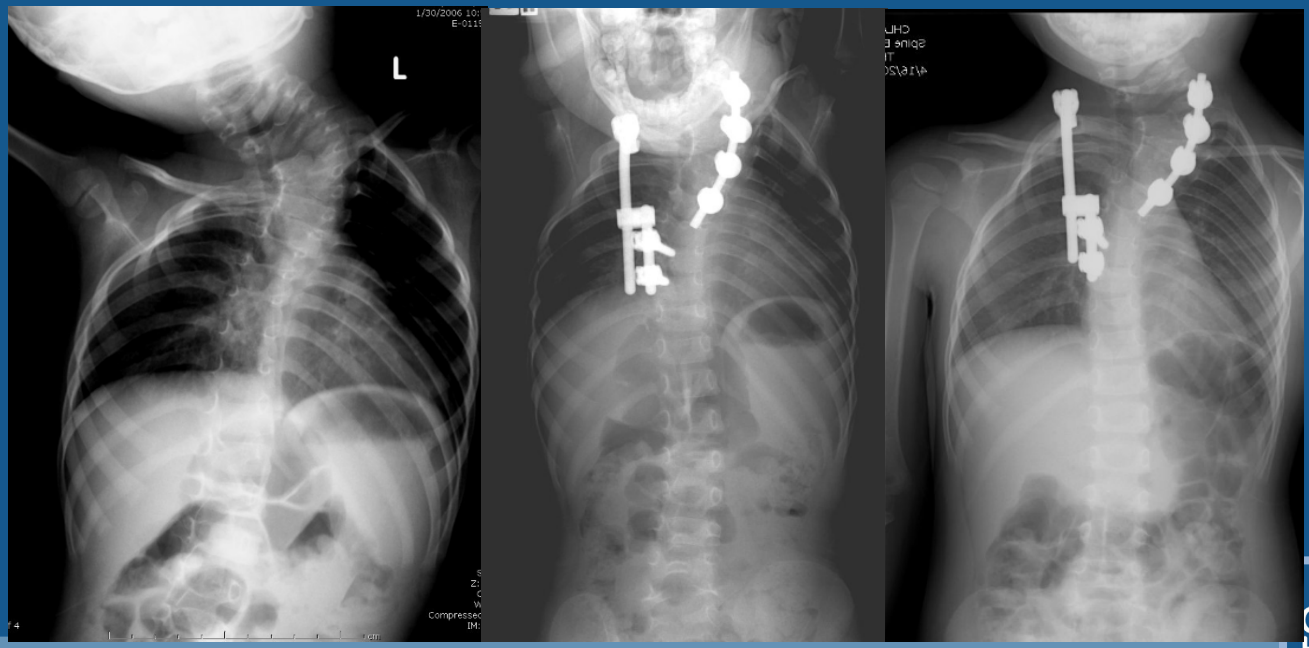

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