Management of the Complex: Too Much Kyphosis

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Disclosures

- **K2M/Stryker – Consultant, Royalties, Speaker Bureau**
- **Depuy Synthes - Consultant, Speaker Bureau**
- **Nuvasive - Consultant, Royalties, Speaker Bureau**
- **Biogen – Consultant**
- **Orthopediatrics – Royalties**
- **Globus - Royalties**

Why is Kyphosis Important

- **Increased risk of PJK**
  1. El-Hawary et al. - Hyperkyphosis → risk ratio 2.8 for PJK
  2. Watanabe et al. - PJK risk → thoracic kyphosis > 60^{o}, shorter instrumentation, large scoliosis

- El-Hawary et al. “What is the risk of developing PJK during growth friendly treatments for EOS” J Pediatr Orthop 2017 37(2):86-91
- Watanabe et al. “Risk Factors for PJK associated with dual rod GR for EOS” Clin Spine Surg 2016 29(8):e428-33

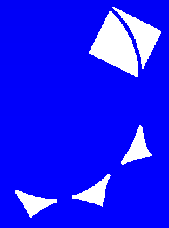
Kyphosis and Complications

- **Increased risk of rod fracture and implant pullout**
  - Chen et al. - Compared NL to Hyperkyphosis (> 50º) → Greater rod fracture and PJK
  - Schroerlucke et al. - Hyperkyphosis (> 40º) → increased implant complication
    - Complications increased linearly with increasing kyphosis
    - Rod breakage most common

- Chen et al. "How does hyperkyphotic early onset-scoliosis respond to GR treatement. J Pediatr Orthop 2017 37(8):e593-598
- Schroerlucke et al. "How does thoracic kyphosis affect patient outcomes in GR surgery" Spine 2012 37(15):133-9

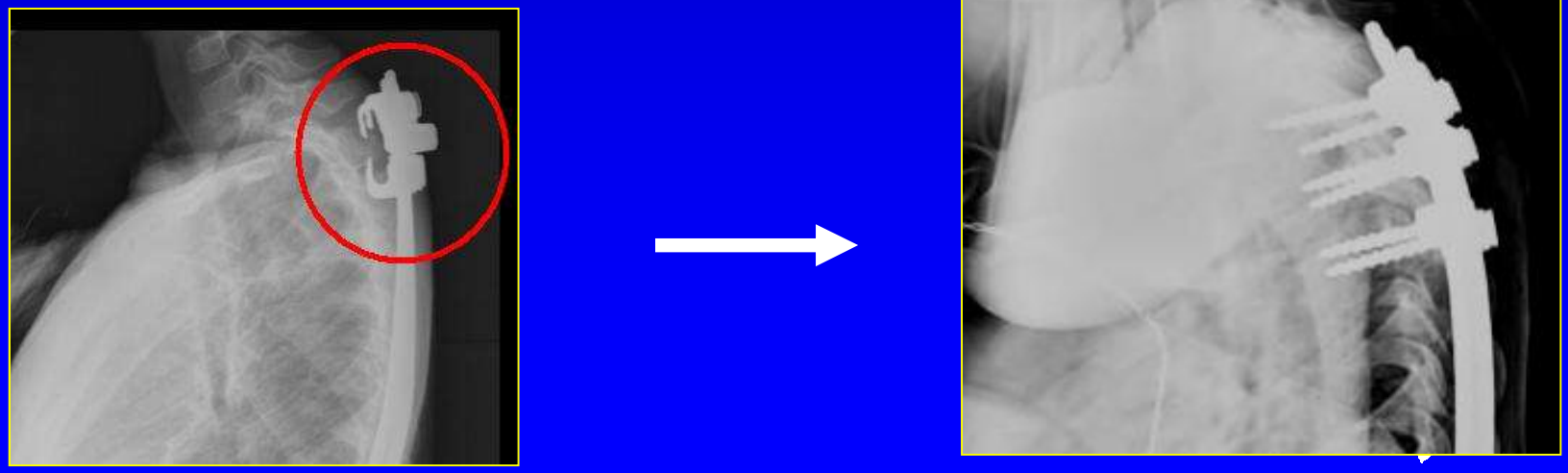
What are the options?

1. **Increase anchor density**
2. **Preoperative traction +/- staged anchor implantation**
3. **Implant → smaller or more contourable**
4. **Change Growth Friendly method**

