

Management of the Complex: How to Approach the Complex Patients and Problems in EOS

Proximal Junctional Kyphosis with Anchor Failure

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November 22, 2019

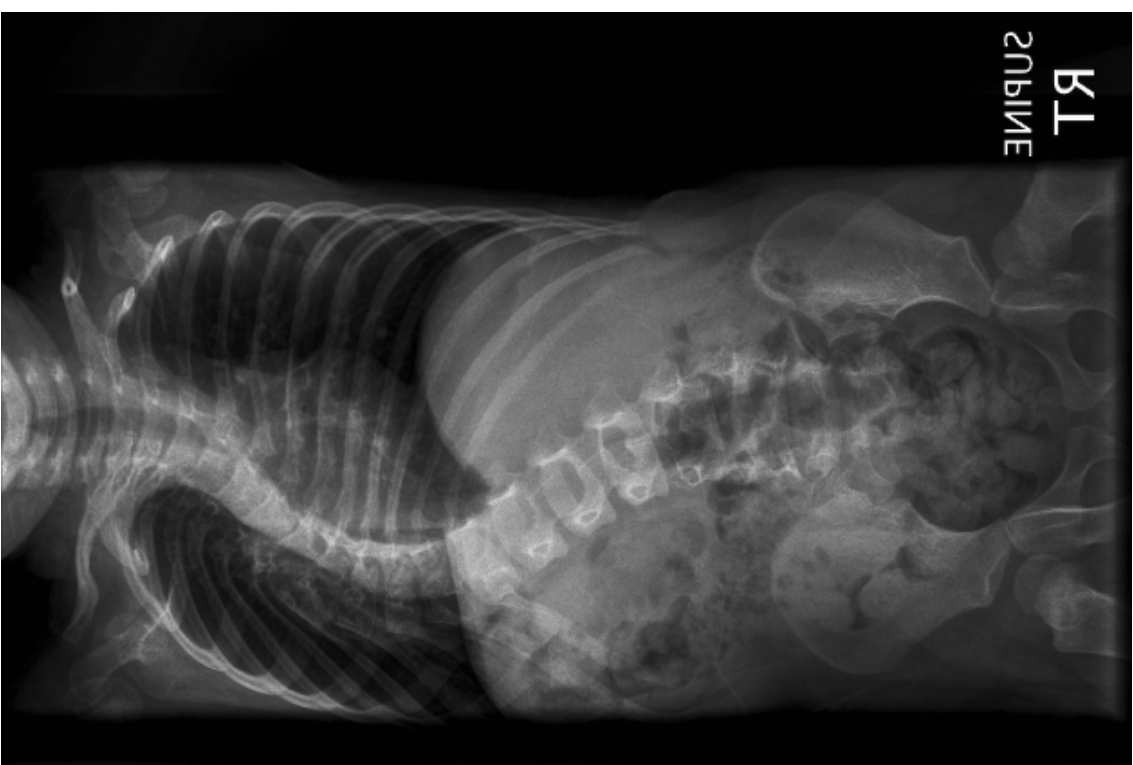


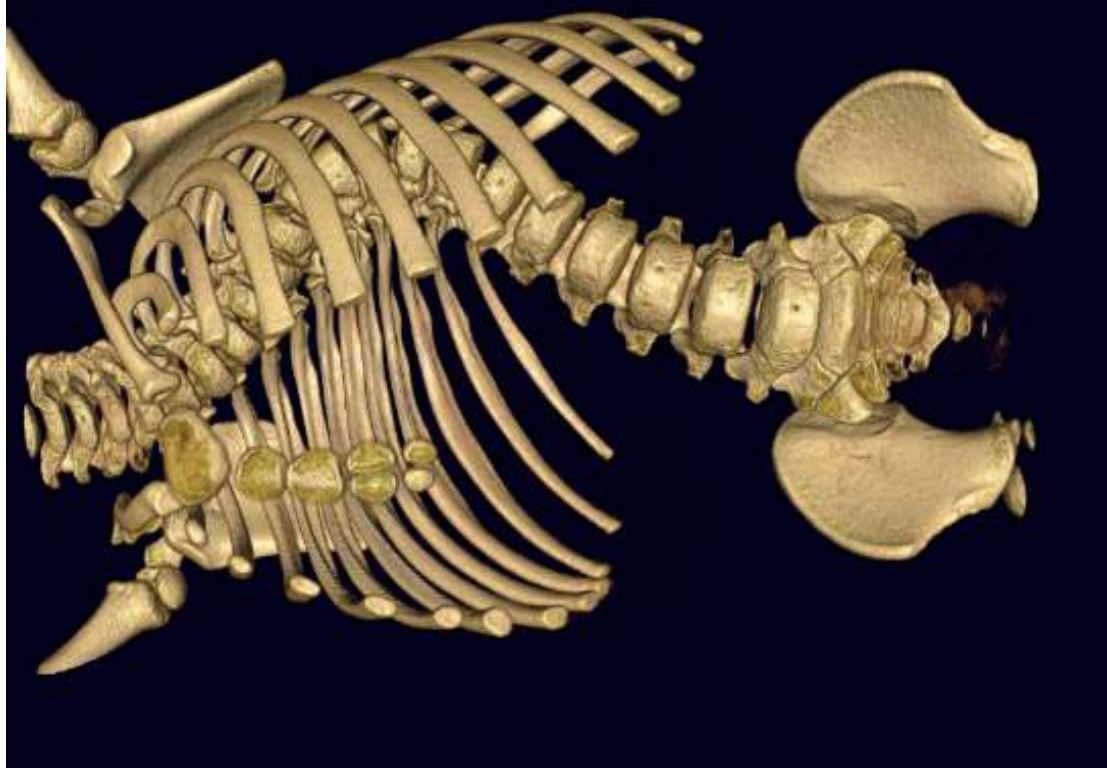
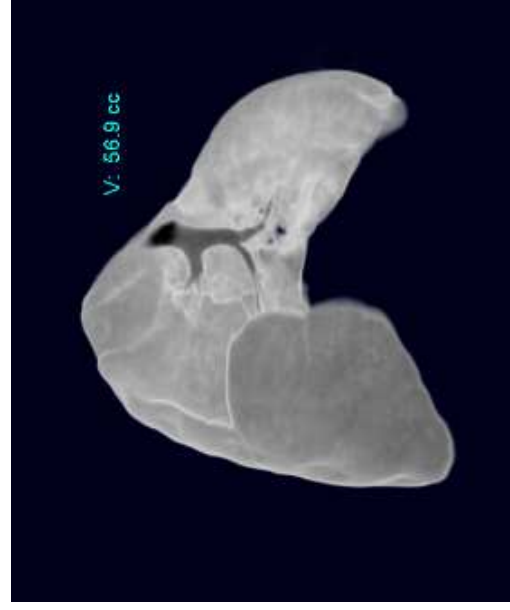
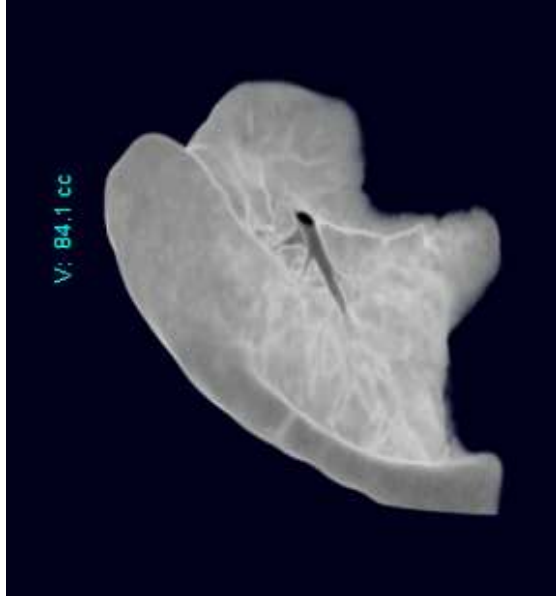
Disclosures