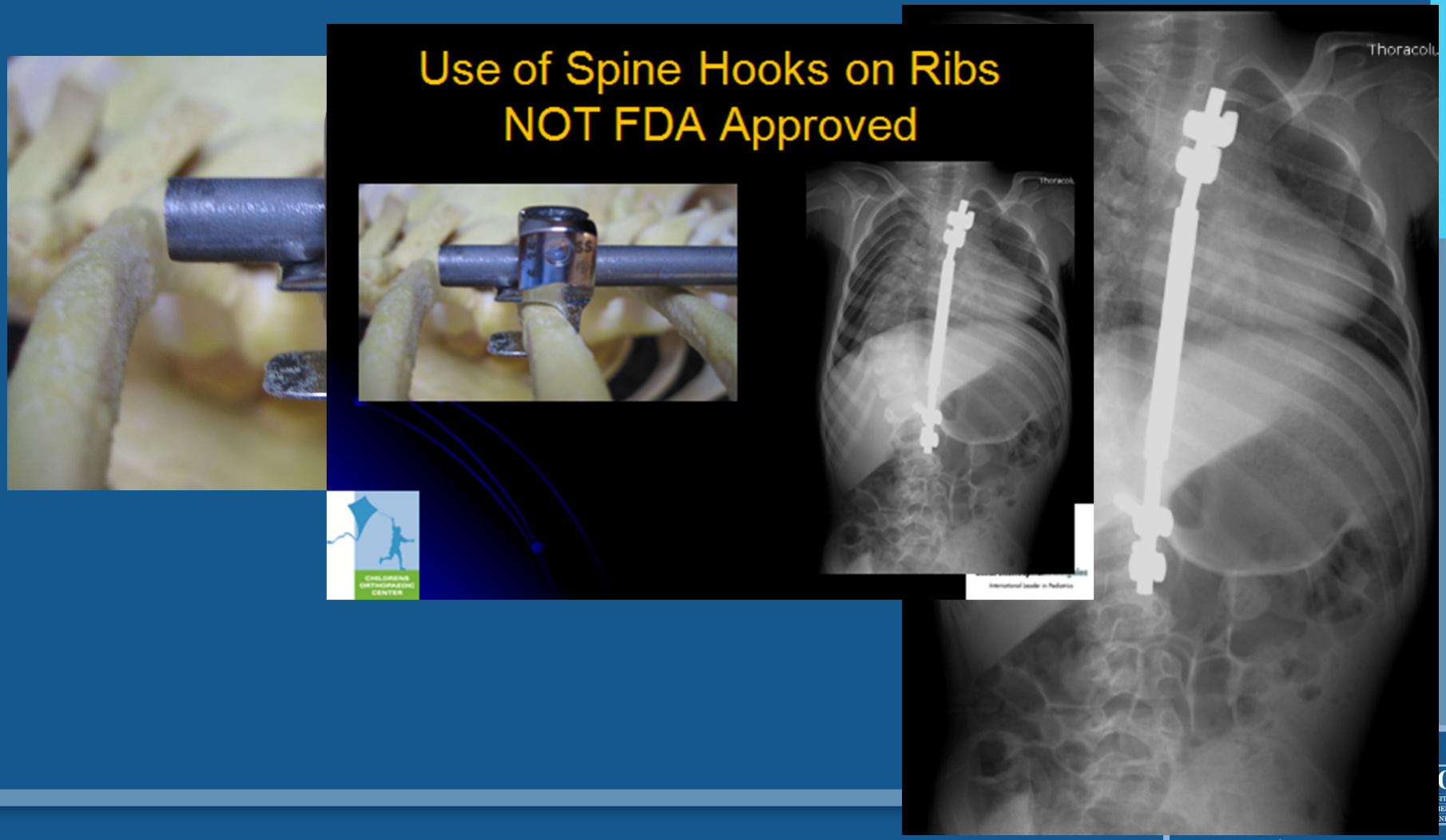
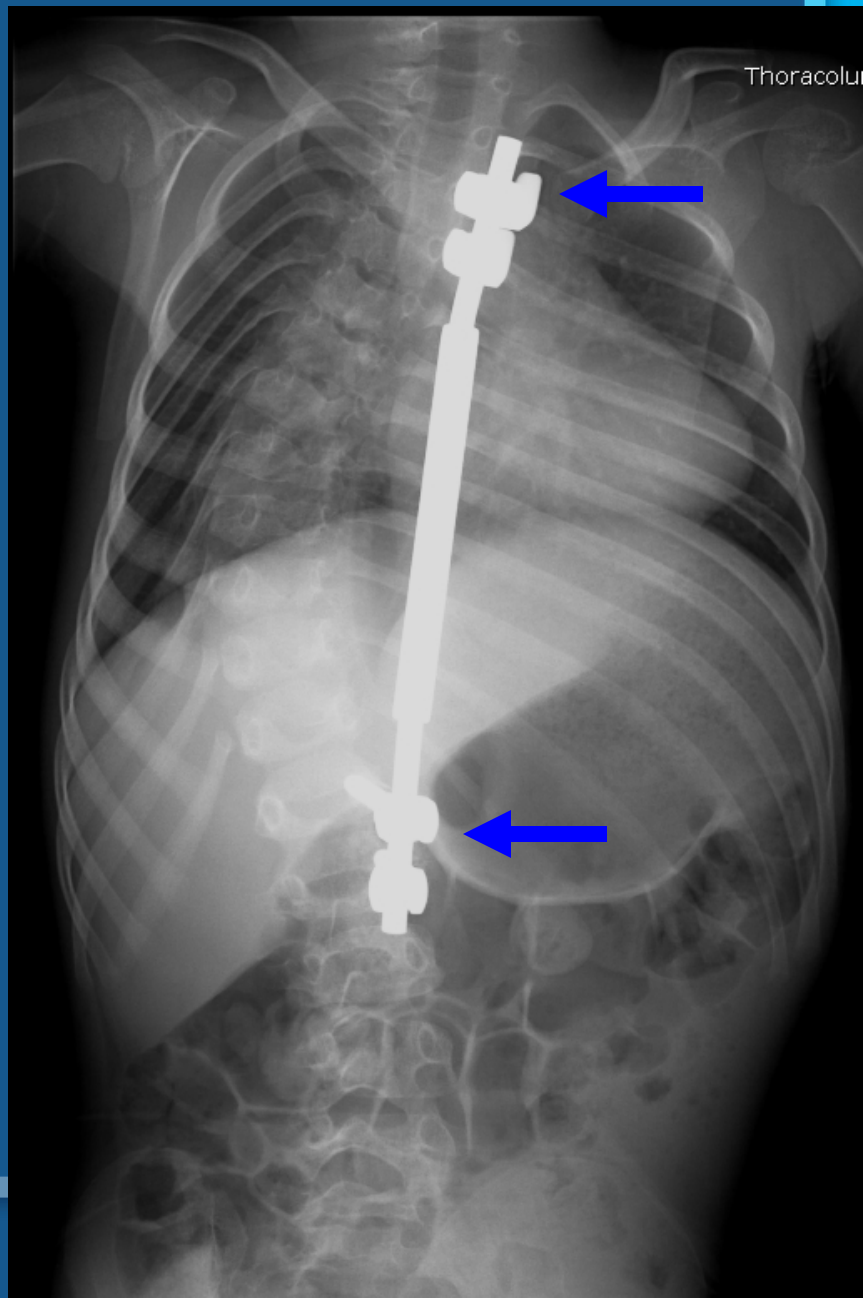