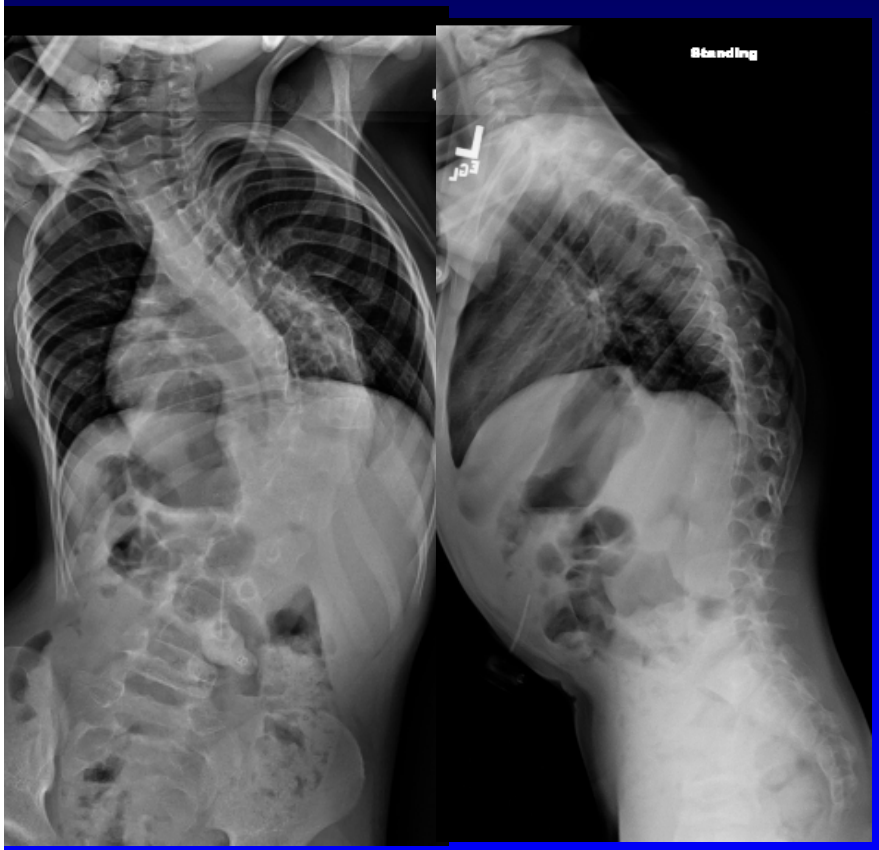


Anchor Density

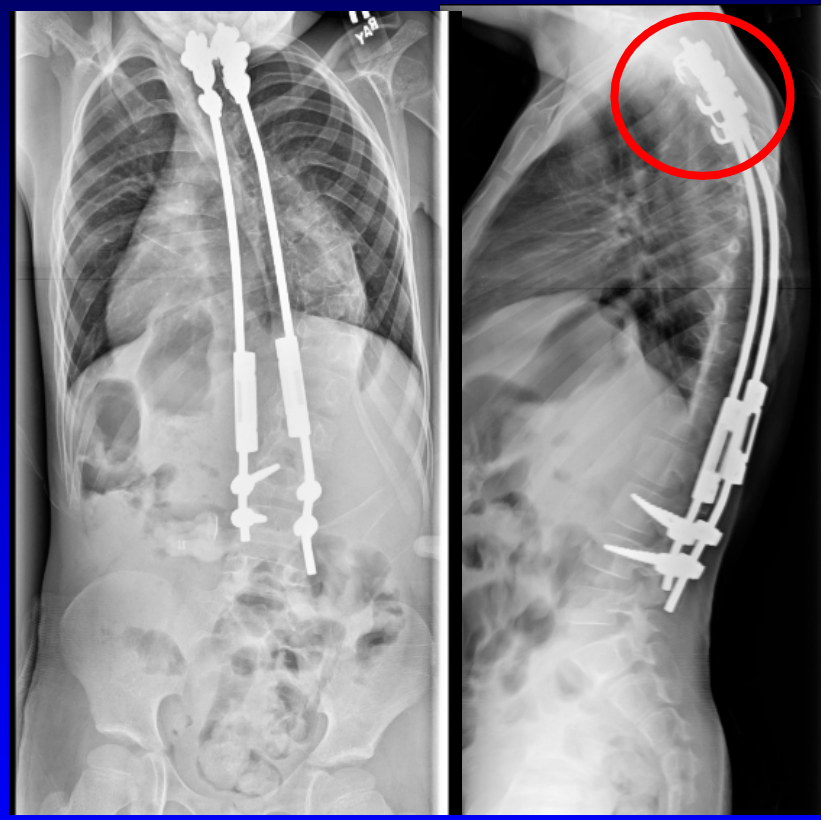
- **Pull out typically requires revision**
- **Harris, Andras et al. "Proximal Anchor Constructs in EOS Treated with GF Implants" – EPOSNA 2017**
  - > 5 anchors → less pull out



Anchor Density



Hyperkyphosis and + sagittal balance



Consider anchor supplementation

Traction + Staged Implantation

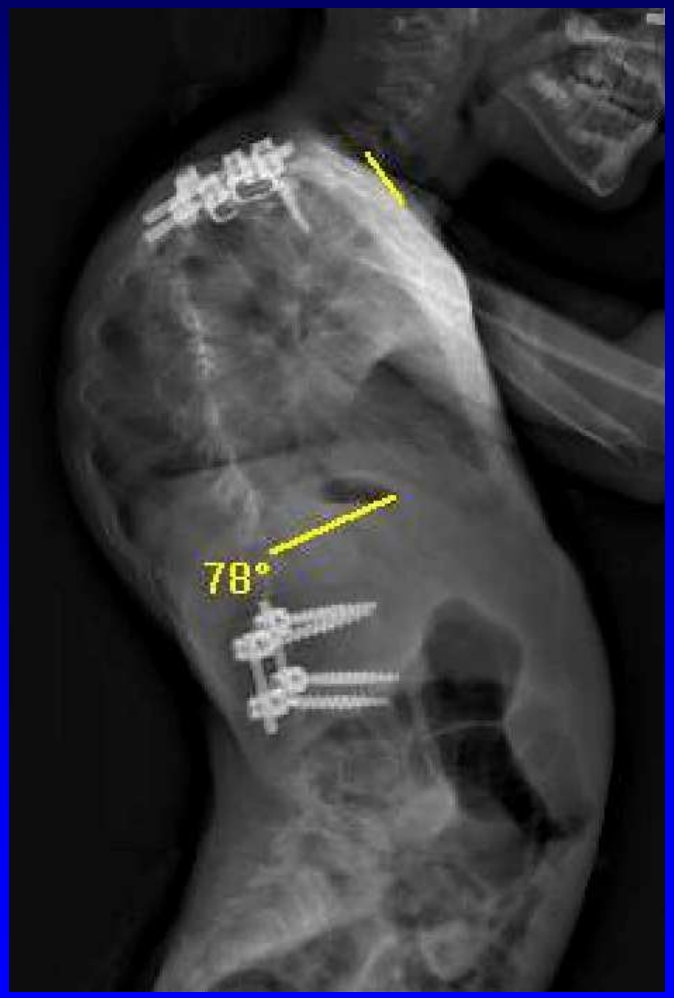
- **Scheflaut et al. -** 15 pts – mean f/u 49.5 mo
  - Hyperkyphosis (11/15) – 71^{o} to 46^{o}
  - No anchor migration or pull out

- **Gomez et al. -** 8 pts – mean f/u 4.9 yrs
  - Indications - poor bone and neurologic changes
  - Halo-gravity traction between stages
  - No instrumentation-bone failure

- Scheflaut et al. “Staged insertion of growing rods in severe scoliosis” Eur Spine J 2018 27(9):2203-2212
- Gomez et al. “Staged growing rods with preimplantation of spinal anchors for complex EOS” J Pediatr Orthop 2017 37(8):E606-611

