

Decisions, Decisions...Choose Wisely



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Disclosures as Listed

**Royalties from K2M, DePuy Synthes.
Research support: DePuy Spine, K2M,
NuVasive, Zimmer Biomet, Medtronic,
EOS Imaging.**

**Licensed IP on tethering to DePuy
Synthes and Spinologics**

The EOS Challenge

- **Easy Problems, Hard Problems**
- **Simple Treatment, Complex Surgery**
- **Good Decisions, Bad Decisions**
- **Good Outcomes, Bad Outcomes**



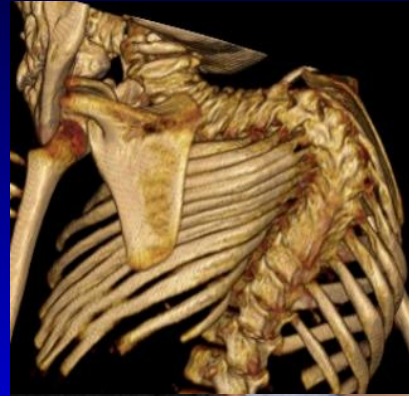
Why Intervene in EOS?

- Prevent deformity
- Promote pulmonary development
- Assumes intervention better than natural history



Two Causes of Severe EOS

1. Patient with big deformity early in life (them)
2. Surgeon with big dreams of helping a patient with “growth friendly” surgery (us)



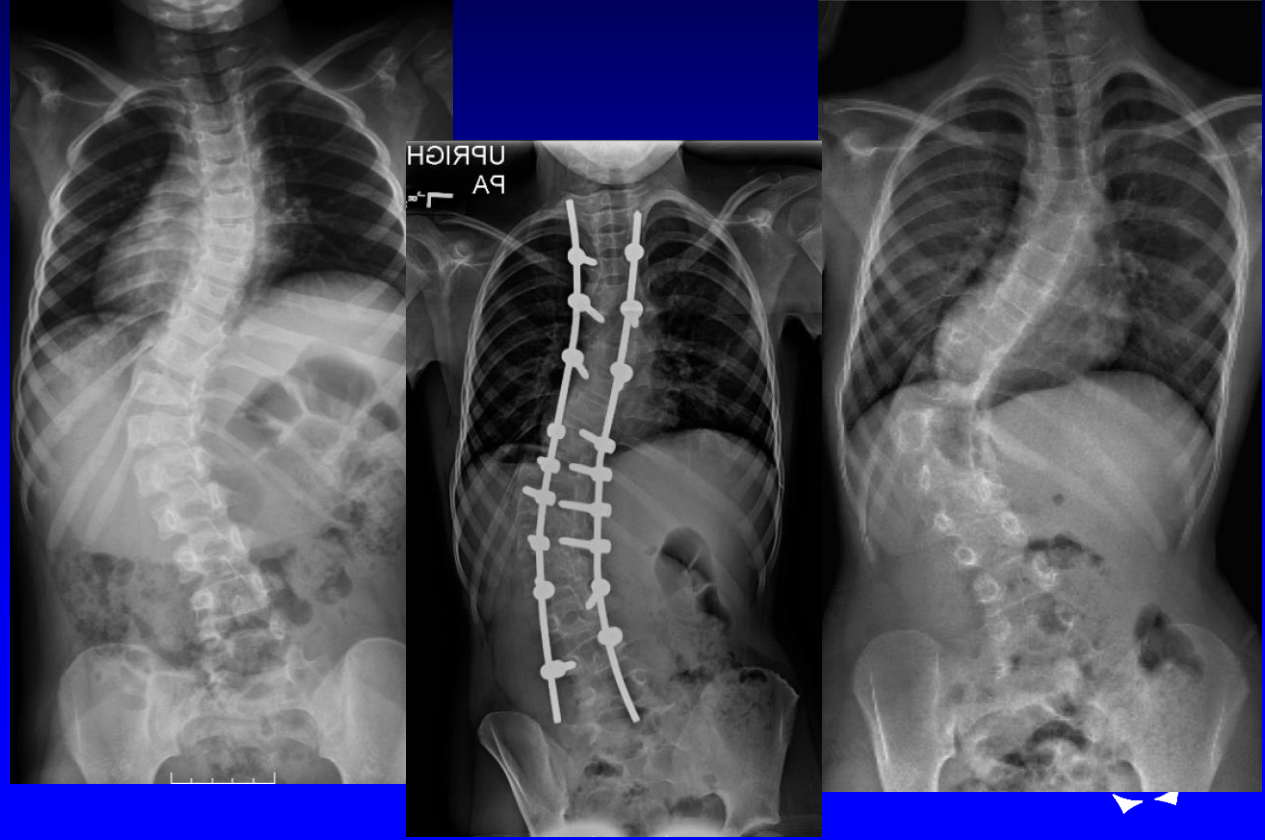
Patient Disease

- 11 mo old
- Neuro-blastoma
- Extensive resection



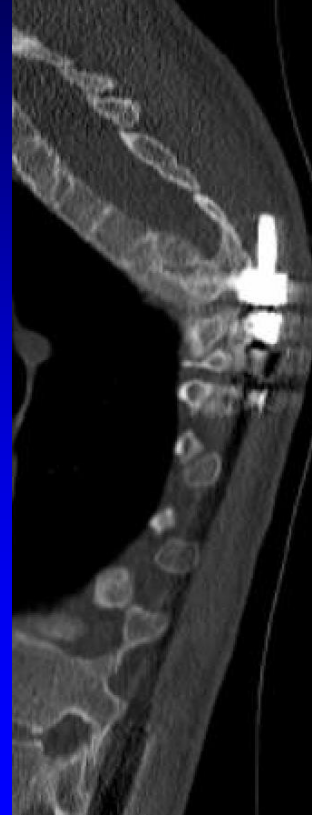
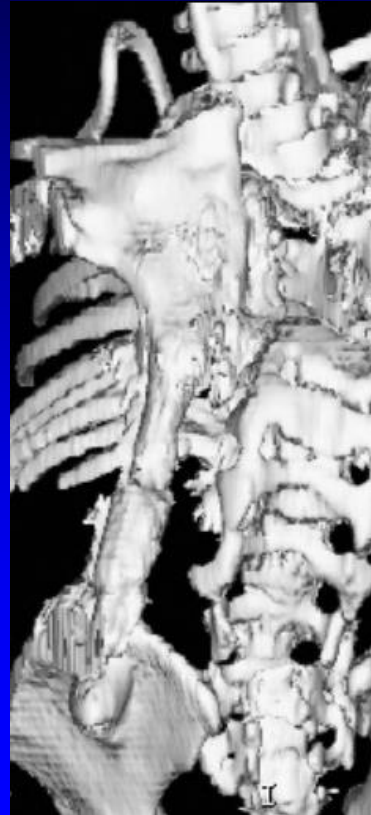
Patient + Surgeon Disease

- JIS
- Shilla
- Loose
- Infection
- Removal
- Progression

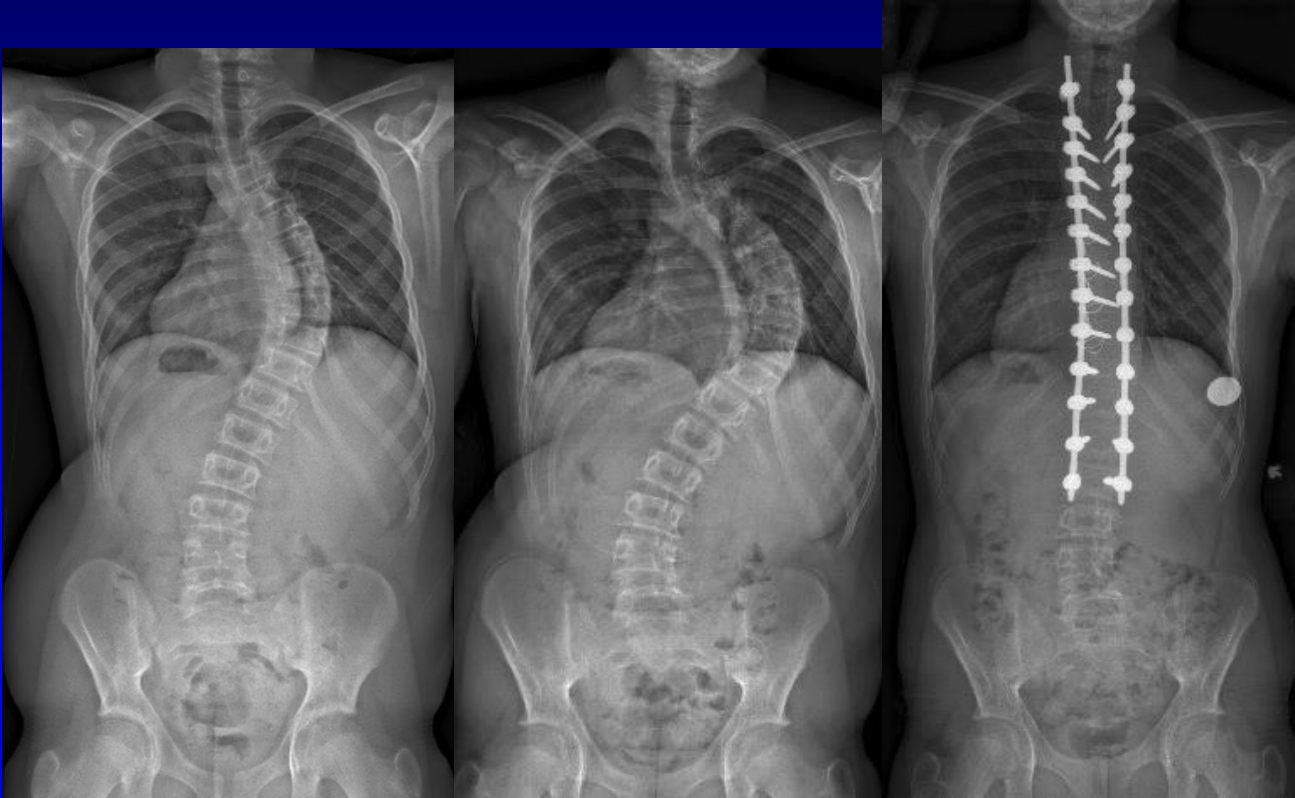


There's no going back...

- **Wear debris**
- **Autofusion**
- **Junctional issues**

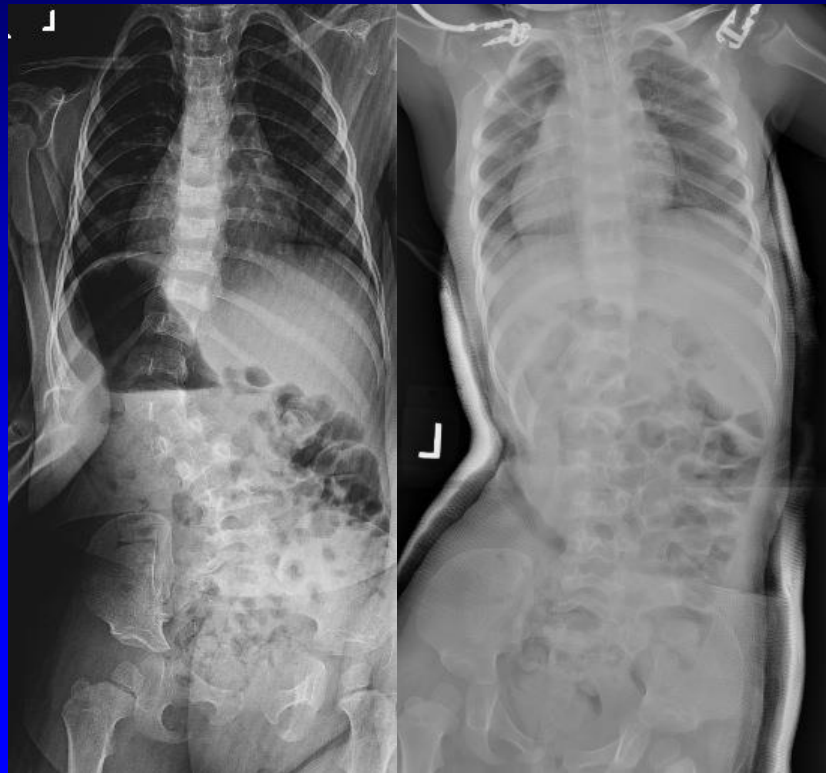


Wait, Wait, Wait... Fuse. One & Done!