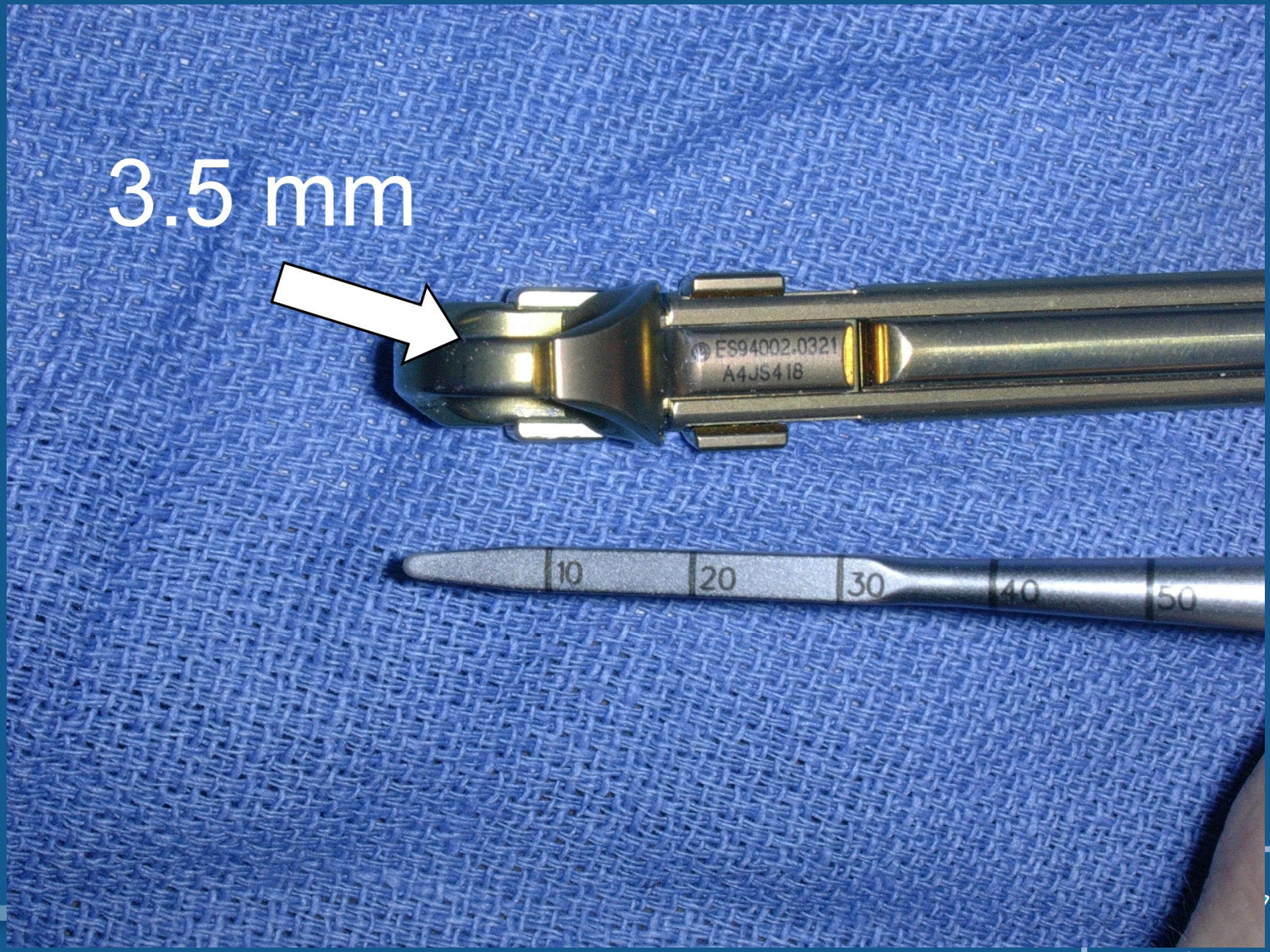
Use of Spine Hooks on Ribs NOT FDA Approved