- Grants / Research Support
 - Depuy-Synthes Spine
 - Medtronic Canada
 - Joint Solutions
 - EOS Imaging
- Consultant
 - Depuy-Synthes Spine
 - Medtronic Canada
 - Apifix Ltd.
 - Wishbone Medical
 - Globus Medical

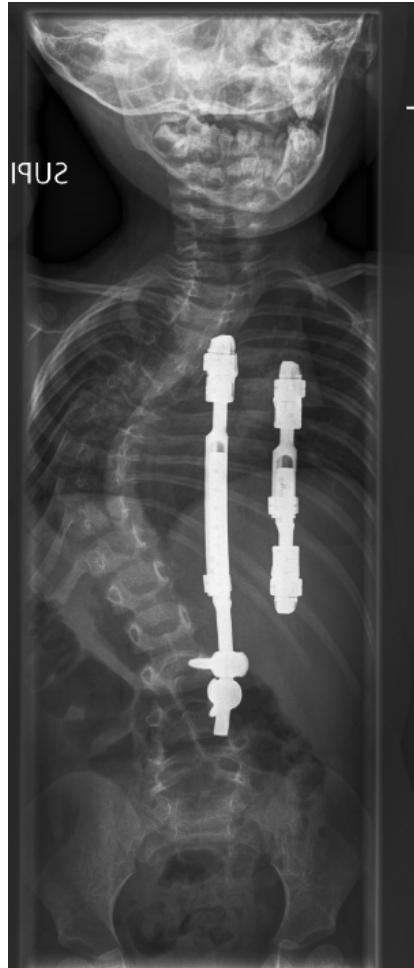
2008 – 2 Year Old Girl with Infantile Idiopathic Scoliosis