Do Everything NOT to Operate Before Age 8, better yet Age 12

- Observation
- Casting
- Bracing
- Halo Traction
- All of the above



Justification to Intervene?



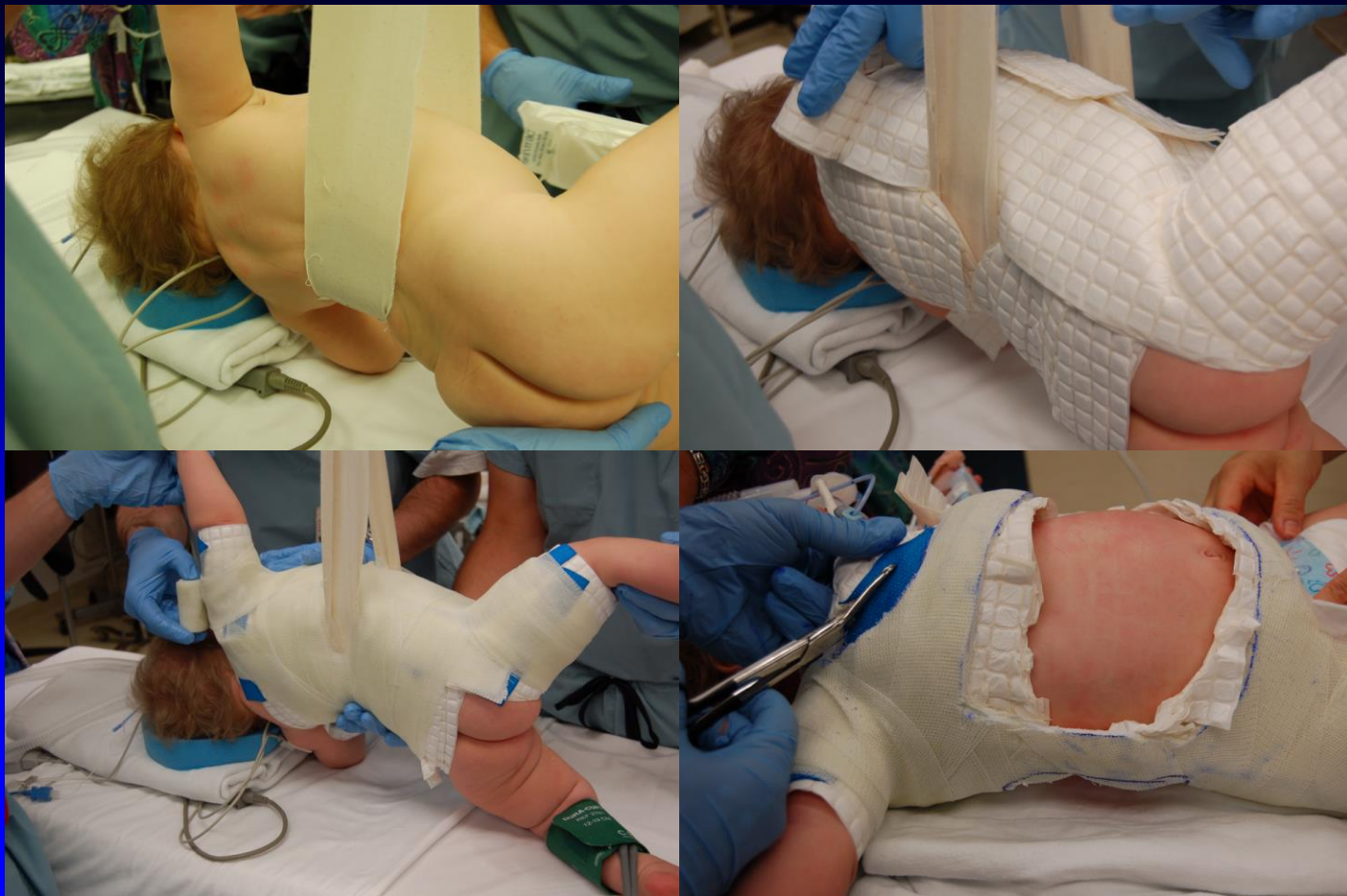
“Growth Modulation” w/ Cast



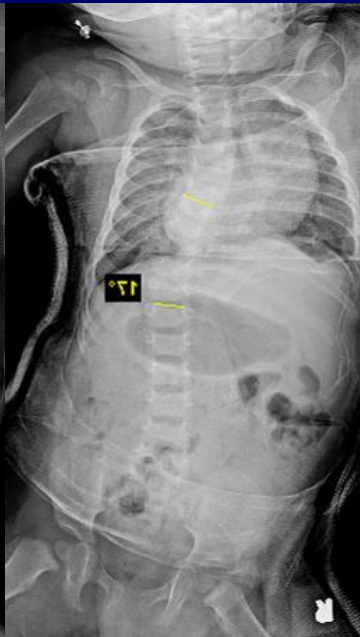
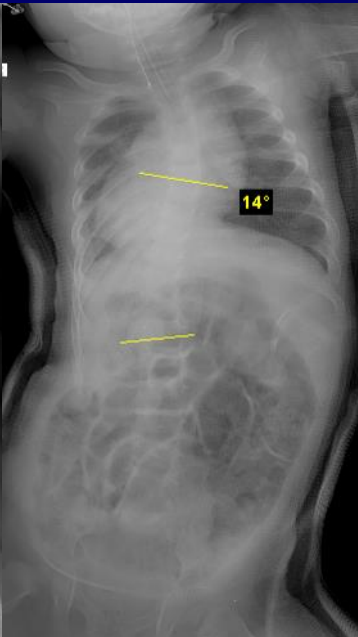
Casting Strategies

- Cotrel
- Risser
- Mehta
- Bending





Serial Casting Works



1st Cast

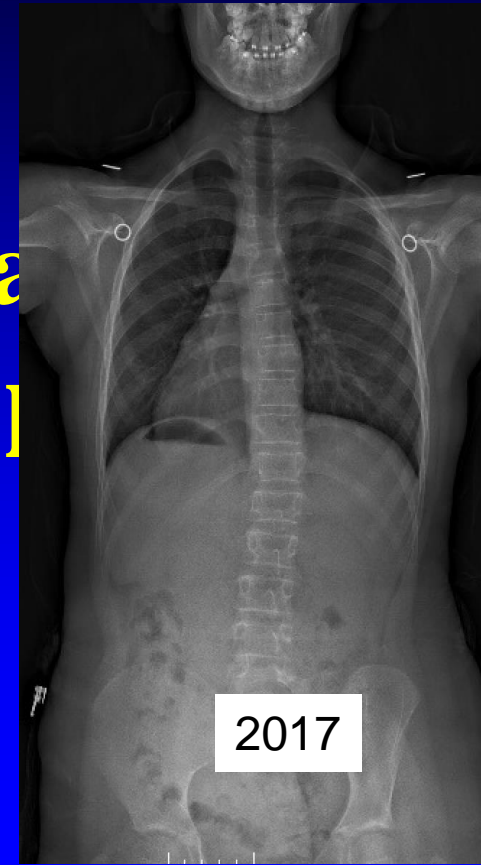
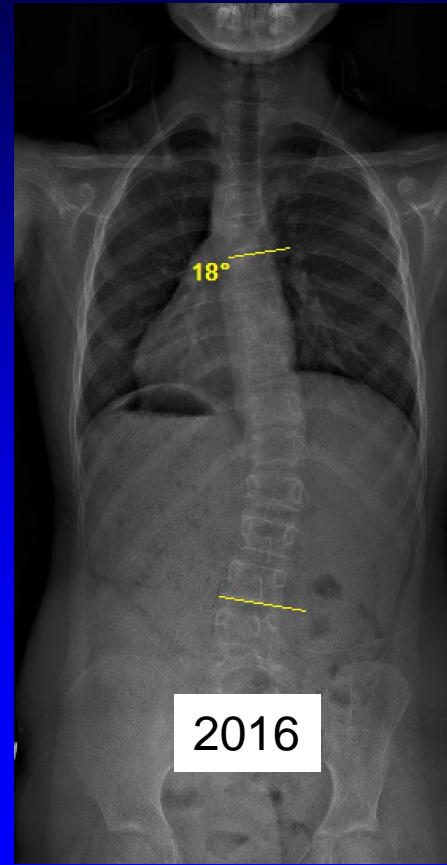
2nd Cast

Age 9

Children's Hospital

~~Growing rod, Shilla, Tether?~~

NO



and/or get a better brace

- **BRAIST trial proved it works**
- **In brace correction matters**
- **Time in brace matters**
- **The brace maker matters**



Casting/Bracing Complications

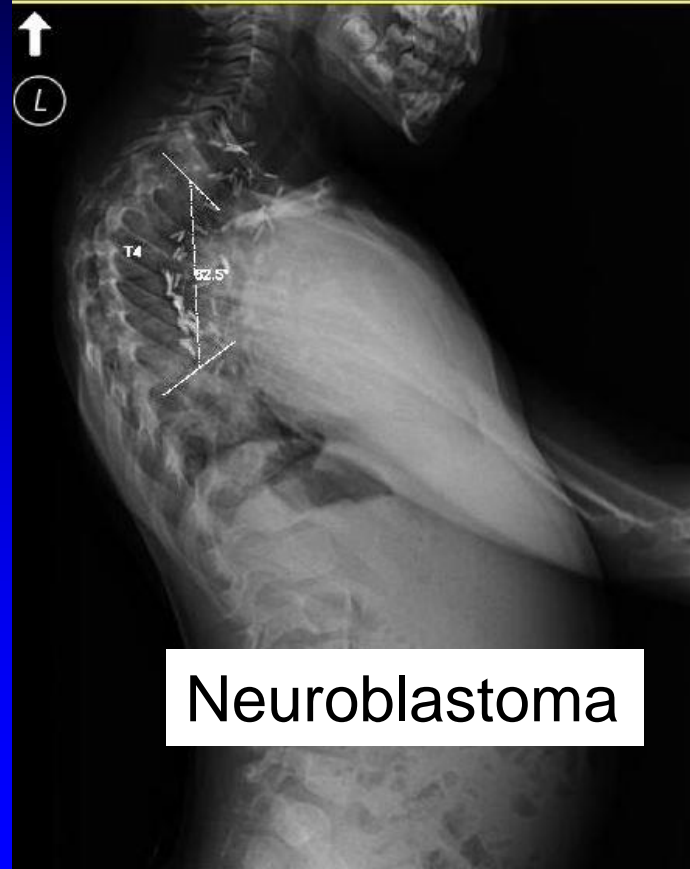
- **Failure to control scoliosis**
- **Chest wall deformity due to cast pressure**
- **Skin breakdown**
- **Negligible compared to “Growth (un)Friendly Surgery”**



Too Proximal for a cast...