6 yo with unknown CTD

Stage 1 – Anchors/Halo



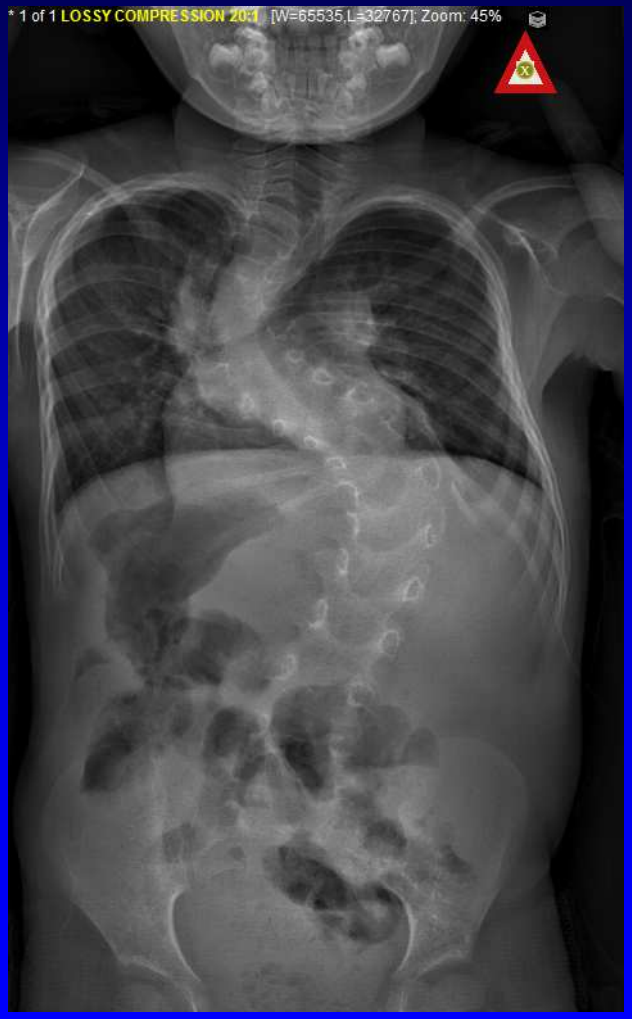
8 week traction

Staged Anchors + Traction

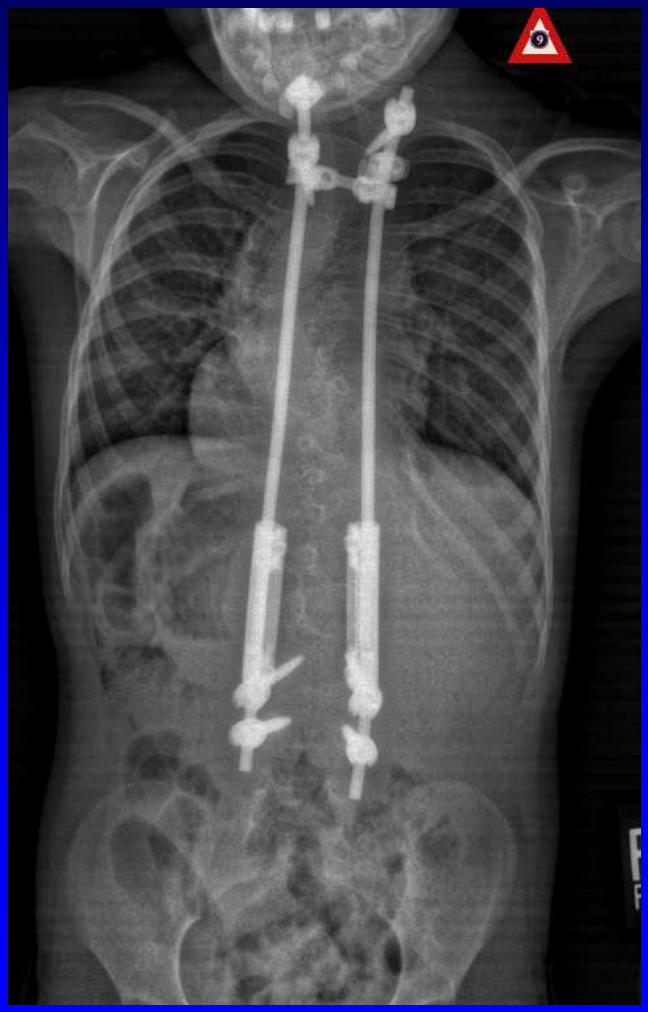
A Case for TGR

- **Varley, Yaszay et al. "The role of traditional growing rods in the ERA of MCGR for the treatment of EOS " SRS 2018**
  - 25 TGR vs MCGR – kyphosis indication in 11
  - Avg kyphosis – TGR 71^{o} vs MCGR 55^{o}