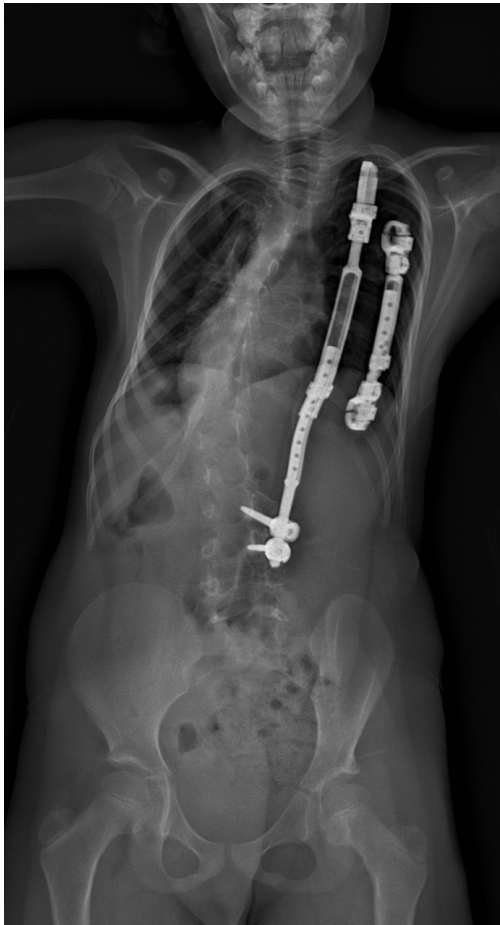


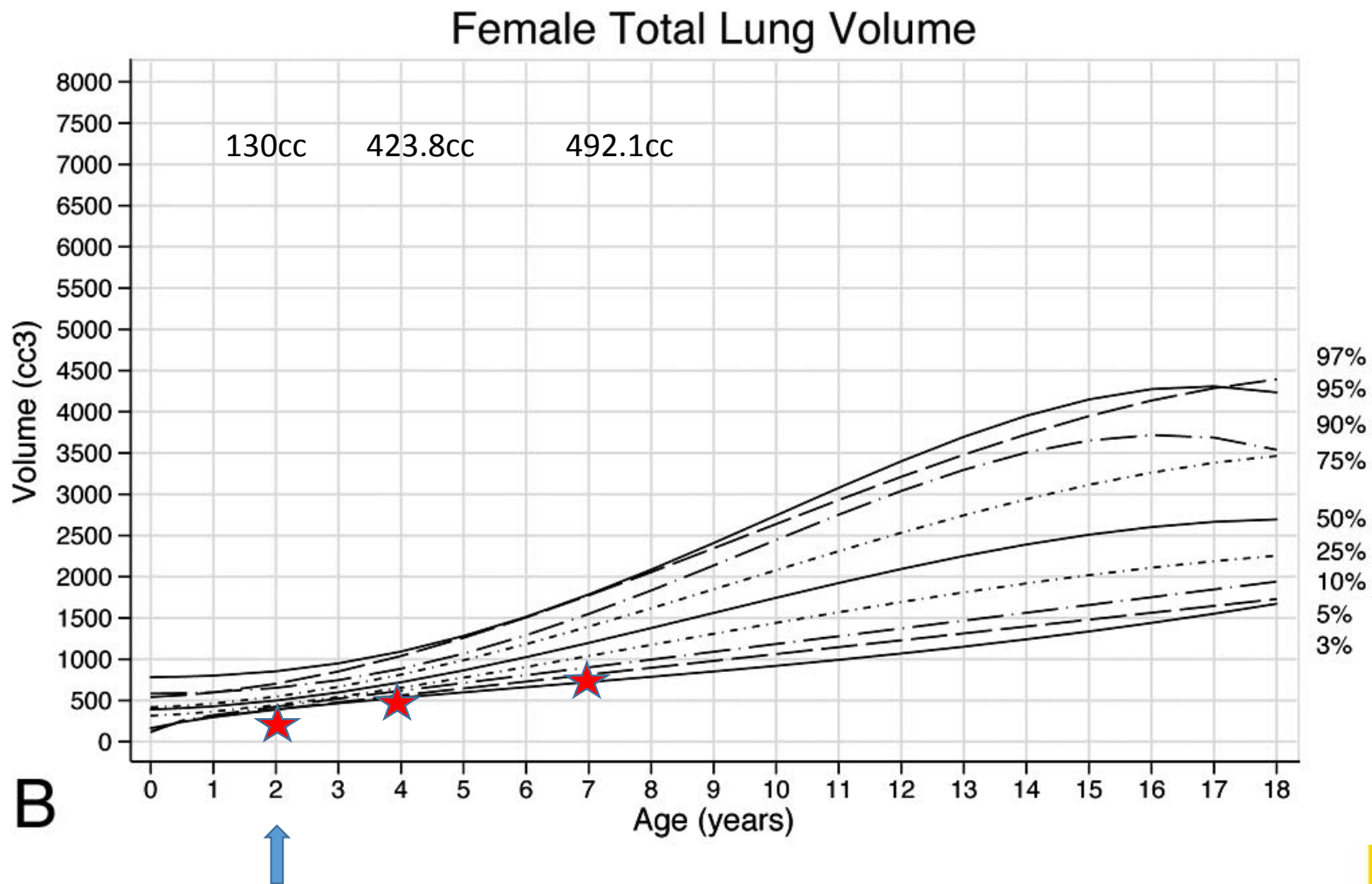


2008

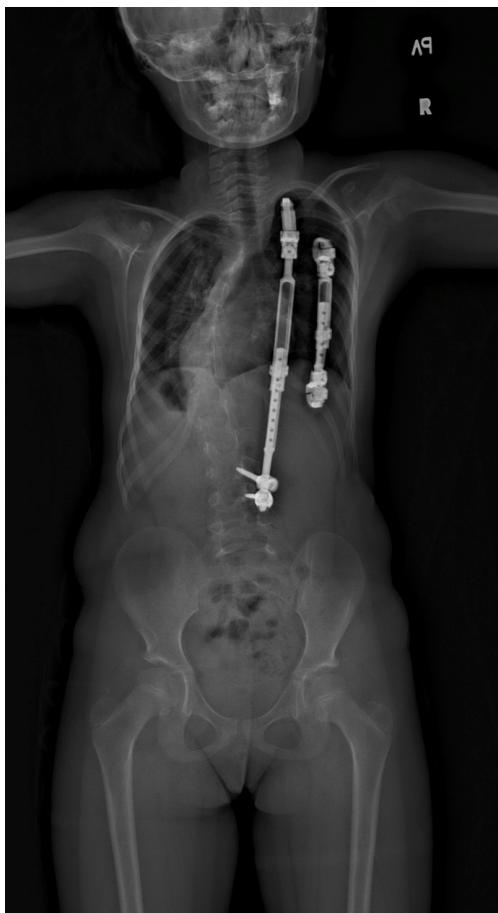


December 2013



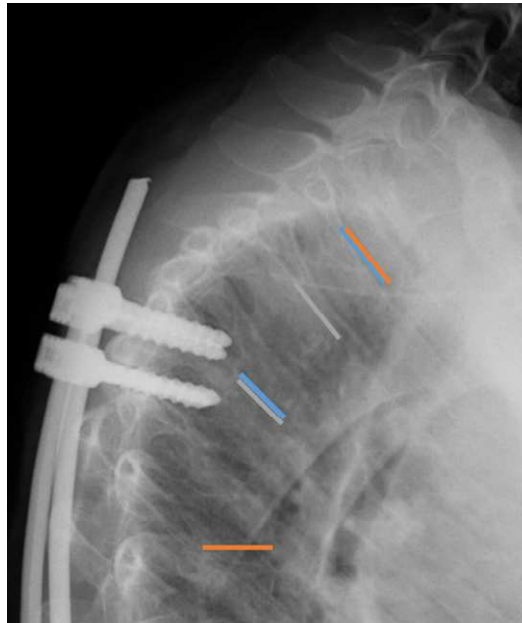


August 2014



General Definition of PJK

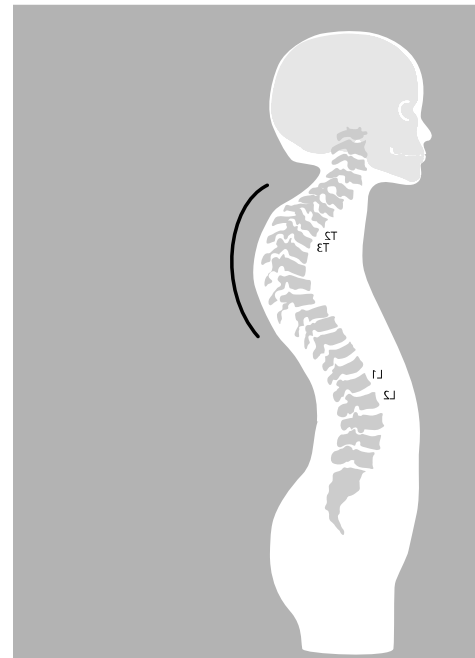
- Non-physiologic, sagittal plane angulation that occurs cephalad to an instrumented spine.