Age 3



Neuroblastoma

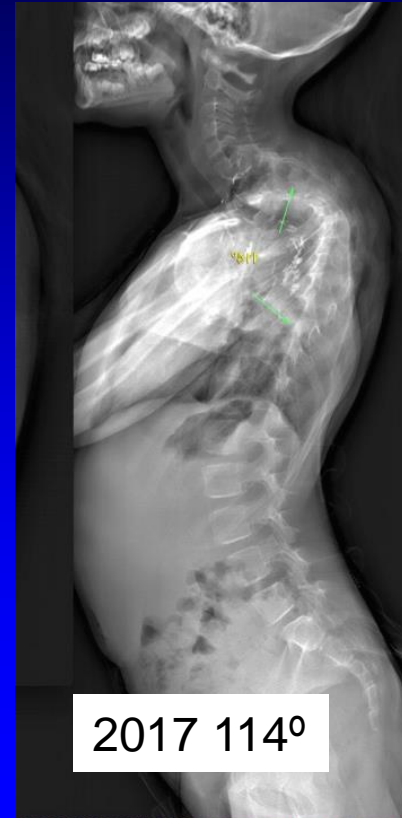




Progression over 4 years (age 7)



Progression over 4 years

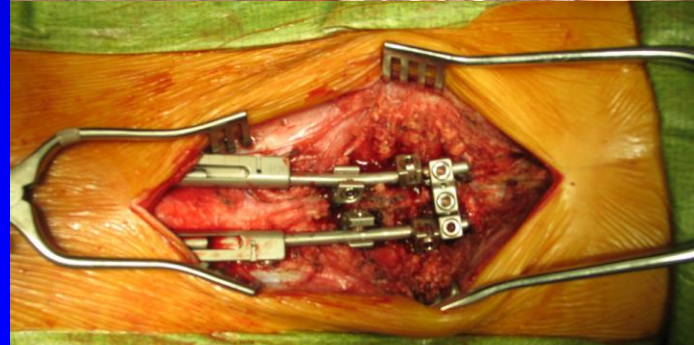


If it doesn't work...

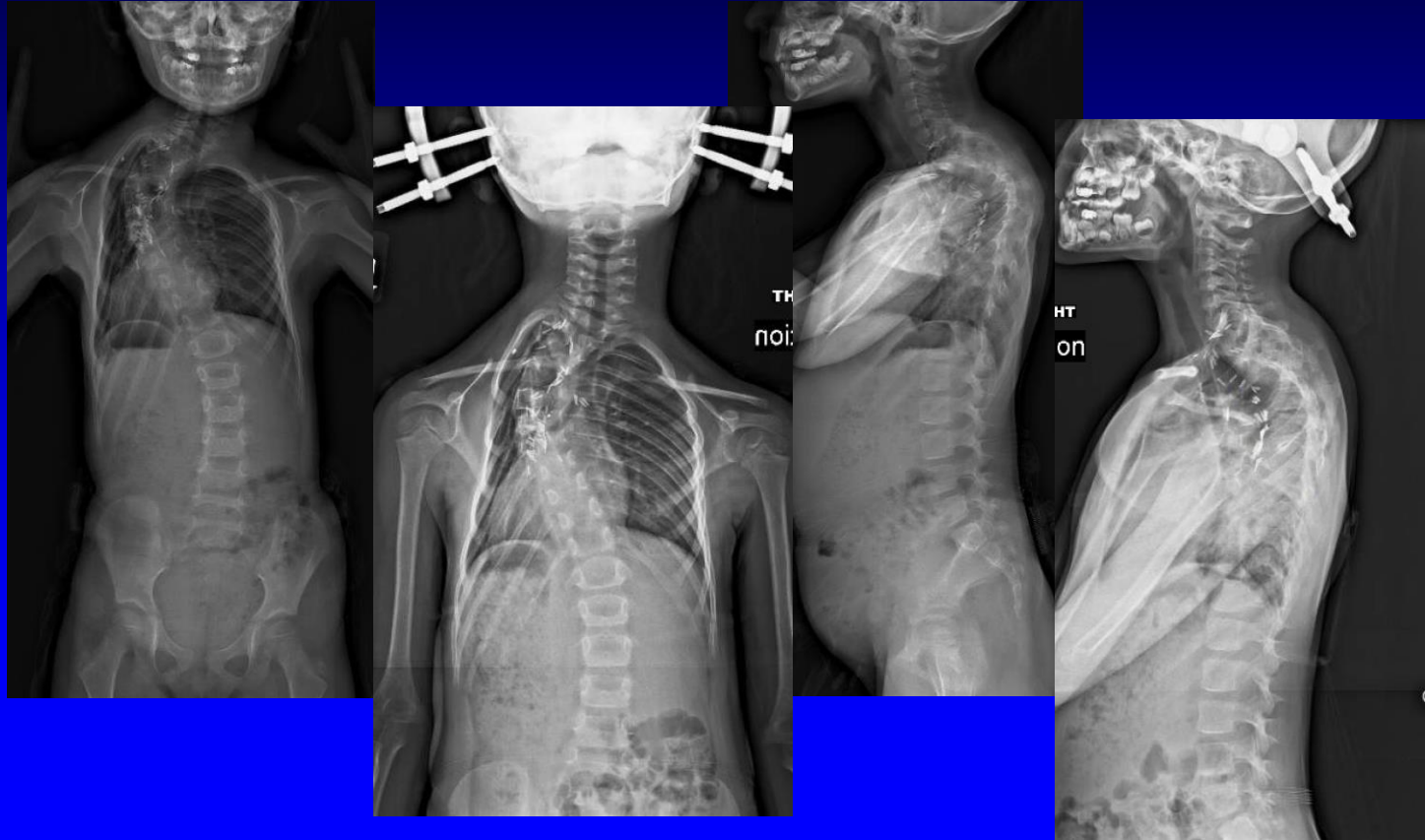


First Stage of Treatment

Second Stage of Treatment



Halo Gravity Traction



HGT - Rarely Disappoints



Few hours/day Holter Txn





- **Surgery (beginning of the end)**
- **Keep delaying (devastating for lungs)**
- **Choose wisely & based on deformity**







Age 8





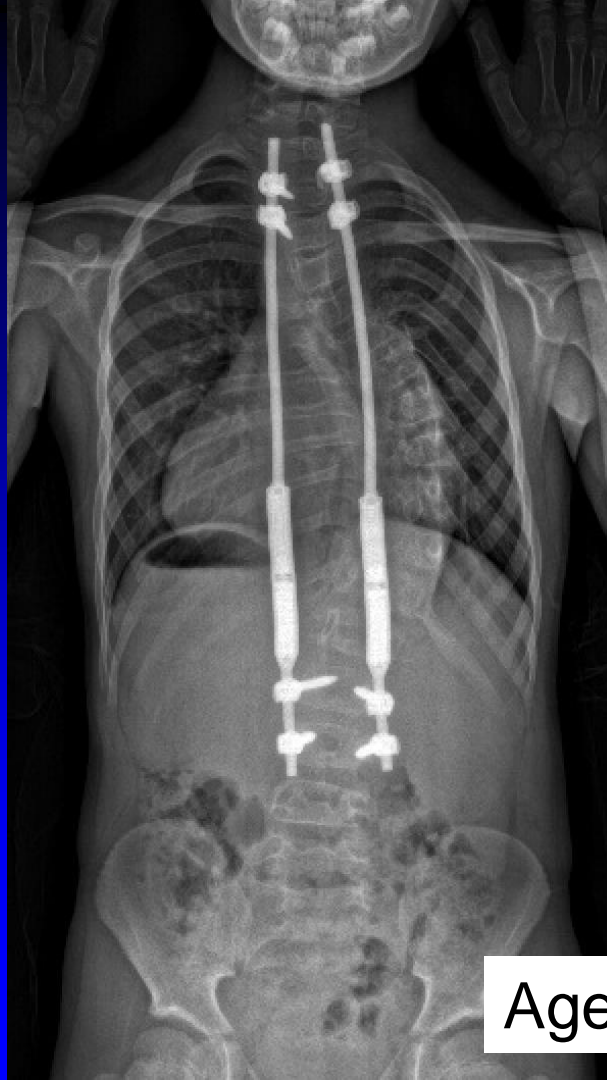
Age 7 male



MITTIS



After HGT



Age 8



First Principle

Delay surgical intervention!

- **Cast**
- **Brace**
- **Traction**
- **Resist the temptation of Easy!**



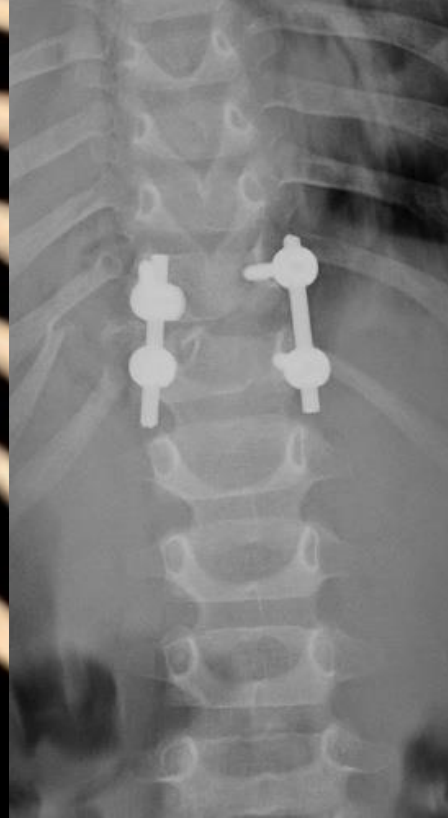
Second Principle...

Know when to break the First Principle!

- **Only for a Short Fusion**
- **Define “Short”...**
- **Depends on age, diagnosis**

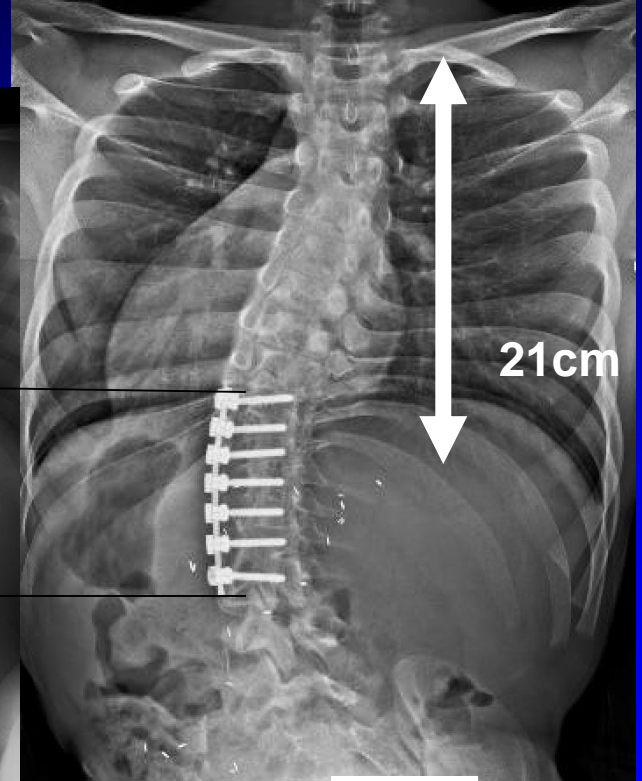
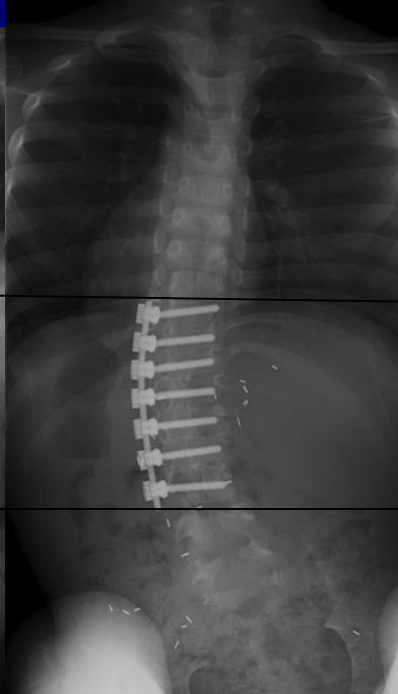
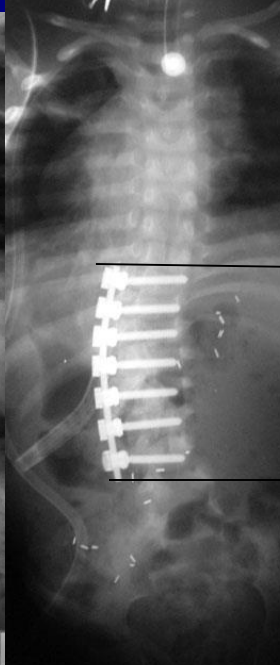