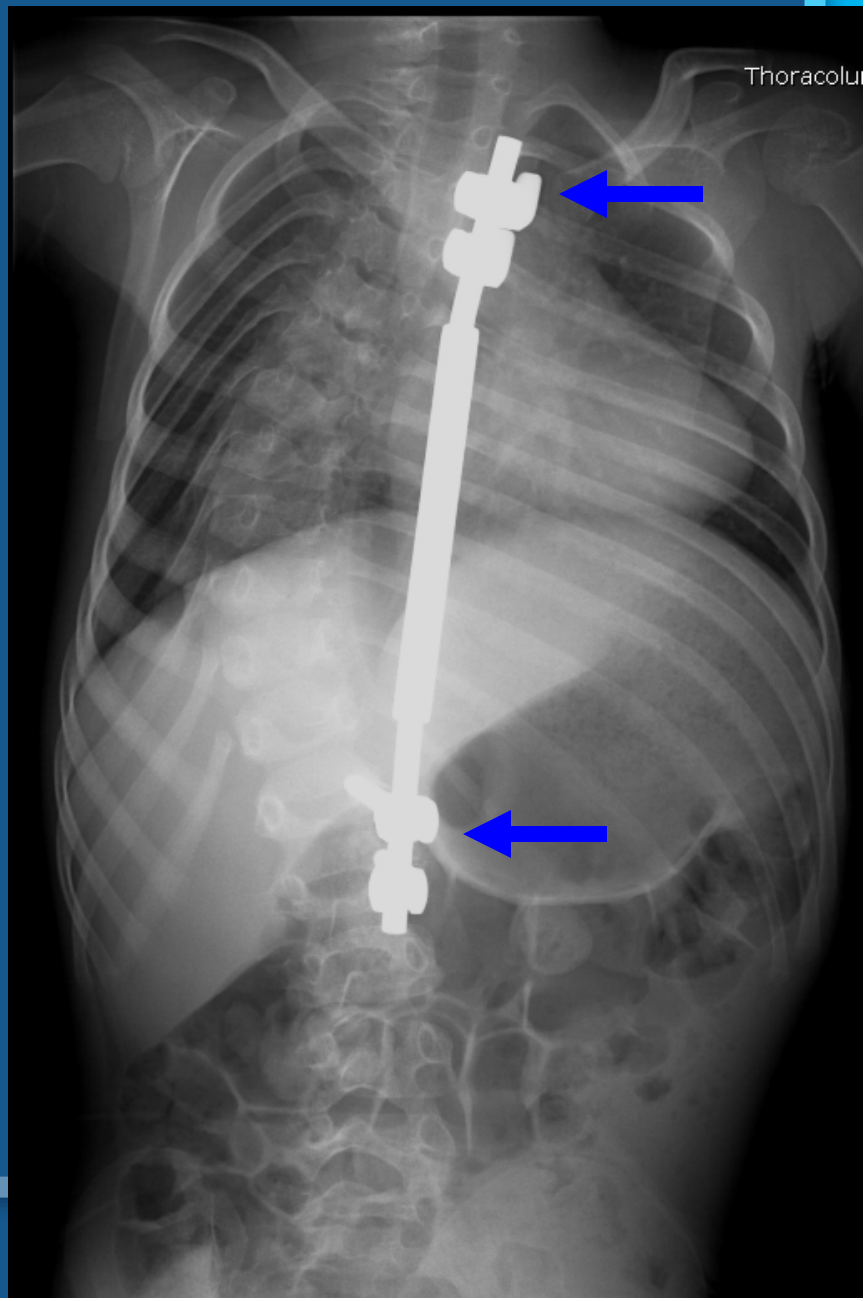


Portable Traction



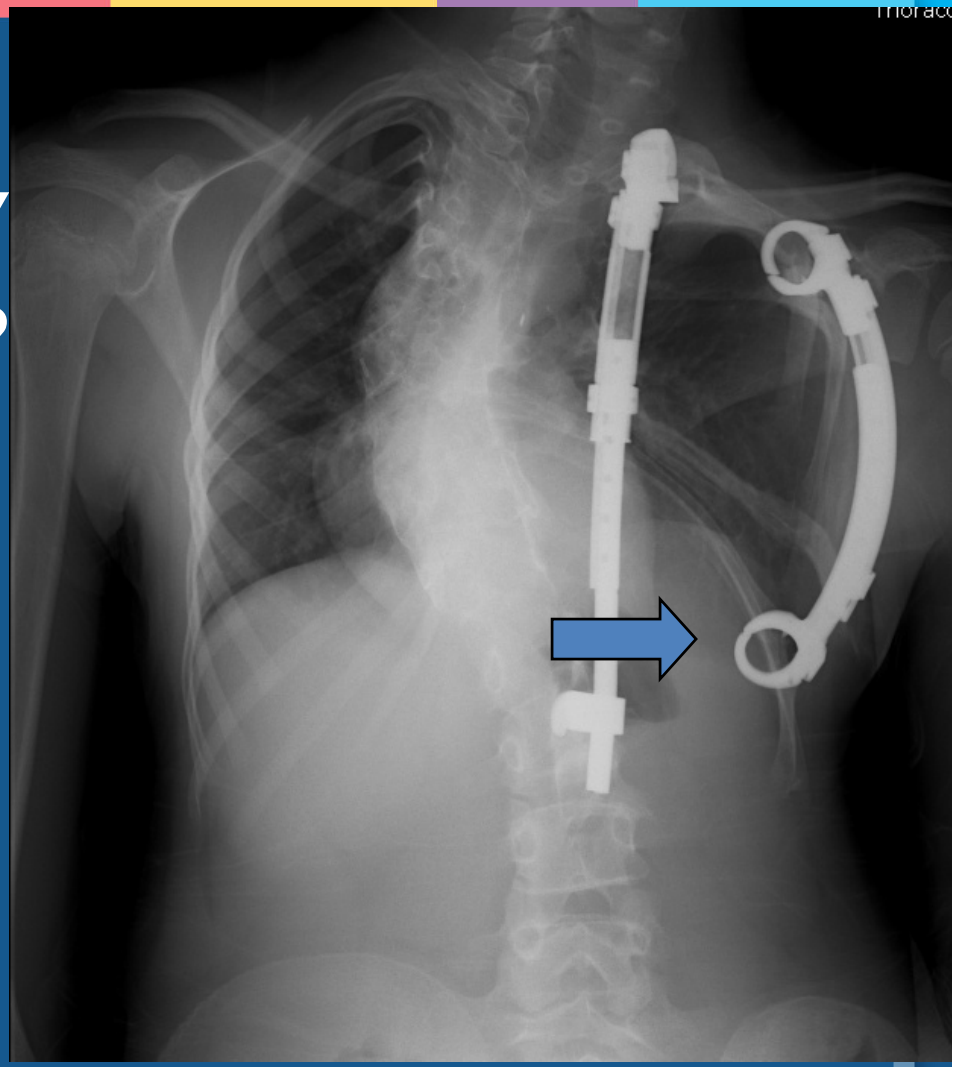

3.5 mm
ES94002.0321
A4JS418
10
20