What is the Risk of Developing Proximal Junctional Kyphosis During Growth Friendly Treatments for Early-onset Scoliosis?

Ron El-Hawary, MD, MSc, FRCSC, Peter Sturm, MD,† Patrick Cahill, MD,‡
Amer Samdani, MD,‡ Michael Vitale, MD, MPH,§ Peter Gabos, MD,|| Nathan Bodin, MD,¶
Charles d'Amato, MD,# Colin Harris, MD,** Ammar Al Khudairy, MBChB, MRCSI, MCh,*
and John T. Smith, MD††*

- Subjects with PJK (Pre-Insertion)
 - Older Age
 - Higher Thoracic Kyphosis

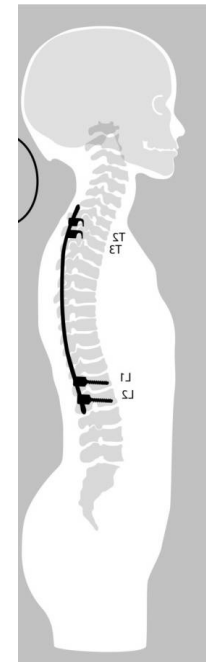


JPO 2015

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- Subjects with PJK (Post-Insertion)
 - Increased Cervical Lordosis
 - Normal Thoracic Kyphosis

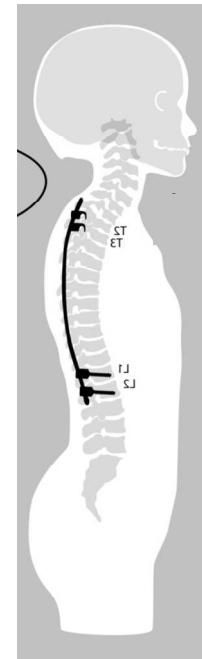


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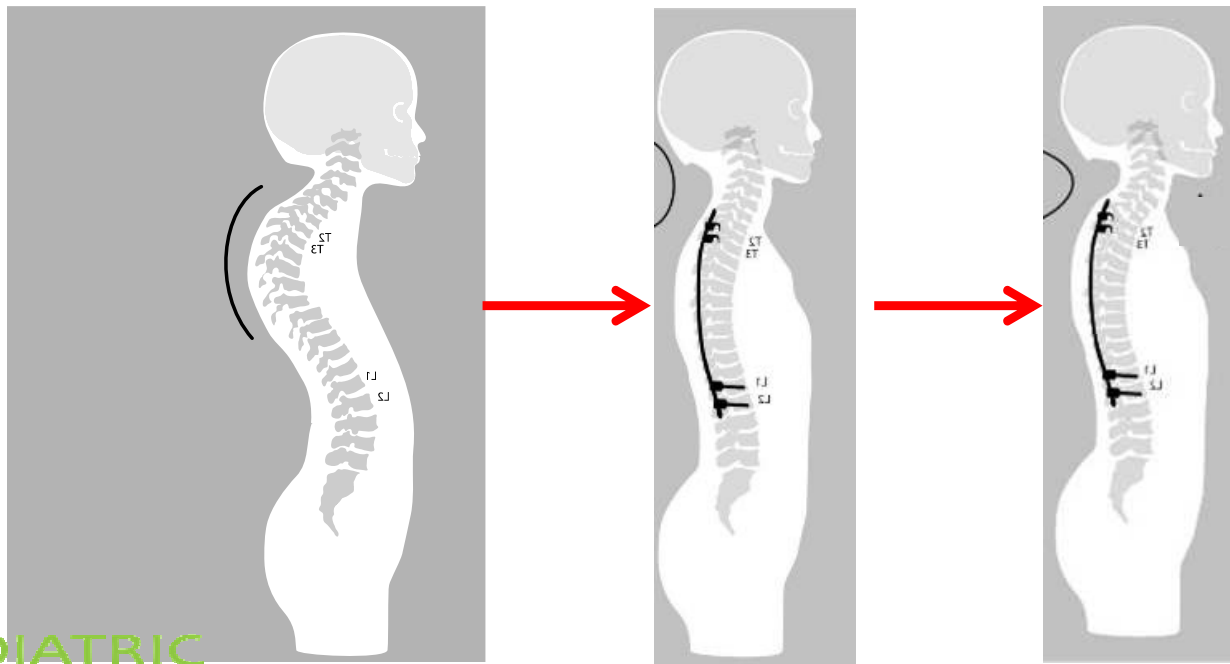
- Subjects with PJK (Final Follow Up)
 - Increased Cervical Lordosis / Increased PJA
 - Normal Thoracic Kyphosis / Increase +SVA