Shortest curve – 1 level fusion



3 y/o paraplegia

“Short” Thoracolumbar Fusion



21cm



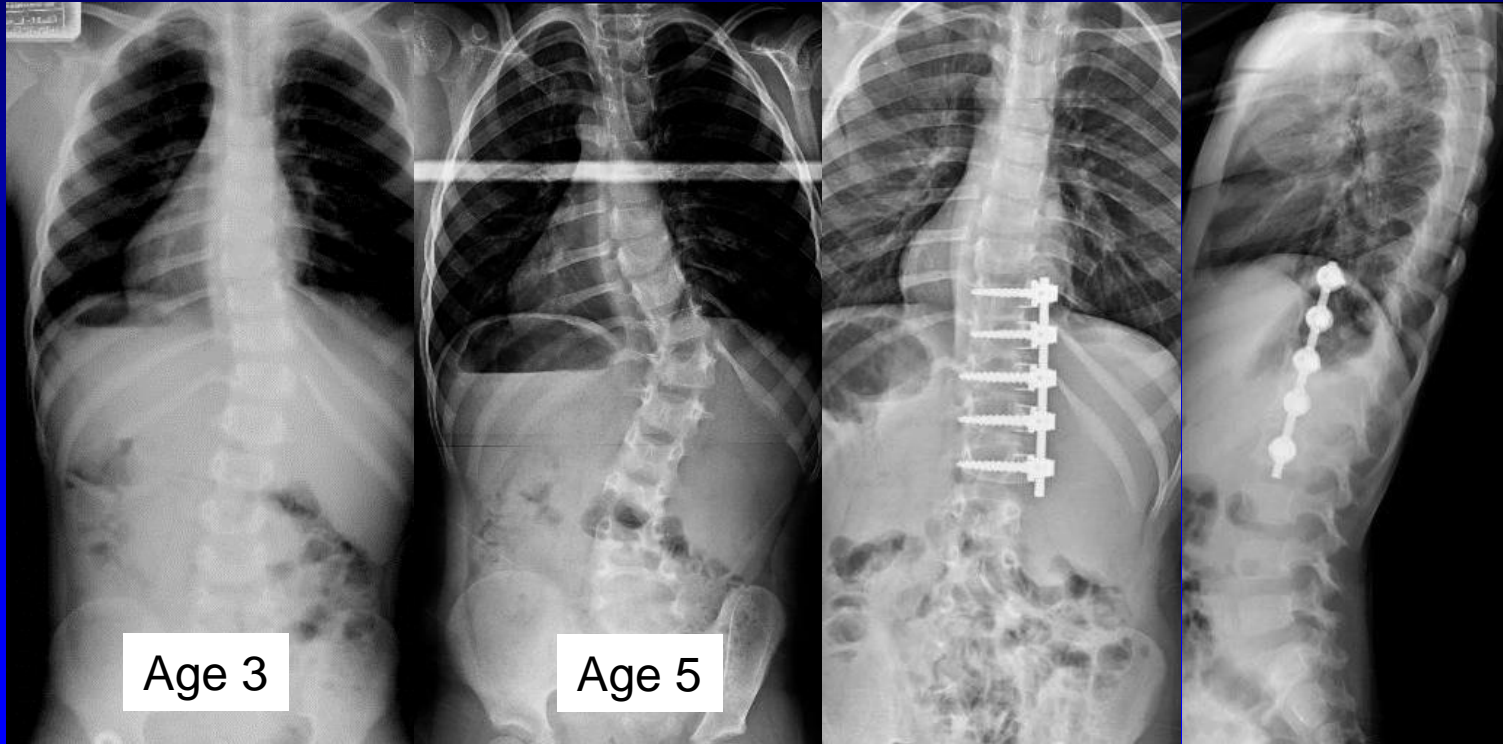
Neuroblastoma

2001

2006

2016

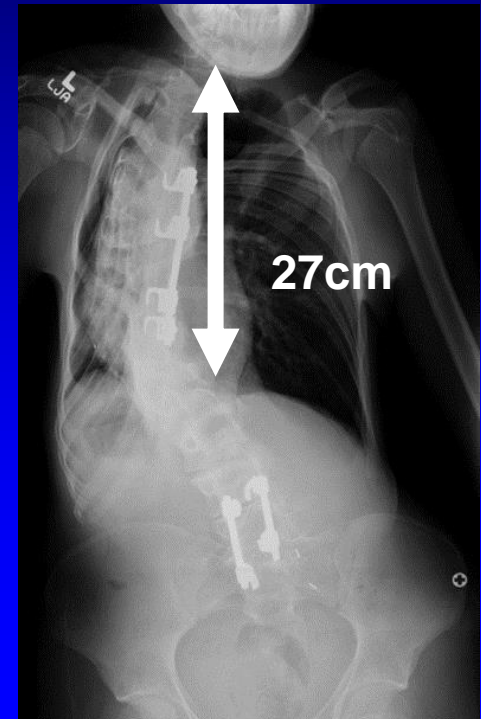
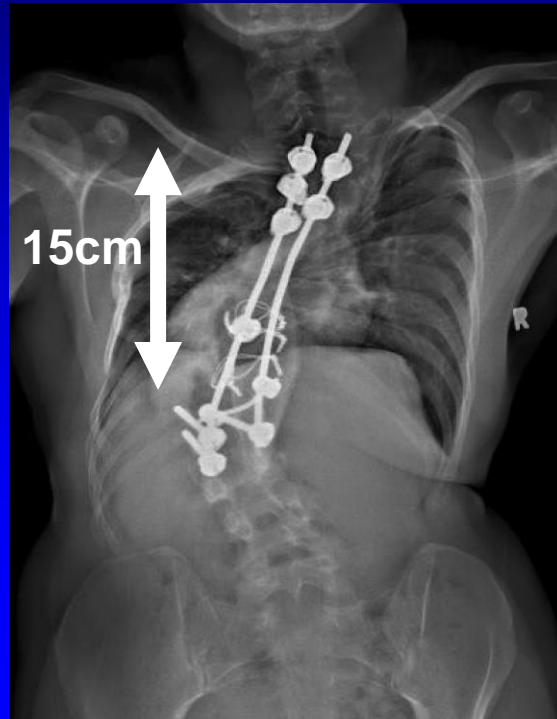
NF1 - Short Curve Early, Short Fusion



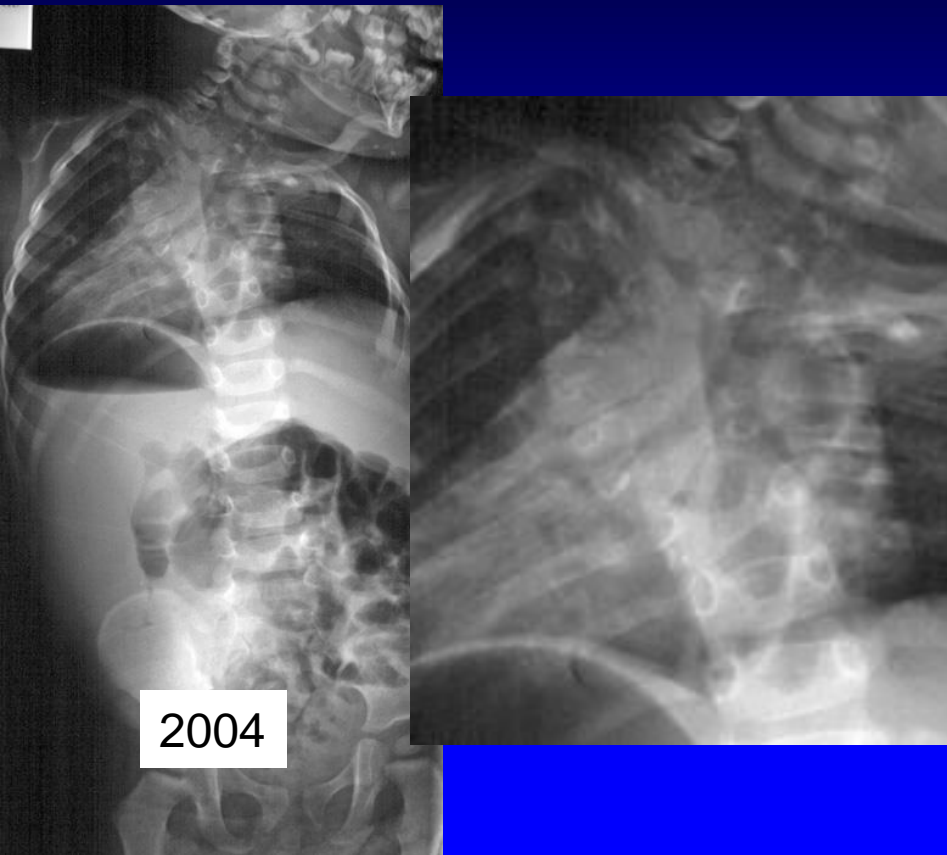
Too much fusion too early vs. Too little too late