30
40
50

Portable Traction



When do you REALLY need a thorocotomy?

- 1/3 of normal respiration from chest wall movement
- Disruption of chest wall hurts PFTs



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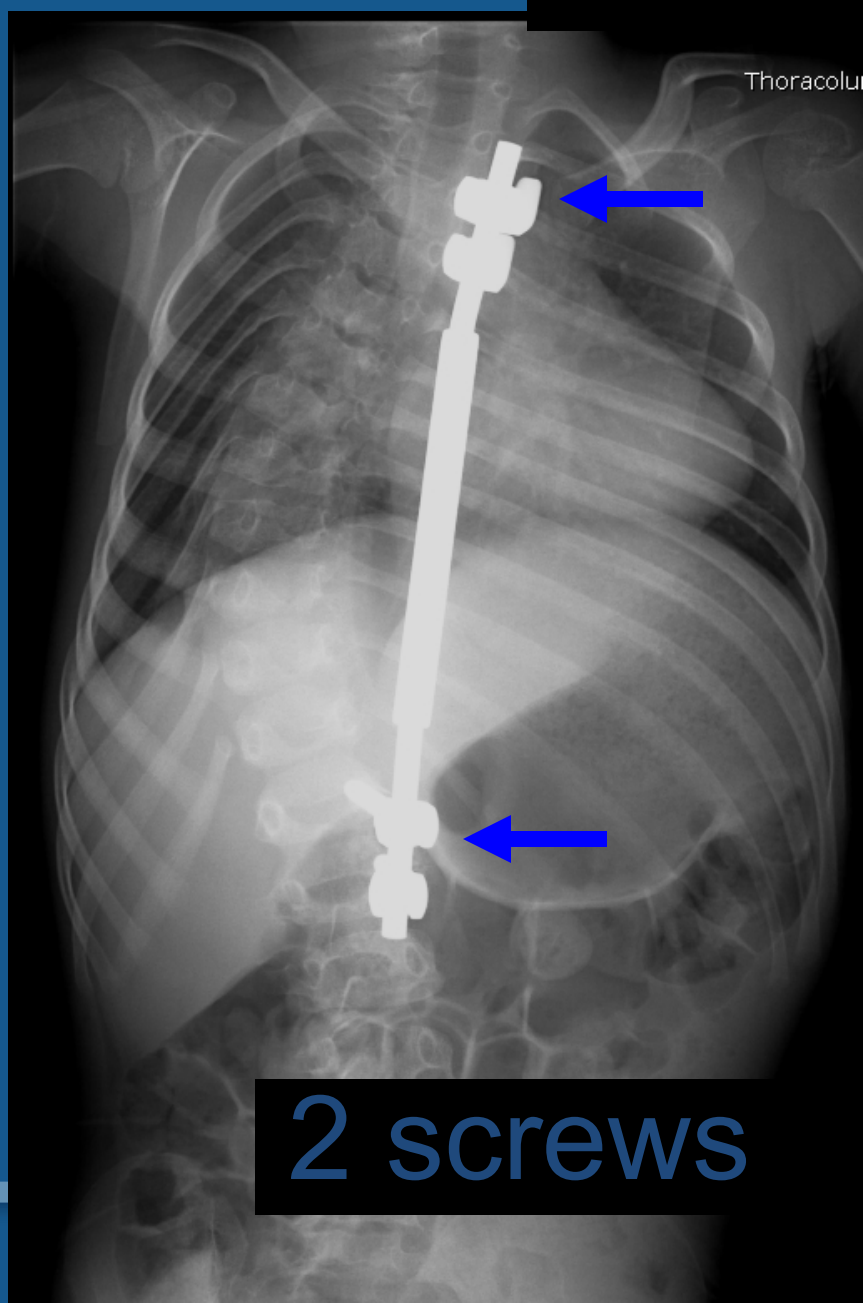
No Thorocotomy