JPO 2015

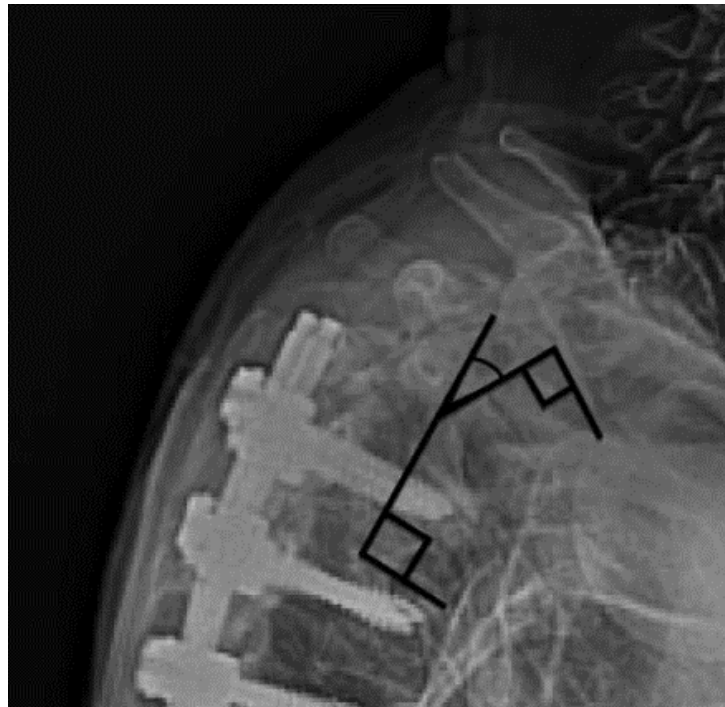
Pre-Operative Hyperkyphosis

- Subjects with PJK



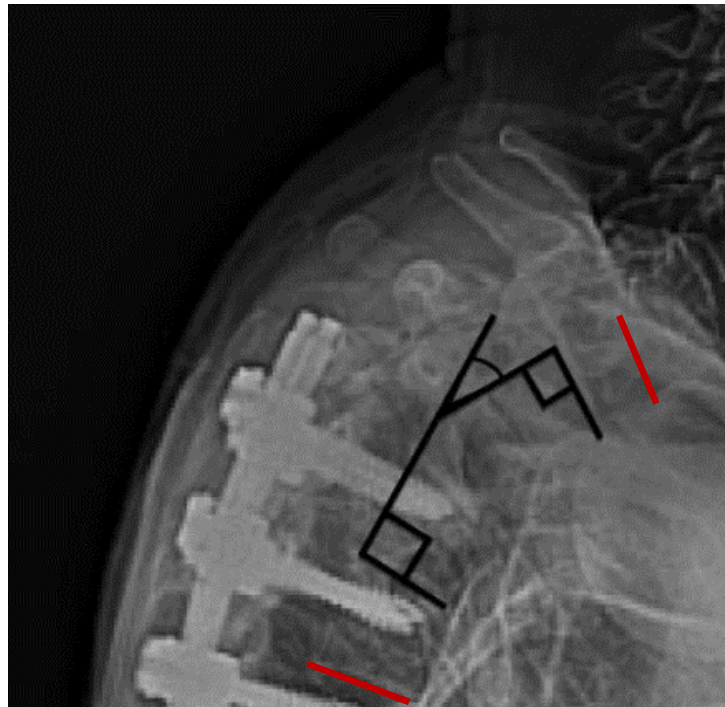
Definition of PJK

- Abnormal Proximal Junctional Kyphosis
 - $PJA \geq 10^\circ$ and at least 10° greater than pre-operative



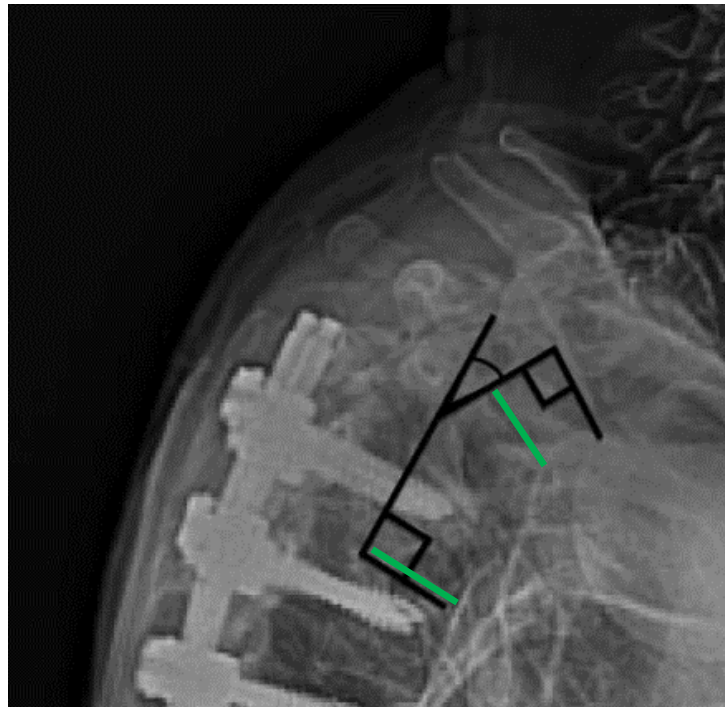
Other Definitions of PJK

- Abnormal Proximal Junctional Kyphosis
 - PJA (2 below UIV and 2 levels cephalad UIV) $>10^\circ$ and at least 10° greater than pre-operative.



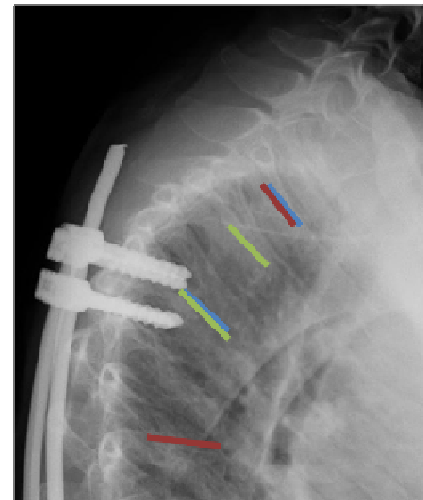
Other Definitions of PJK

- Abnormal Proximal Junctional Kyphosis
 - PJA (UIV to one level cephalad to UIV) $> 20^\circ$