Goal

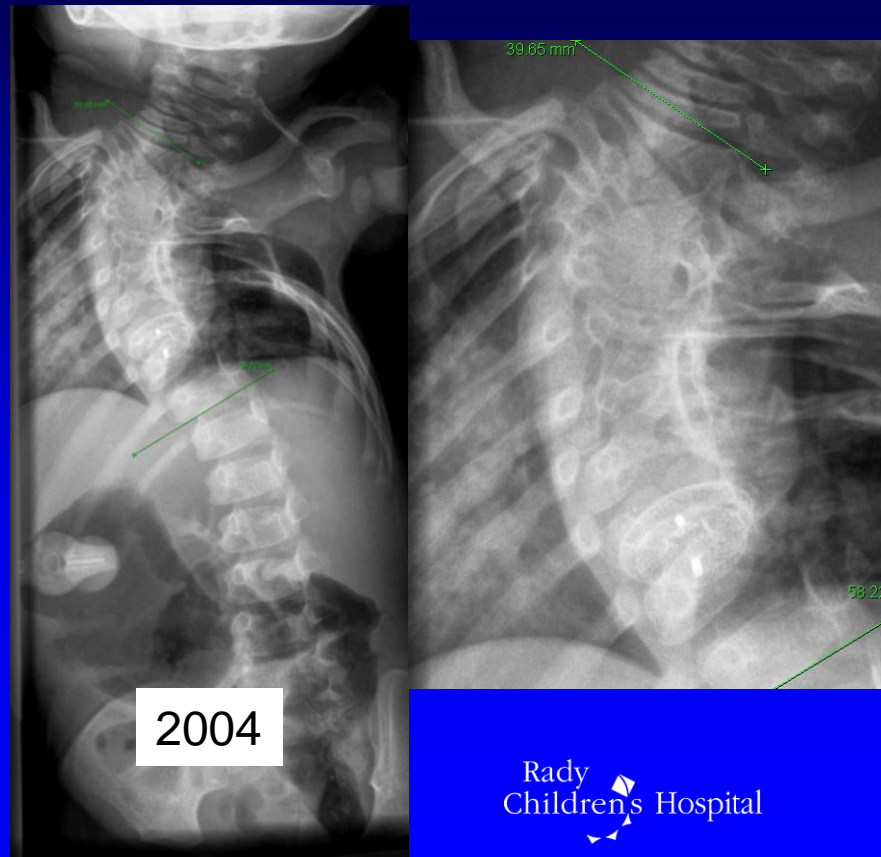
- T1-12
- 20-22cm

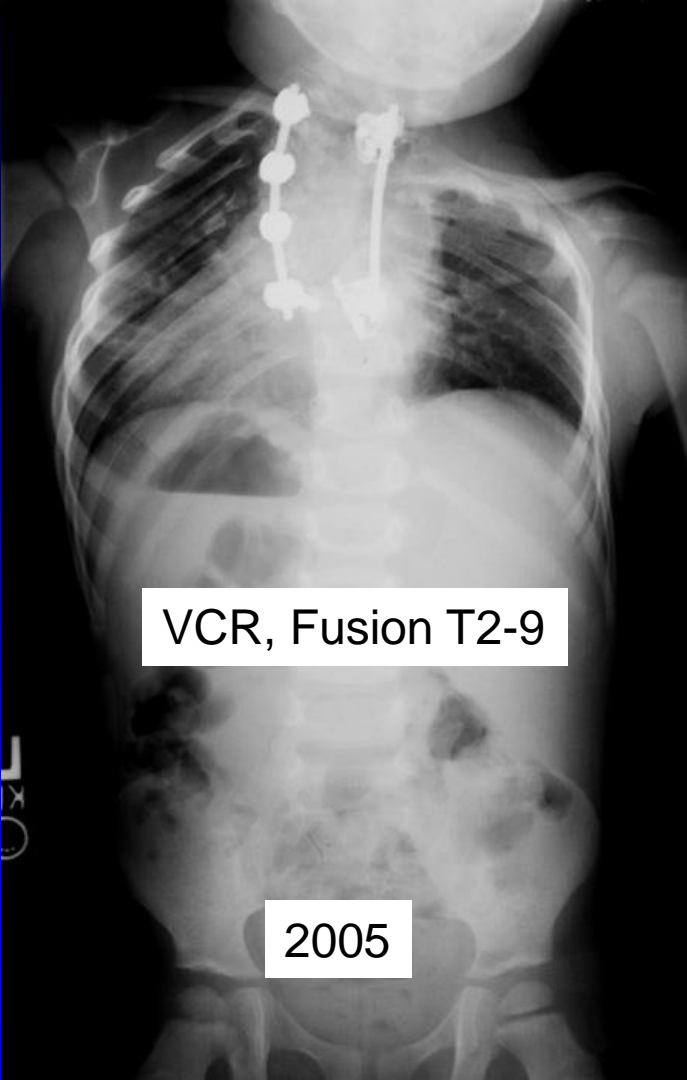


Patient 1



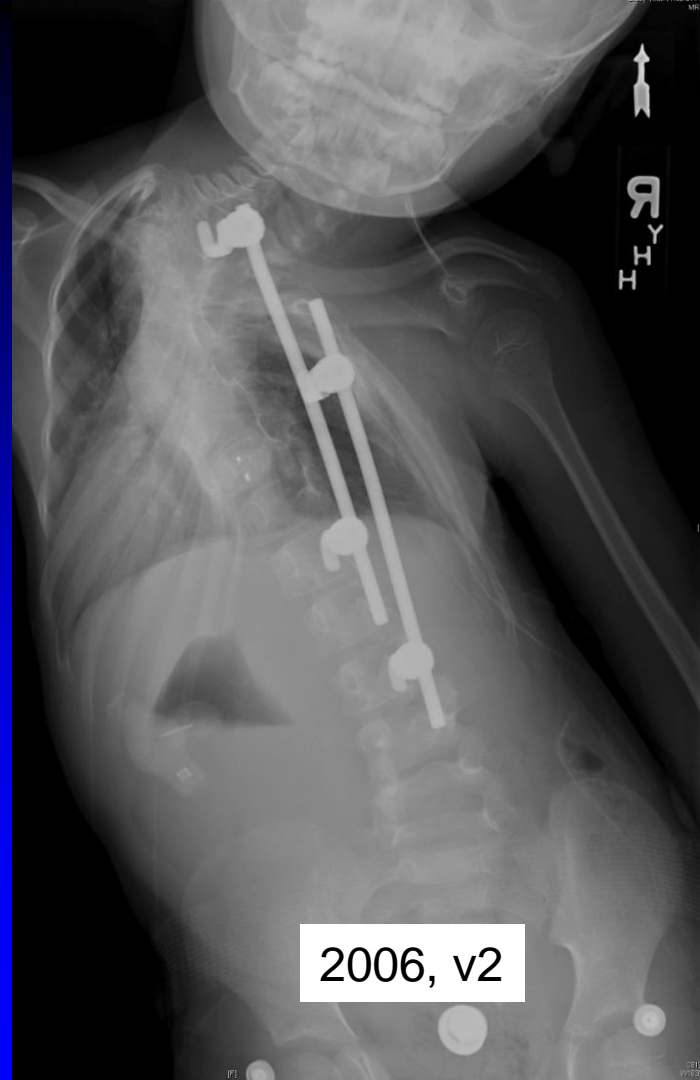
Patient 2







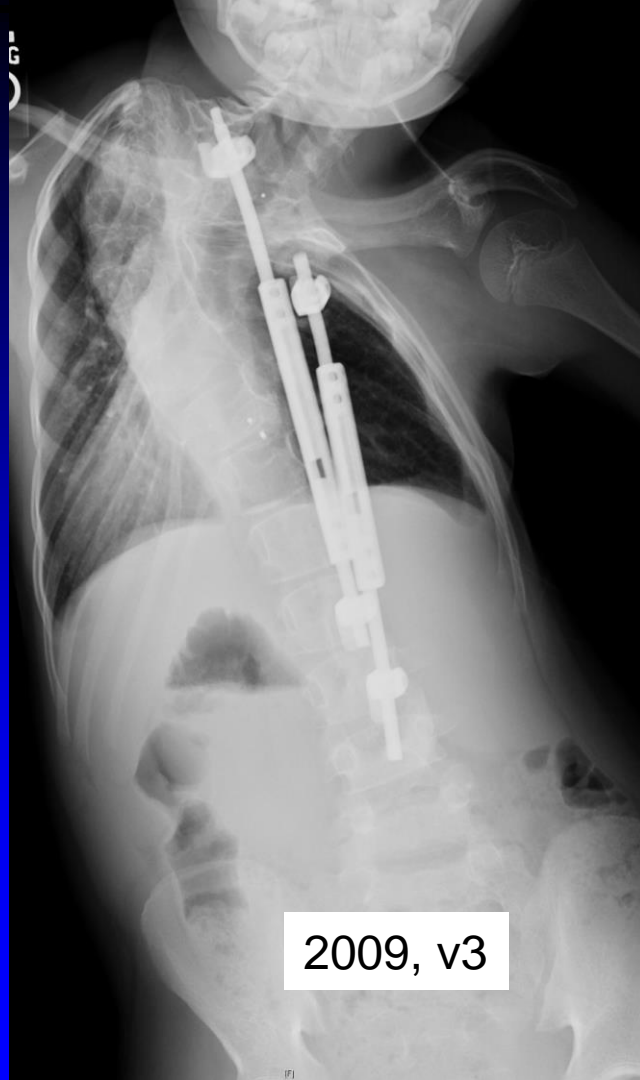
2006



2006, v2



2009



2009, v3

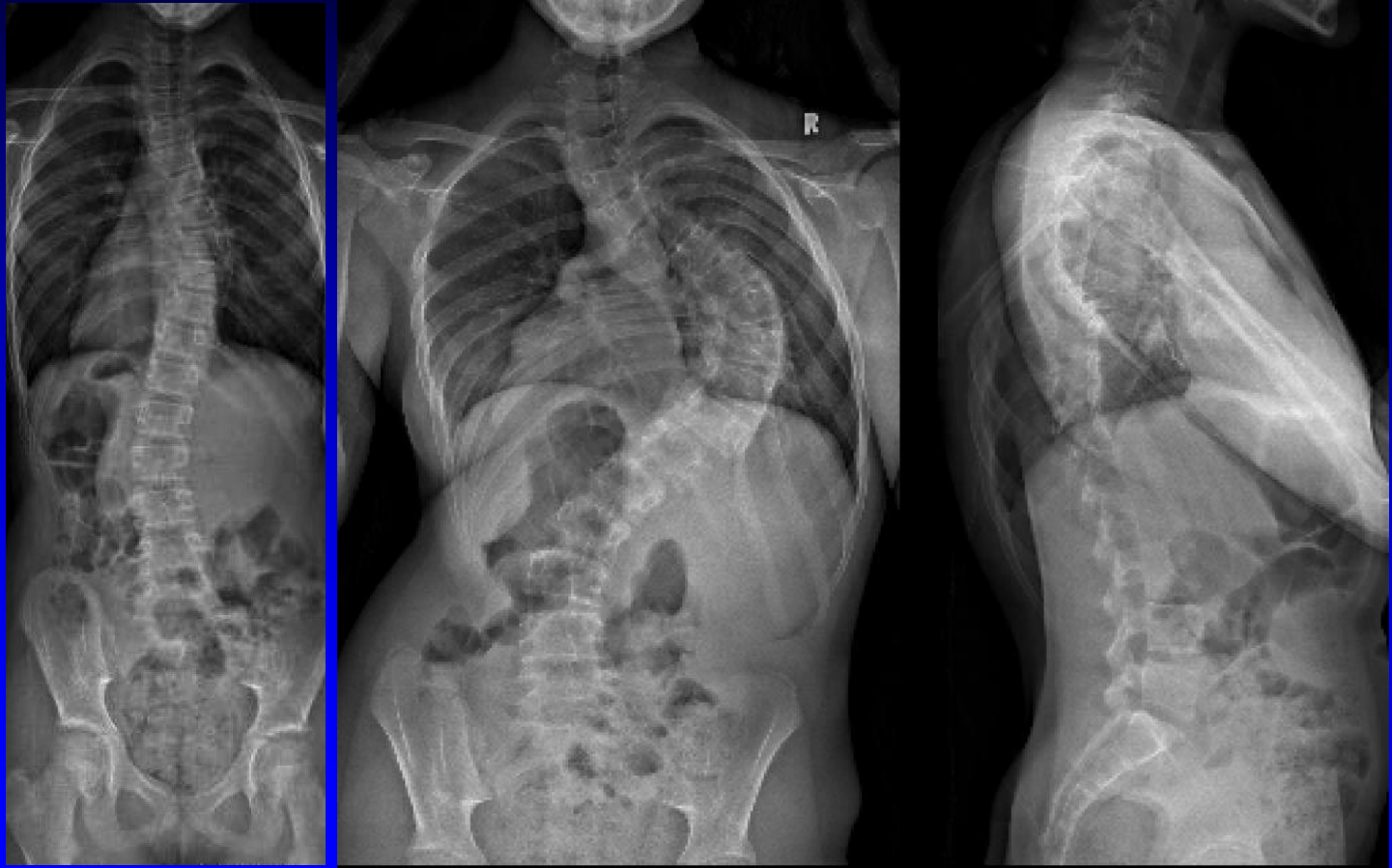


Decisions Matter More in EOS

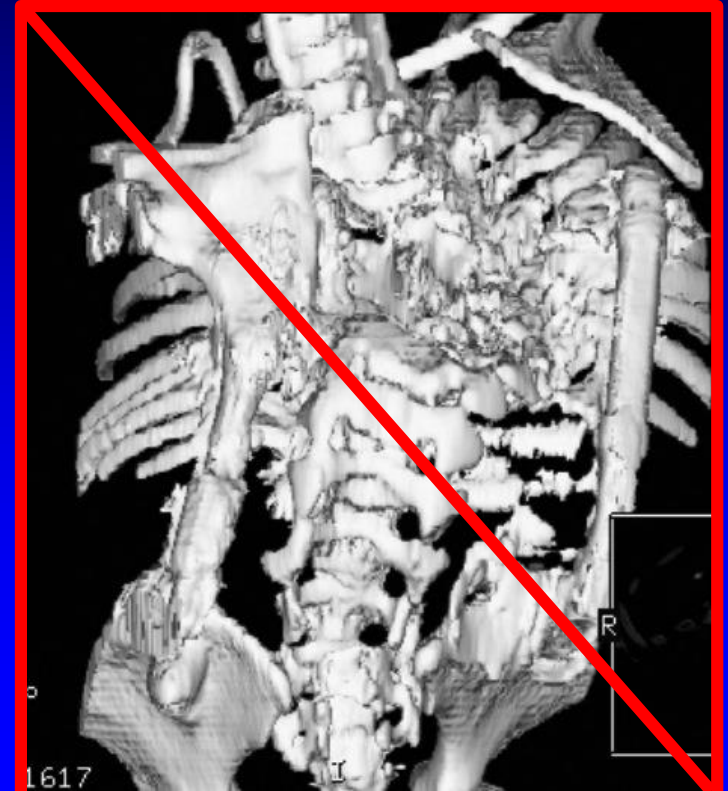
- Resist the urge to do easy surgery too early
- Resist the urge to instrument more than the “bad” spine/chest
- The younger the patient, the greater the importance of getting it right



Large Curve, “Virgin” Spine