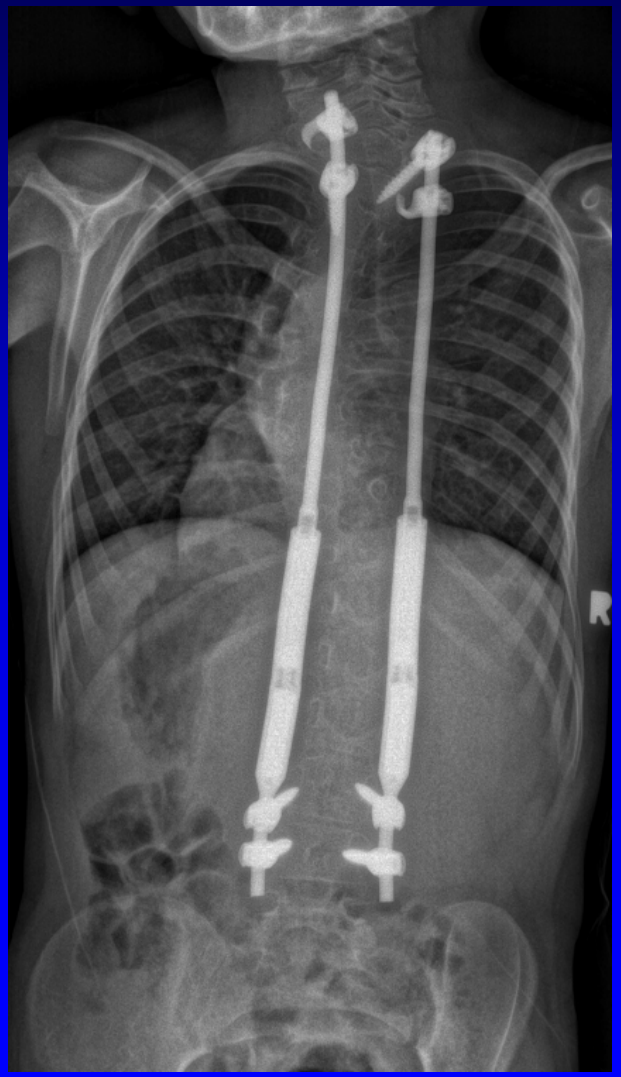
5 yo with chromosomal abnl

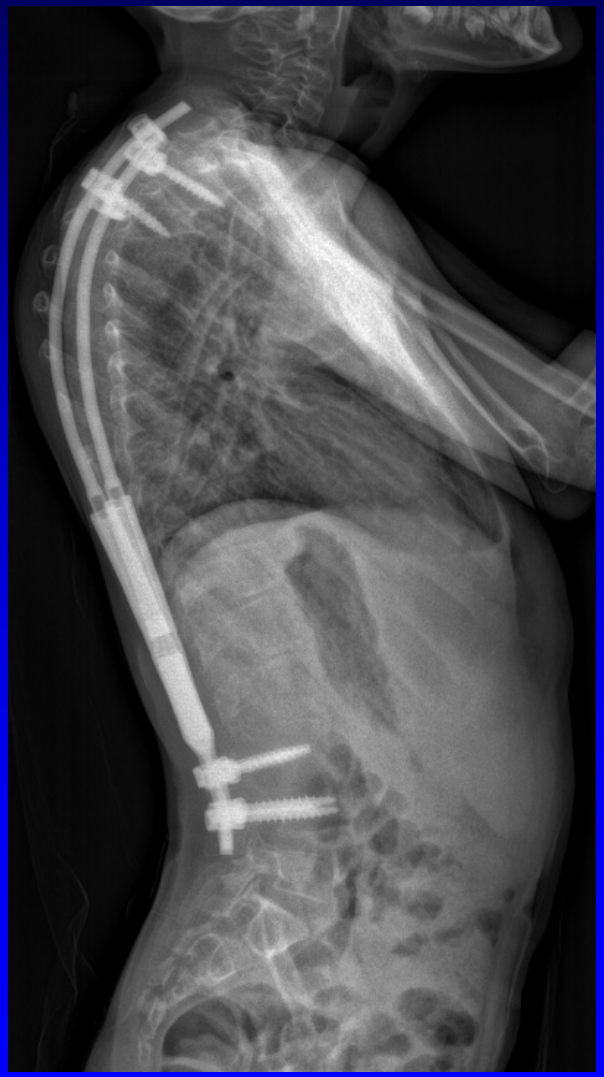


TGR



MCGR



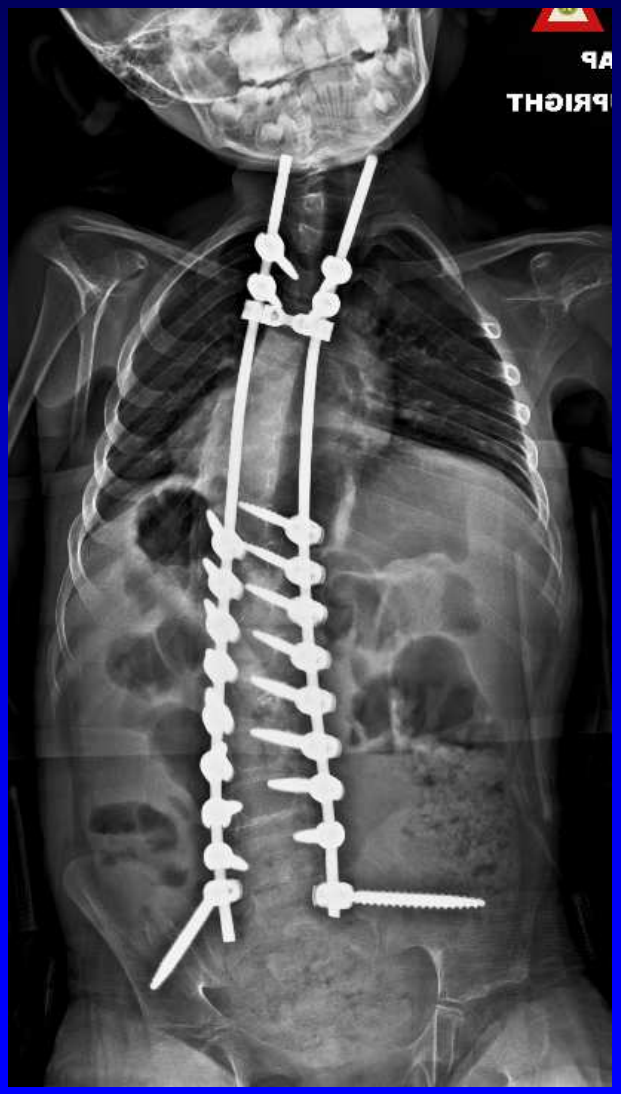


Alternative Growth Friendly Methods

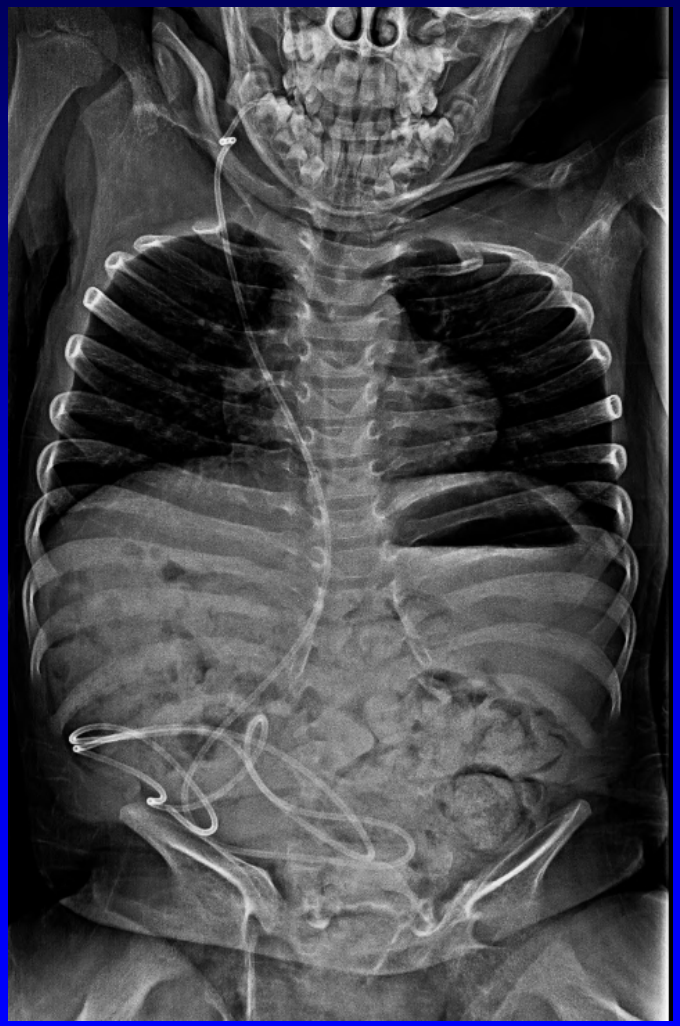
- **Attempt to control or correct kyphosis**
  - Shilla technique
  - Fusion
  - Osteotomies - VCR