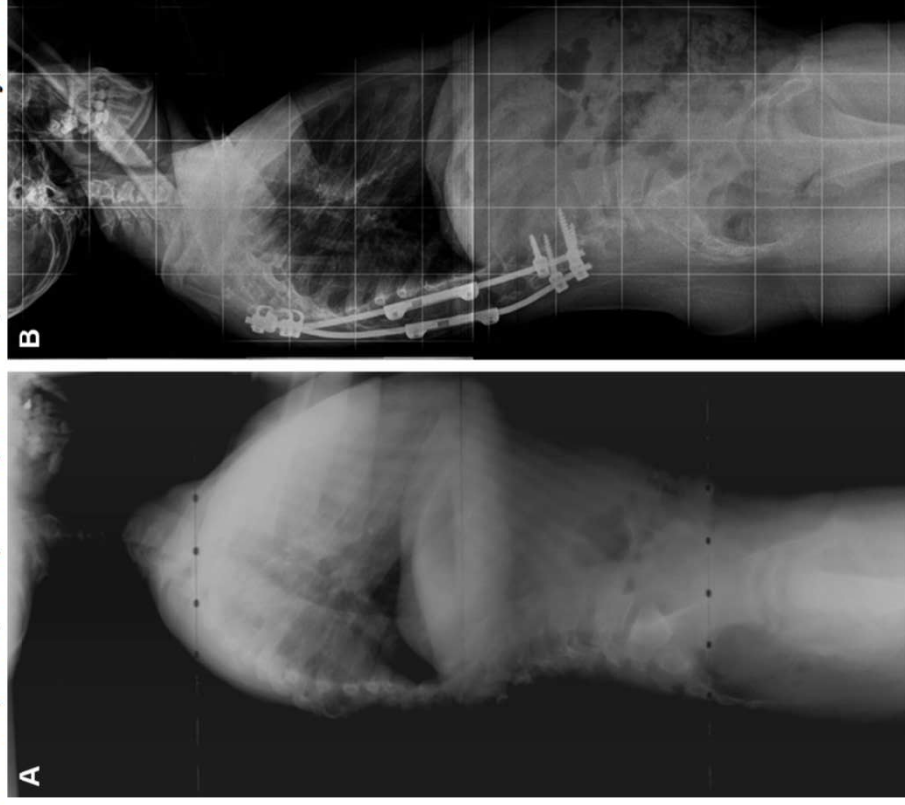
ICEOS 2011 – 3 PJK Studies

- Definition 1 = **28%** risk
 - (PJA) $\geq 10^\circ$ and PJA at least 10° greater than pre-op
- Definition 2 = **56%** risk
 - 2 below UIV to 2 above UIV $> 10^\circ$ and 10° greater than Pre-op
- Definition 3 = **7%** risk
 - UIV to one cephalad to UIV $> 20^\circ$
- Definition vs. Sample



Reliability of Proximal Junctional Kyphosis Measurements for Young Children With Scoliosis

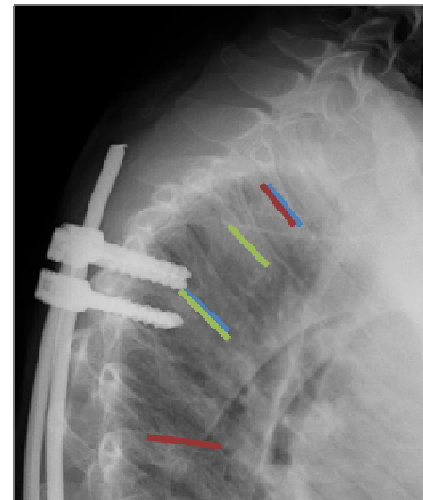
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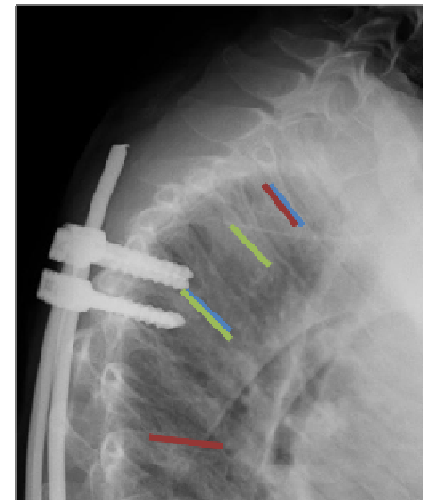
- Same Sample
- Definition 1 = 21%
- Definition 2 = 39%
- Definition 3 = 7%



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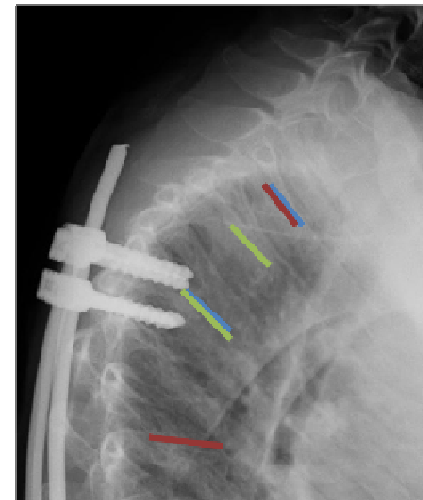
- PJK (Inter Observer)
- Definition 1 = Kappa 0.31 Fair
- **Definition 2 = Kappa 0.40 Moderate**
- Definition 3 = Kappa 0.38 Fair



Reliability of Proximal Junctional Kyphosis Measurements for Young Children With Scoliosis