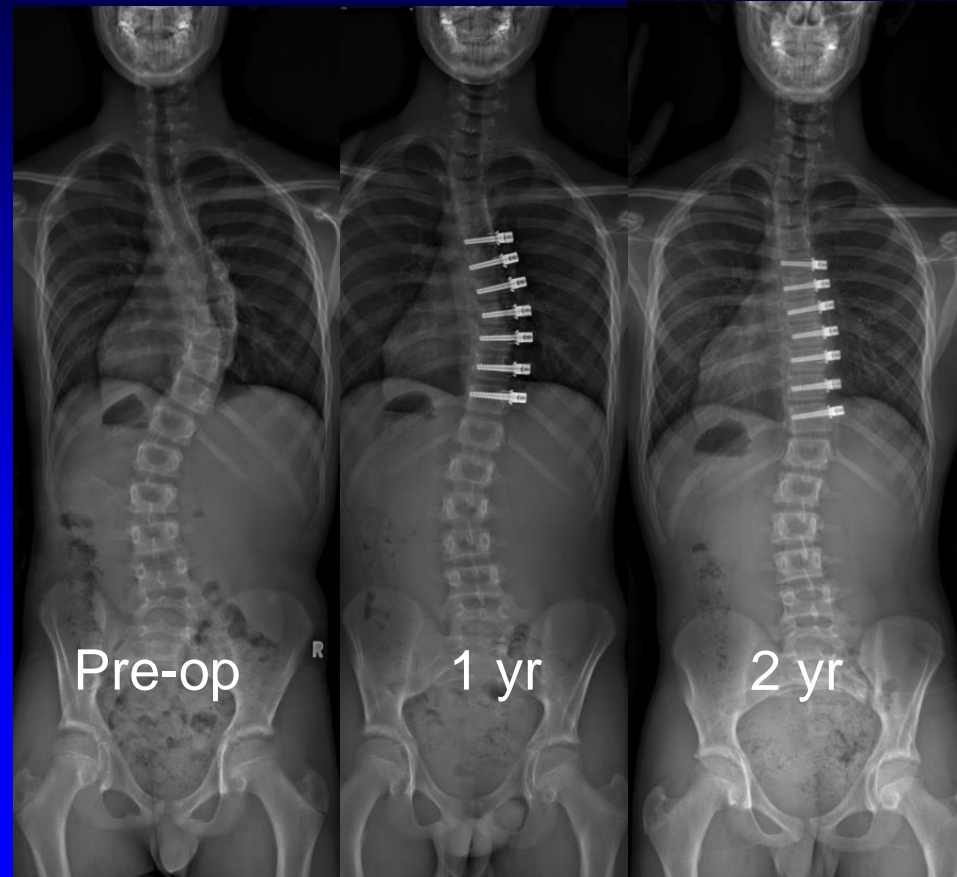


**Always easier than one previously treated
with growth sparing instrumentation**

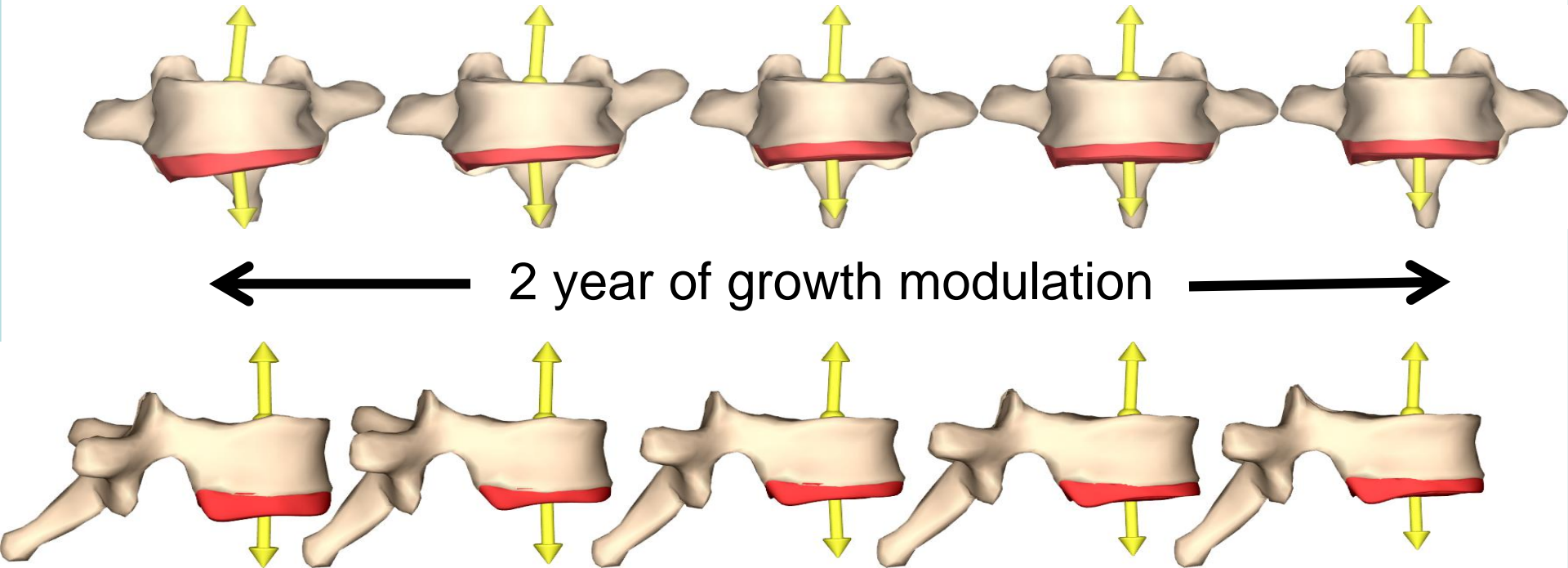


Anterior Spinal Growth Tethering

- **Maintains motion**
- **Modulate growth**
- **Heuter-Volkman**
- **Reshape vertebrae**
- **Requires real growth (2-3 years)**



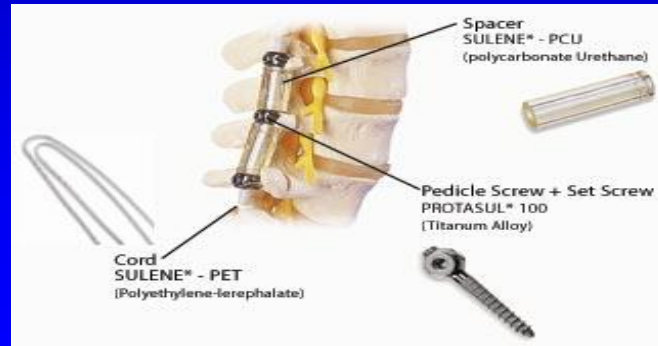
Apical Vertebra Shape Change



Clinical Anterior Tethering

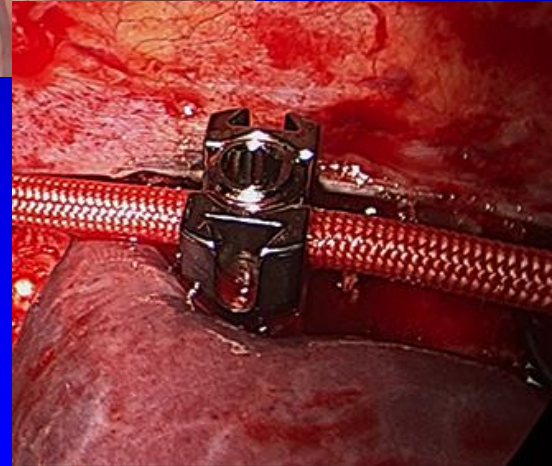
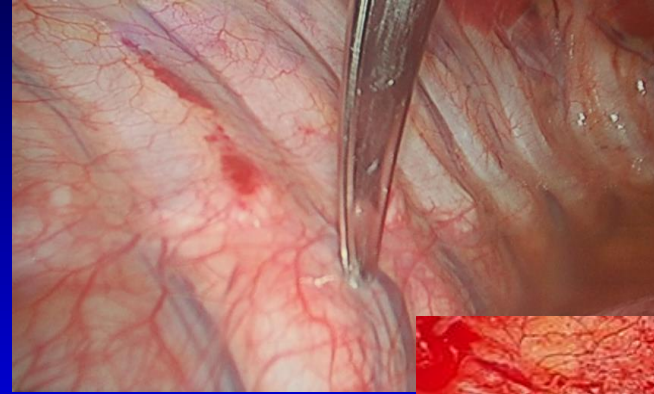
“Physician Directed Use” w/ 510k Cleared Device