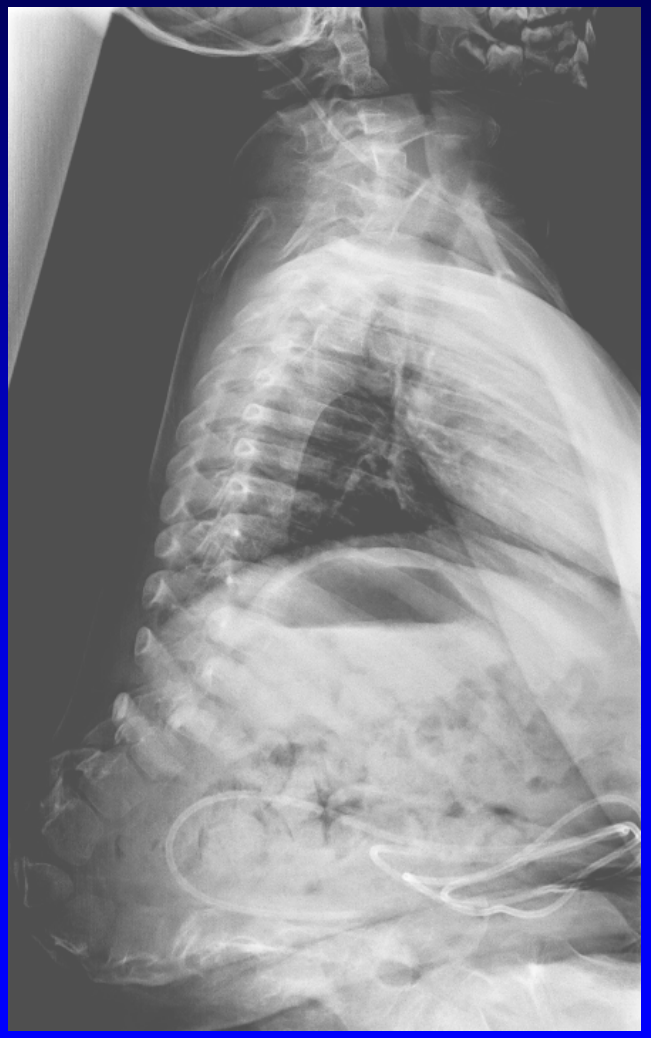
8 yo with CMD

Shilla Technique

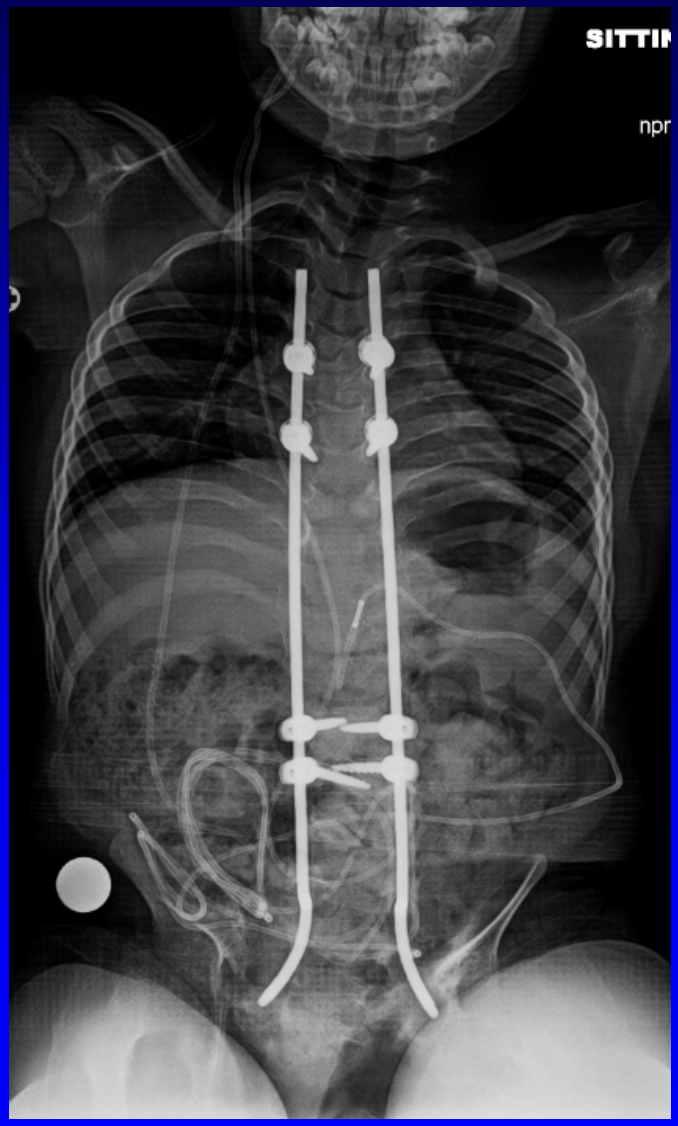


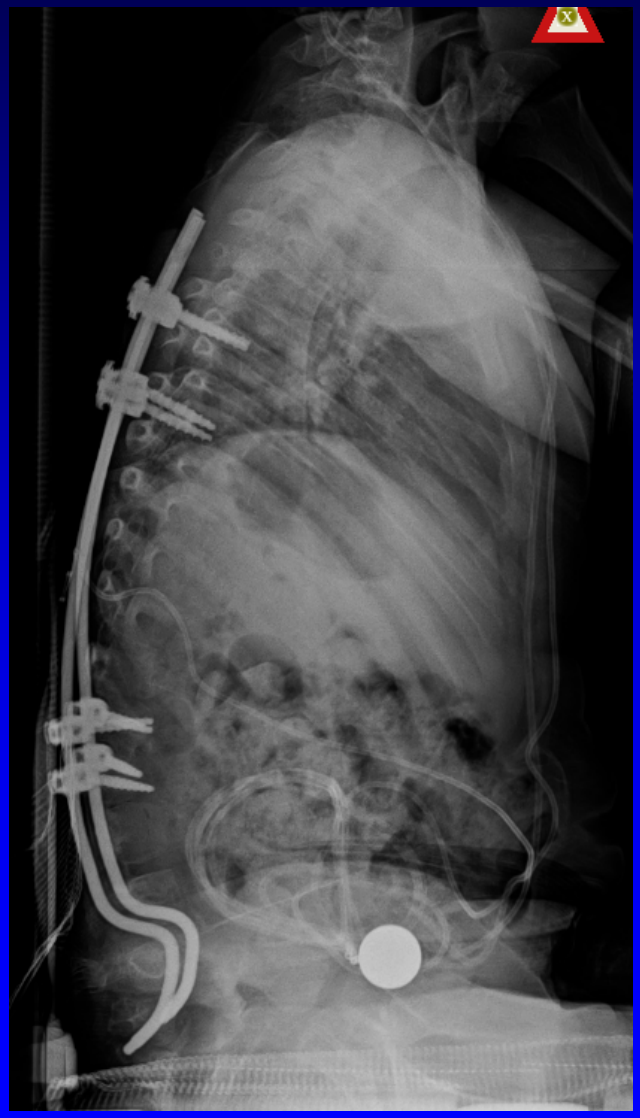
5 yo with spina bifida



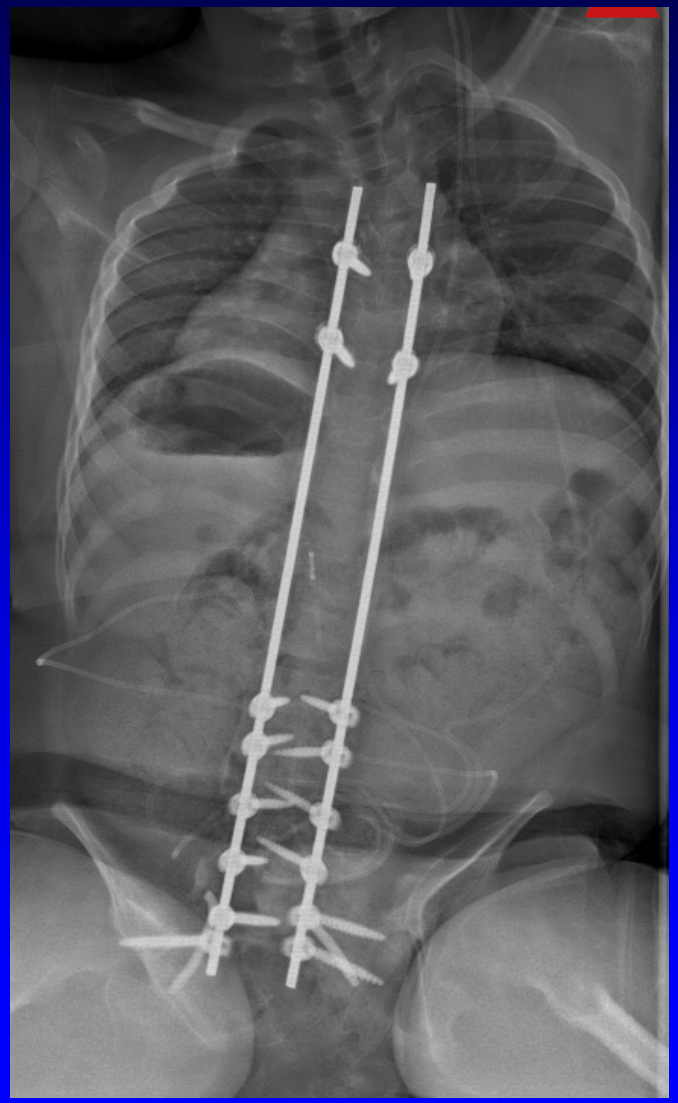


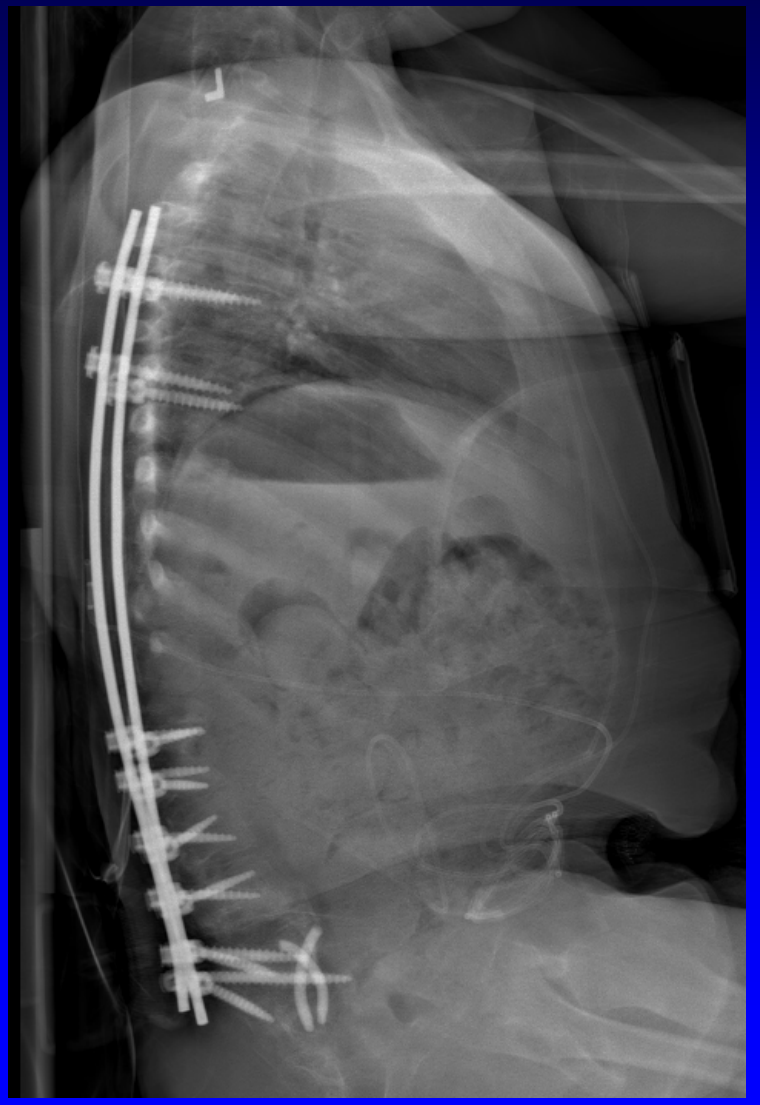