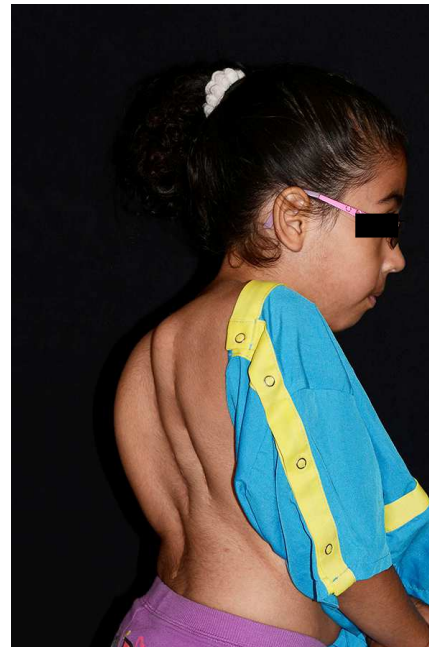
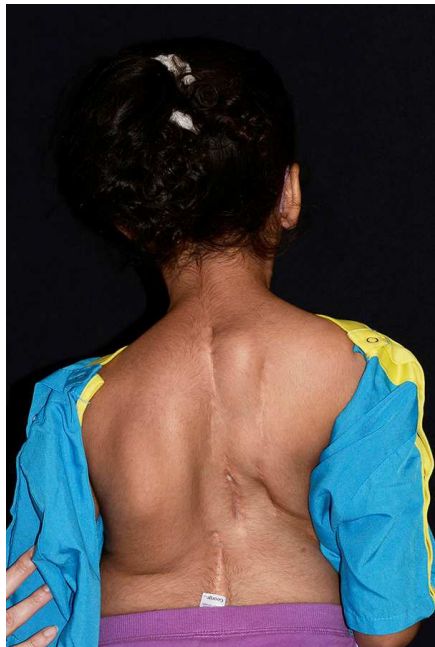
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- PJA T1 vs. T2 (Intra Observer)
- Definition 1 = ICC 0.61 Good
- **Definition 2 = ICC 0.82 Excellent**
- Definition 3 = ICC 0.69 Good



Clinical Effects of PJK

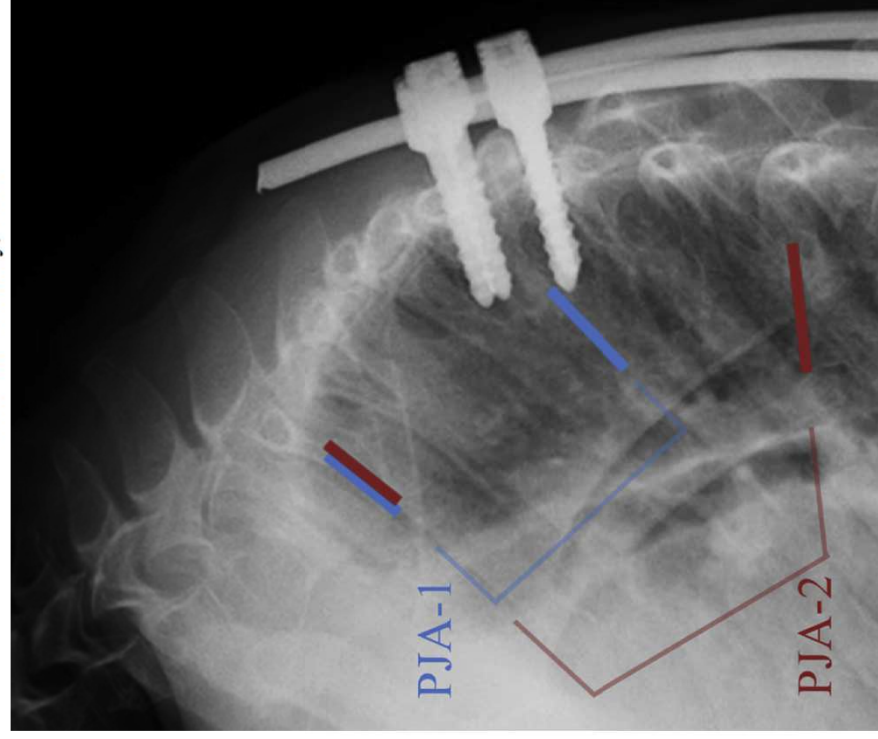
Implant failure which requires **superior extension** of the upper instrumented level during revision surgery.



Superior Extension of Upper Instrumented Vertebrae in Distraction-based Surgery: A Surrogate for Clinically Significant Proximal Junctional

Kyphosis

Nadim Joukhadar, MD^a, Ozren Kubat, MD^b, John Heflin, MD^c, Mohamad S. Yasin, MD^d,
Anna McClung, RN^e, Tara Flynn, BSc^f, Megan Sheppard, BSc, MSc^g, David Skaggs, MD^h,
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Superior Extension of Upper Instrumented Vertebrae in Distraction-based
Surgery: A Surrogate for Clinically Significant Proximal Junctional
Kyphosis

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419 patients with pre-op age of 5.6 years
5.2-year rib vs. 6.0-year spine ($p < 0.001$)

Scoliosis 73°
69° rib vs 77° spine ($p < 0.001$)

Kyphosis 51°
47° rib vs 56° spine ($p < 0.01$)

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	Rib-based		Spine-based		p	Total
Number of subjects	219	200	6.0		<.001	419
Preoperative age (years)	5.2				<.001	5.6
Preoperative scoliosis (°)	69	77			<.001	73
Preoperative kyphosis (°)	47	56			<.01	51
Clinical risk of PJK (%)	24	15			.03	20



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Regression analysis demonstrated that these differences in age, scoliosis, and kyphosis between anchor type did not account for a significant proportion of the measured variance.



Spine Deformity 7 (2019) 371–375



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20% risk of developing clinically significant PJK