- **Posterior Adult Lumbar system**
- **Cord and Screws used anteriorly**

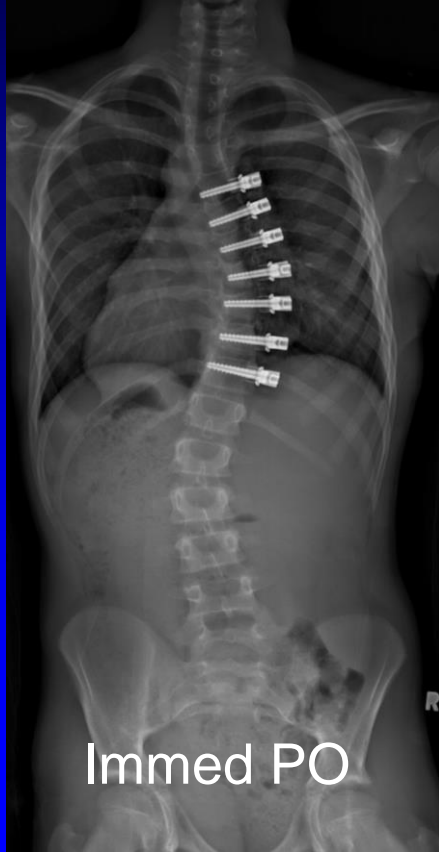


Thoracoscopic Approach

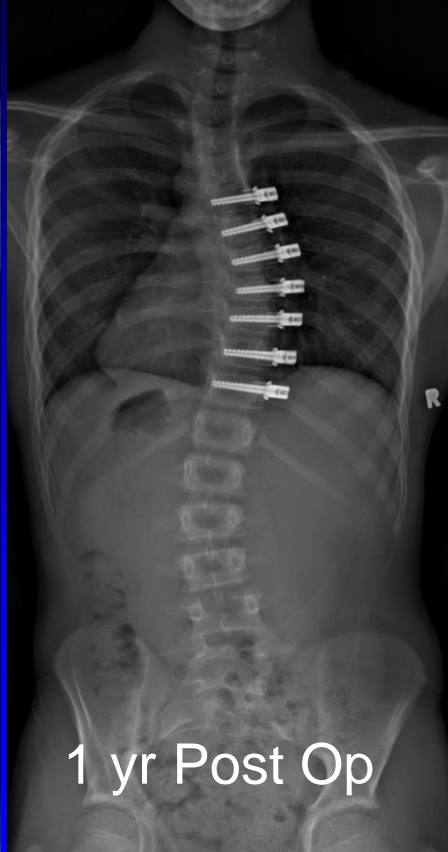
- **Single lung ventilation**
- **4 incisions (15mm)**
- **Divide segmental vessels**
- **Vertebral pronged staple & screw**
- **Tension the tether**



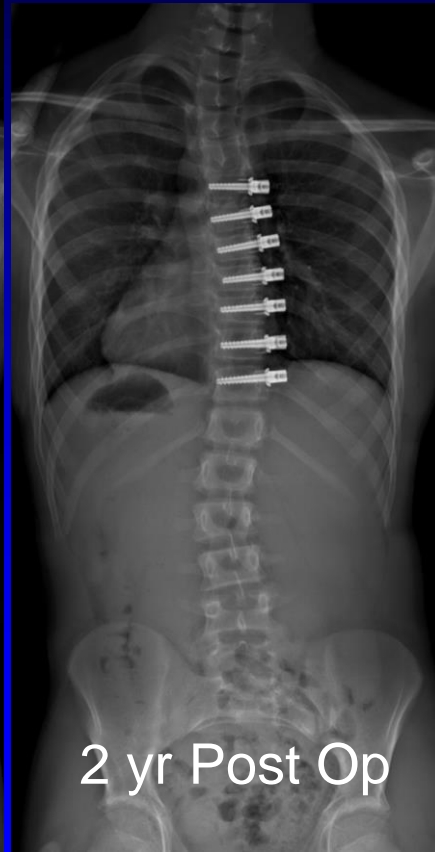
Results at/after Maturity



Immed PO



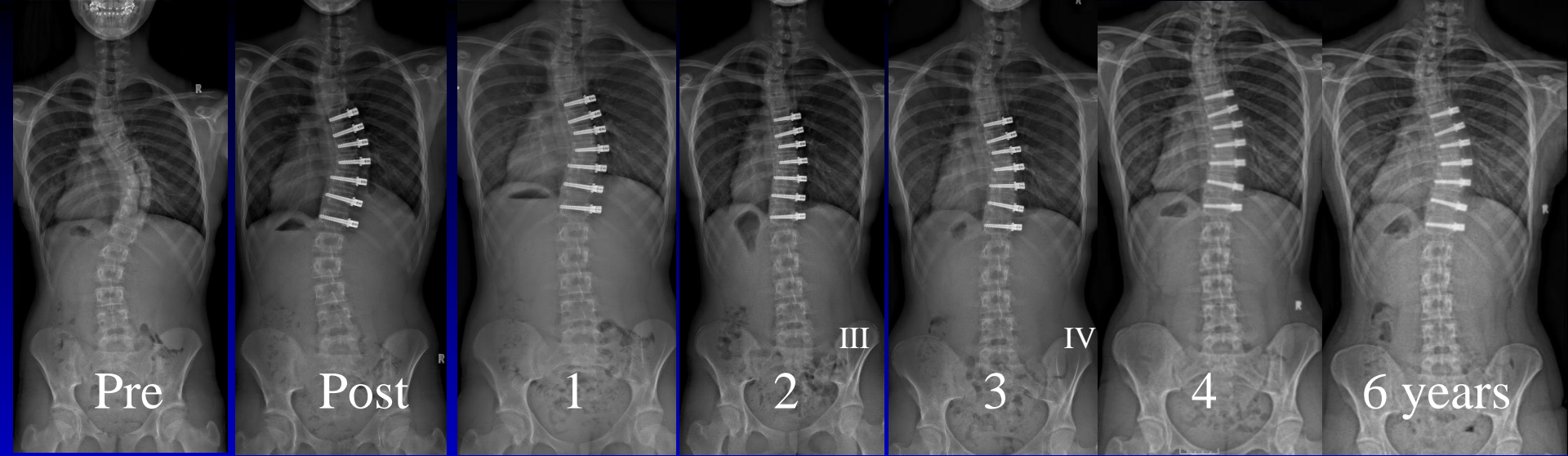
1 yr Post Op



2 yr Post Op



Maturity

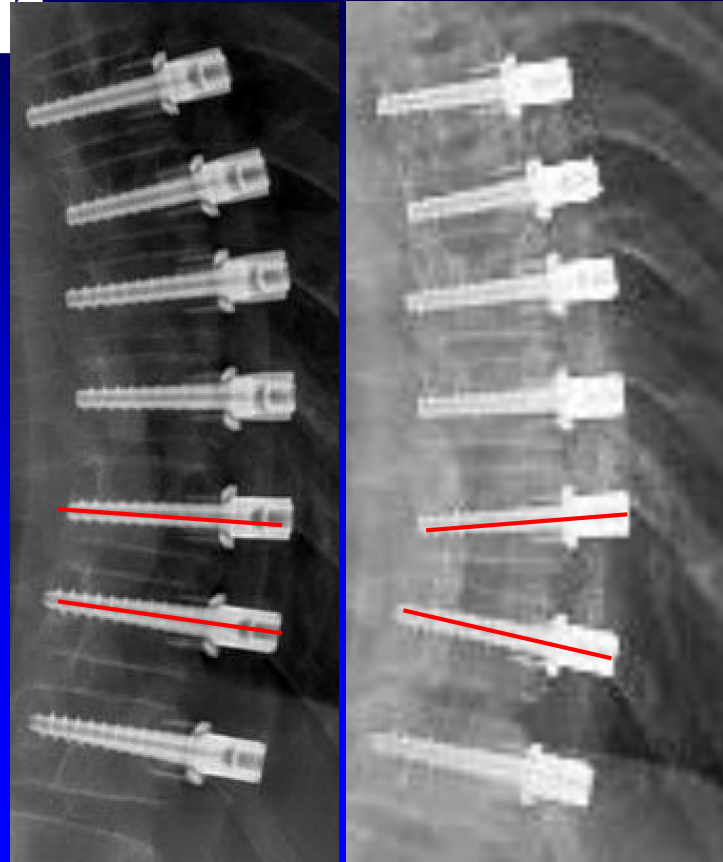
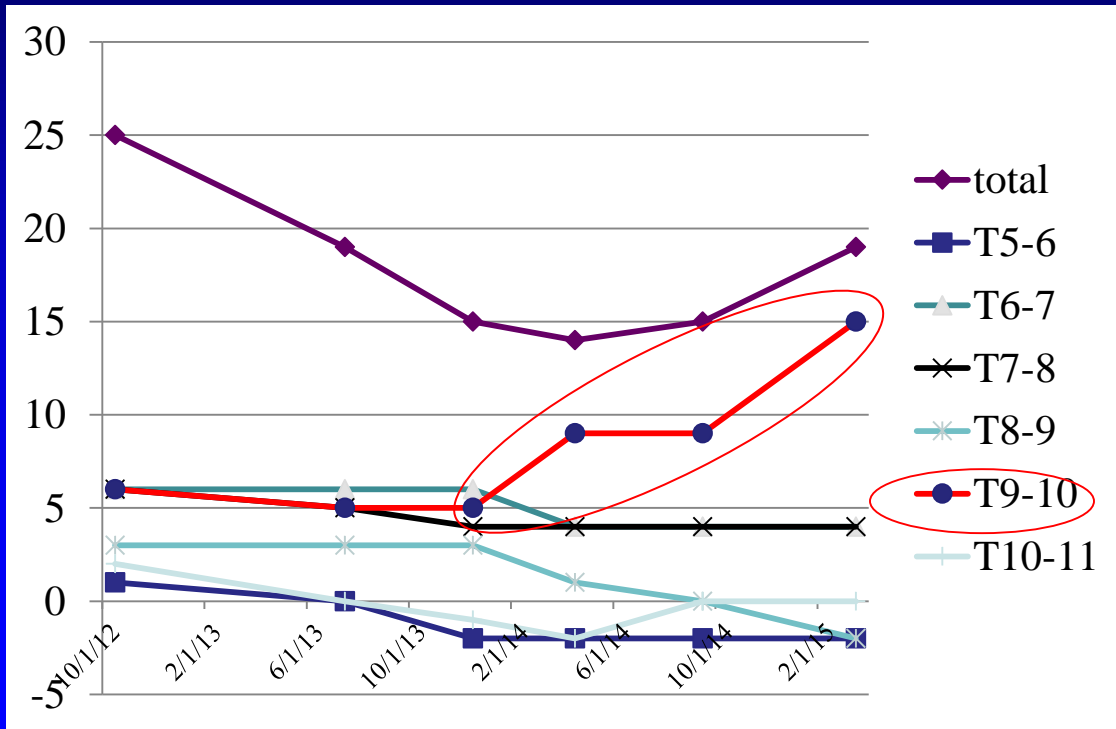


- **12 y/o F, Risser 0, closing TRC, 53° curve**
- **Modest loss of correction, starting at 2 yrs**
- **Broken tether near completion of growth**