Kyphectomy + Shilla



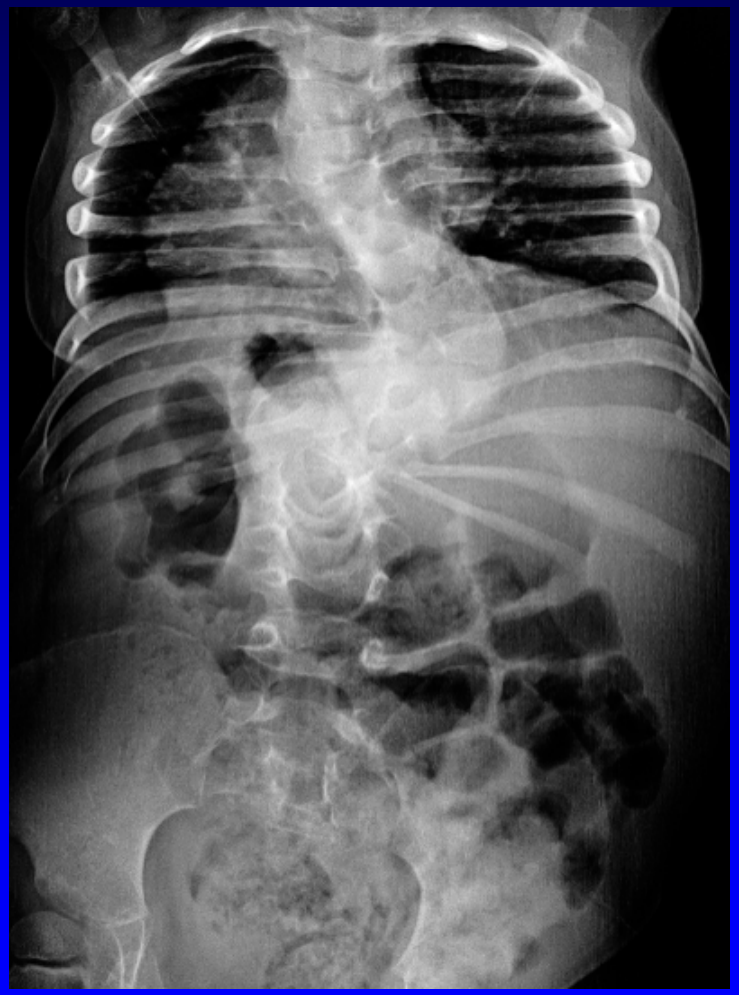


Revision x 1 for broken rods



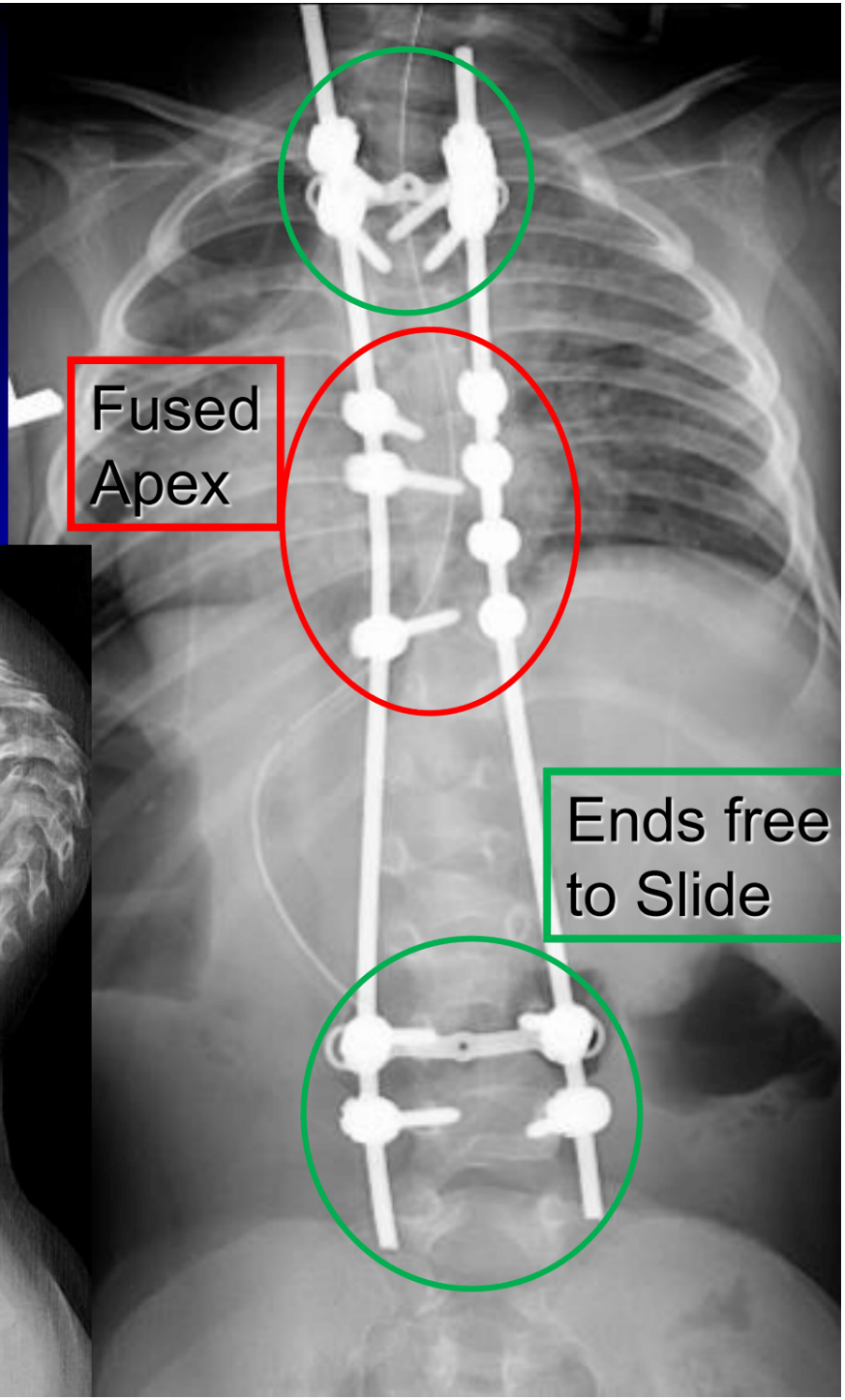


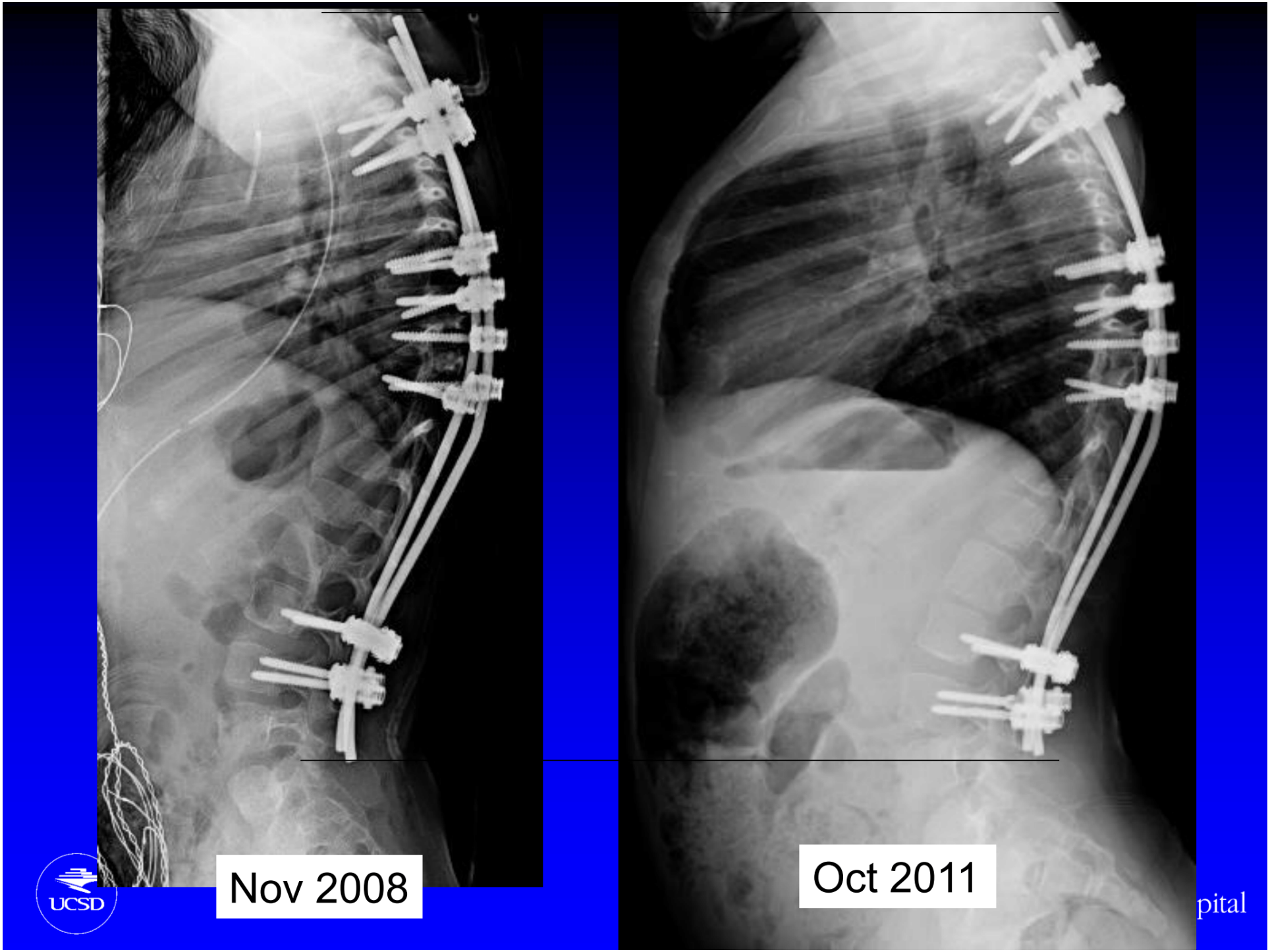
4 yo with Conradi Hunermann Syndrome