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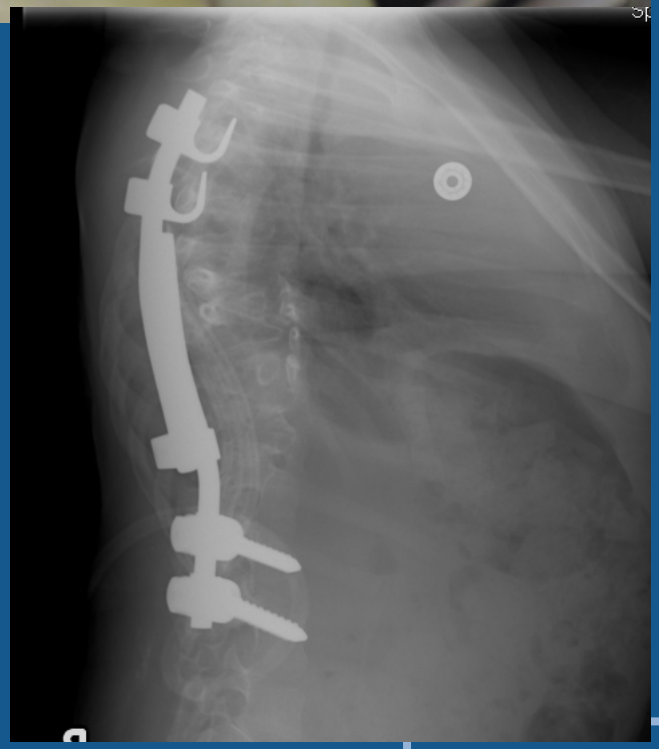
- FDA Off label
- No IRB approval
- $ < VEPTR
- Allows precise hook placements – non-constrained
  - Sagittal contouring



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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

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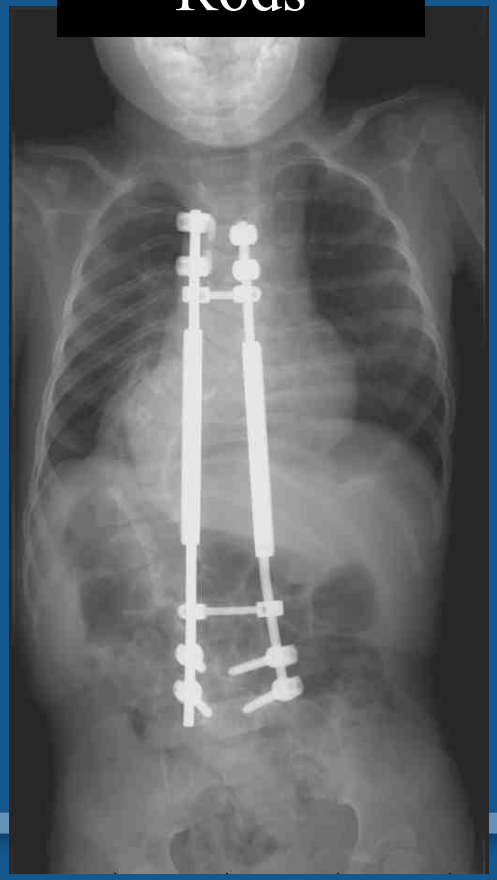
Wudbhav, et al, Spine, 2010

36 patients – mean age 4
Mean f/u 51 mo
Mostly Congenital, NM

Fewest CCXs/yr
Fewest CCXs/cm

VEPTR

Growing Rods



Hybrid