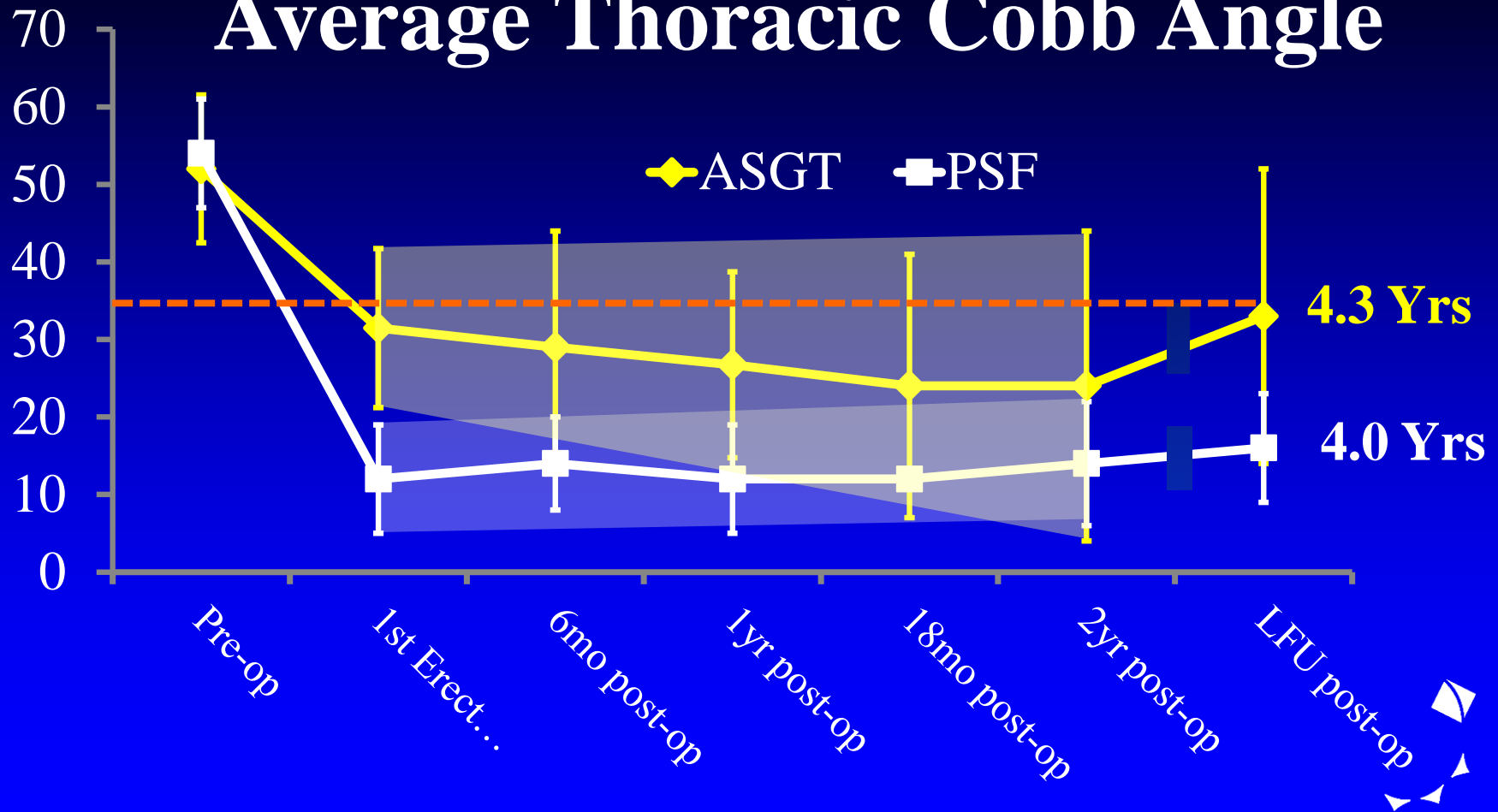


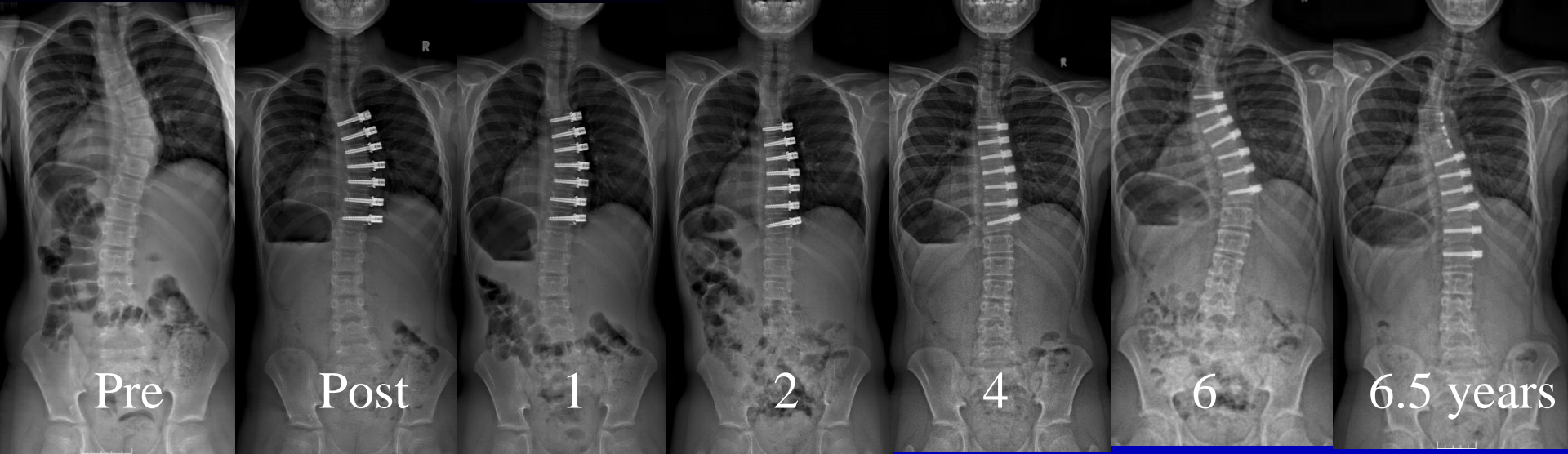
Segmental Angulation Changes

$>6^\circ$ = Broken tether



Average Thoracic Cobb Angle



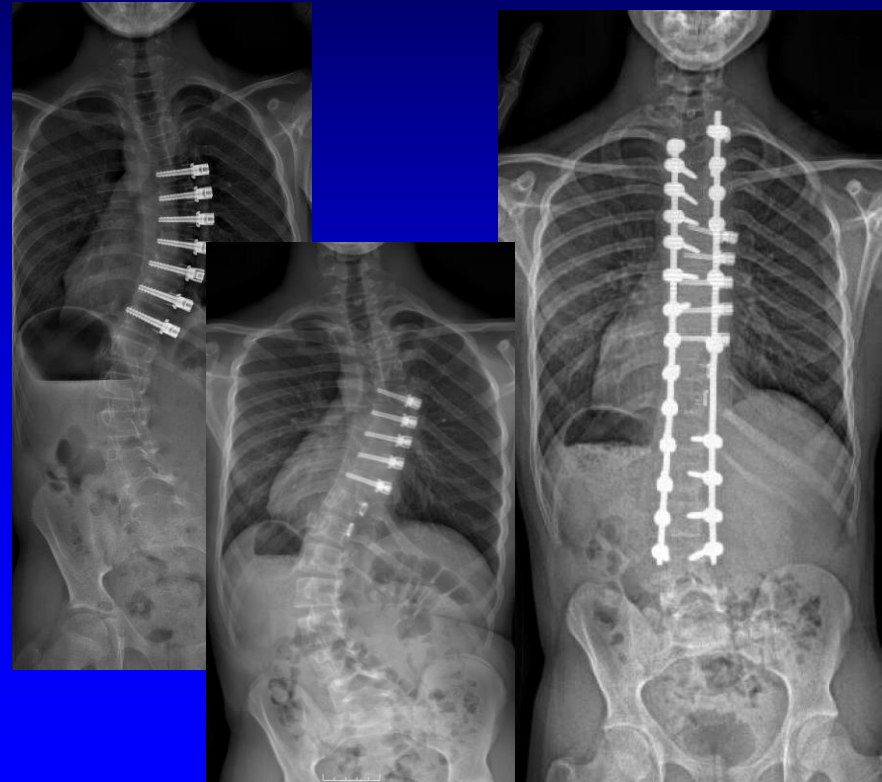


- **10 y/o male, very immature, Small curve**
- **Proximal overcorrection**
- **Distal adding on, broken tether (2 levels)**
- **Revised with partial removal and extended**

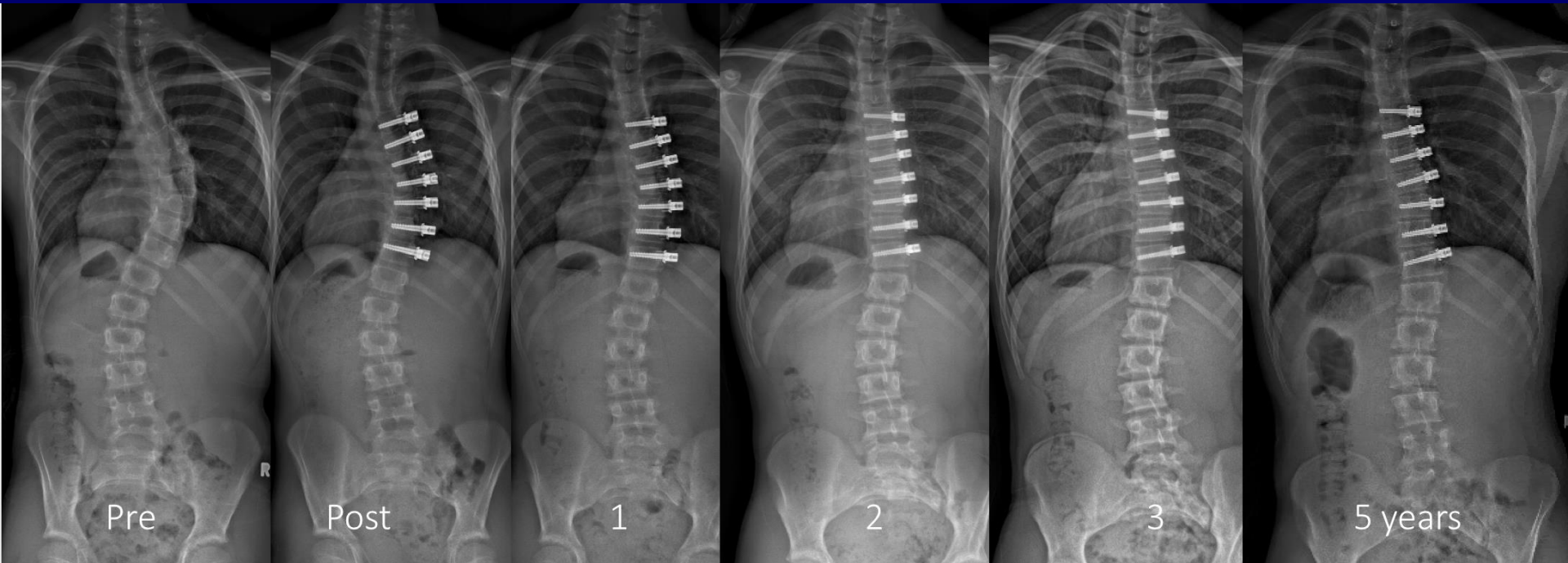


Not a “One & Done” for All

- **Risser 0, Open TRC cohort**
- **Early outcomes excellent**
- **4-6 yrs outcomes mixed**
- **53% required 2nd Surgery**
- **71% have avoided Fusion**
- **Tether failures common (not obvious)**



Some Outstanding...



Decision, Decisions

- **EOS is tough**
- **Often no perfect solution**
- **Buy time, even if it's hard**
- **Choose wisely with an eye on the final solution**



**Make the first procedure
count!**

**There is only one first time!
(especially from the back)**