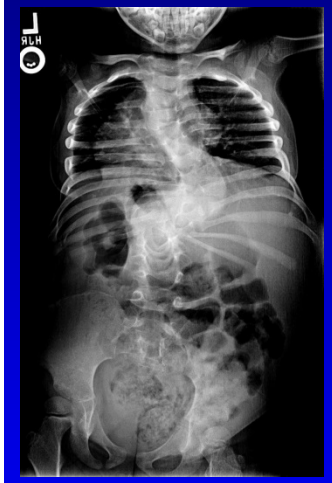
Courtesy of Peter Newton

Apical Fusion/VCR, Growth Guidance "Shilla"



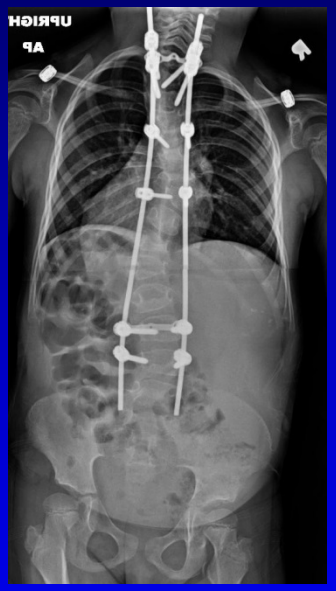

Nov 2008
Oct 2011
pital

Apical VCR + “Shilla”

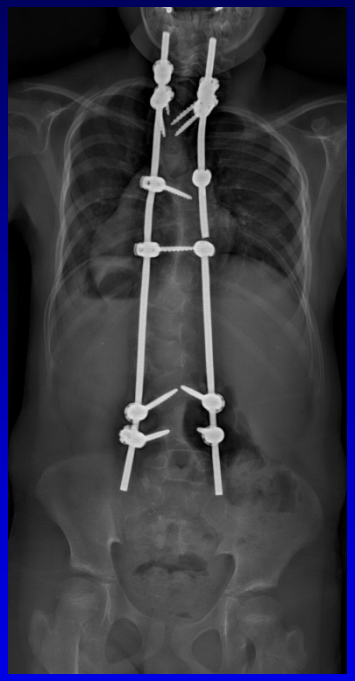


4 years old

4.5 years



7 years



11 years

Final Fusion
13 years

Conclusion

- **To Much Kyphosis**
  1. Increase anchor density (> 5)
  2. Preoperative traction +/- staged anchor implantation
  3. Implant → smaller or more contourable
  4. Change Growth Friendly method