24% Rib-based proximal anchors

15% Spine-based proximal anchors

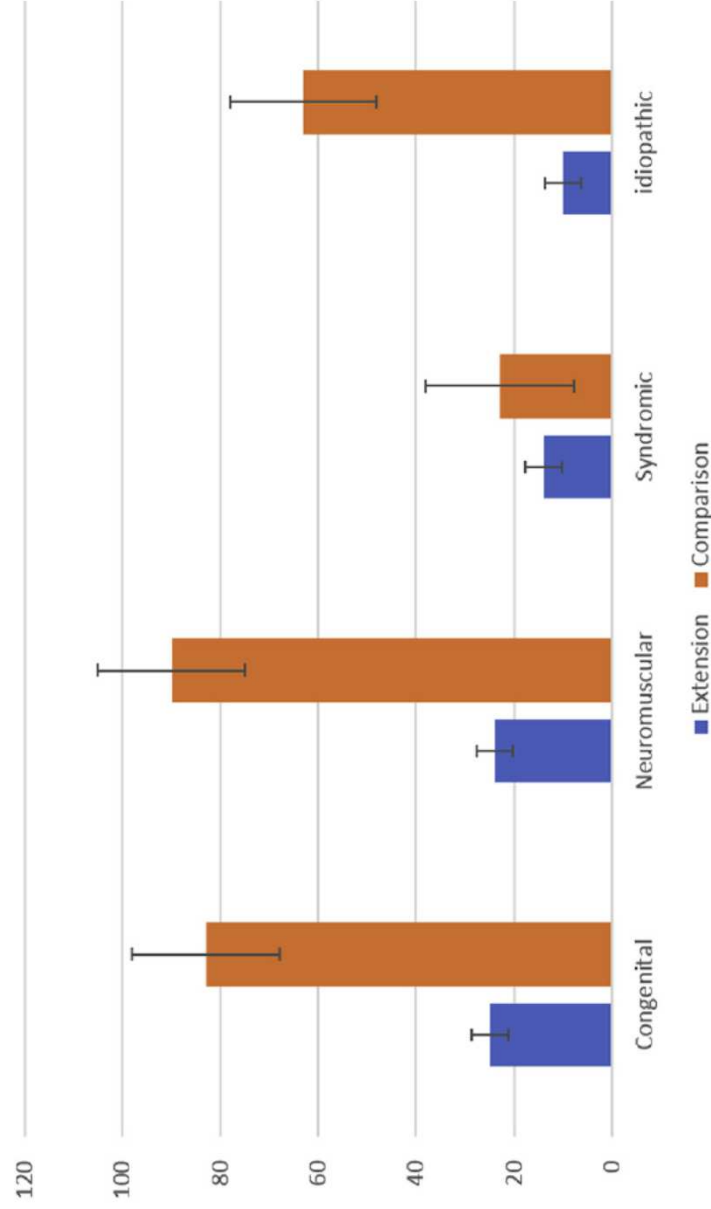


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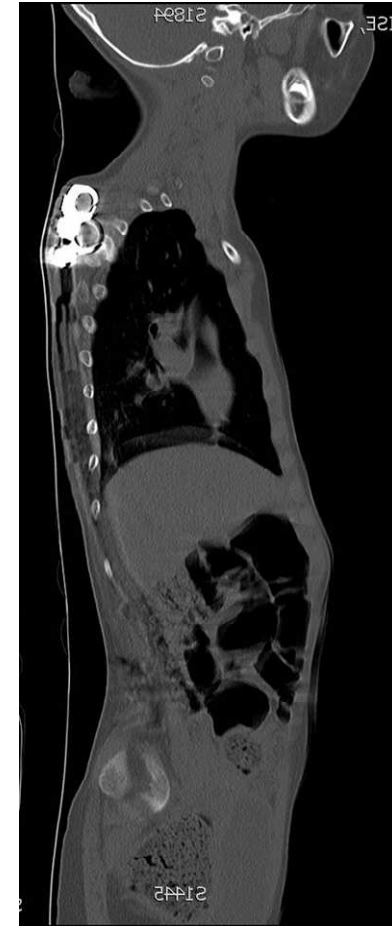
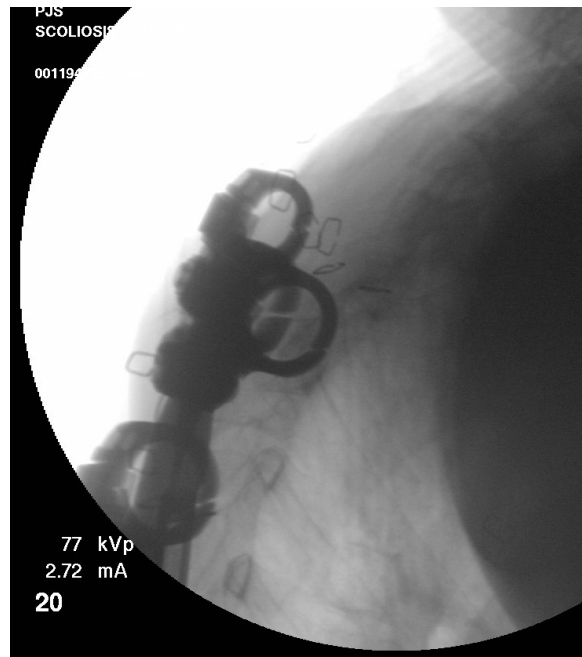
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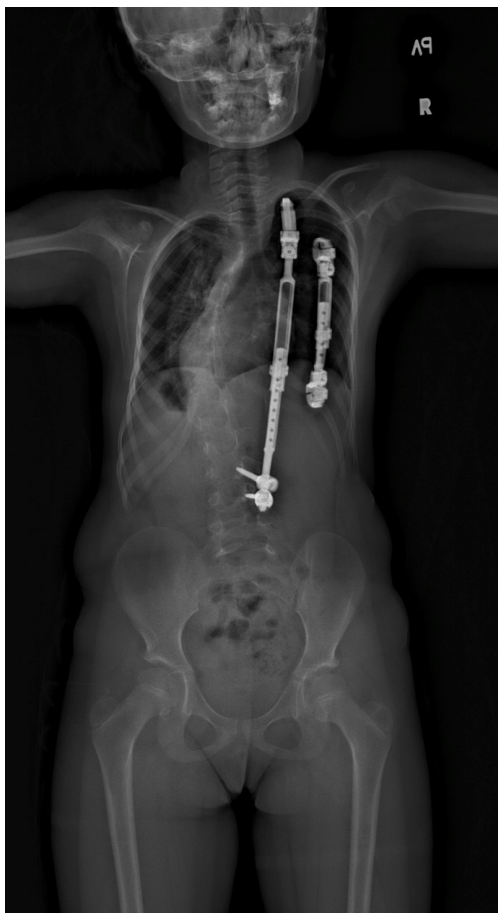
Implant Failure?



... or Rib Hook Drift?



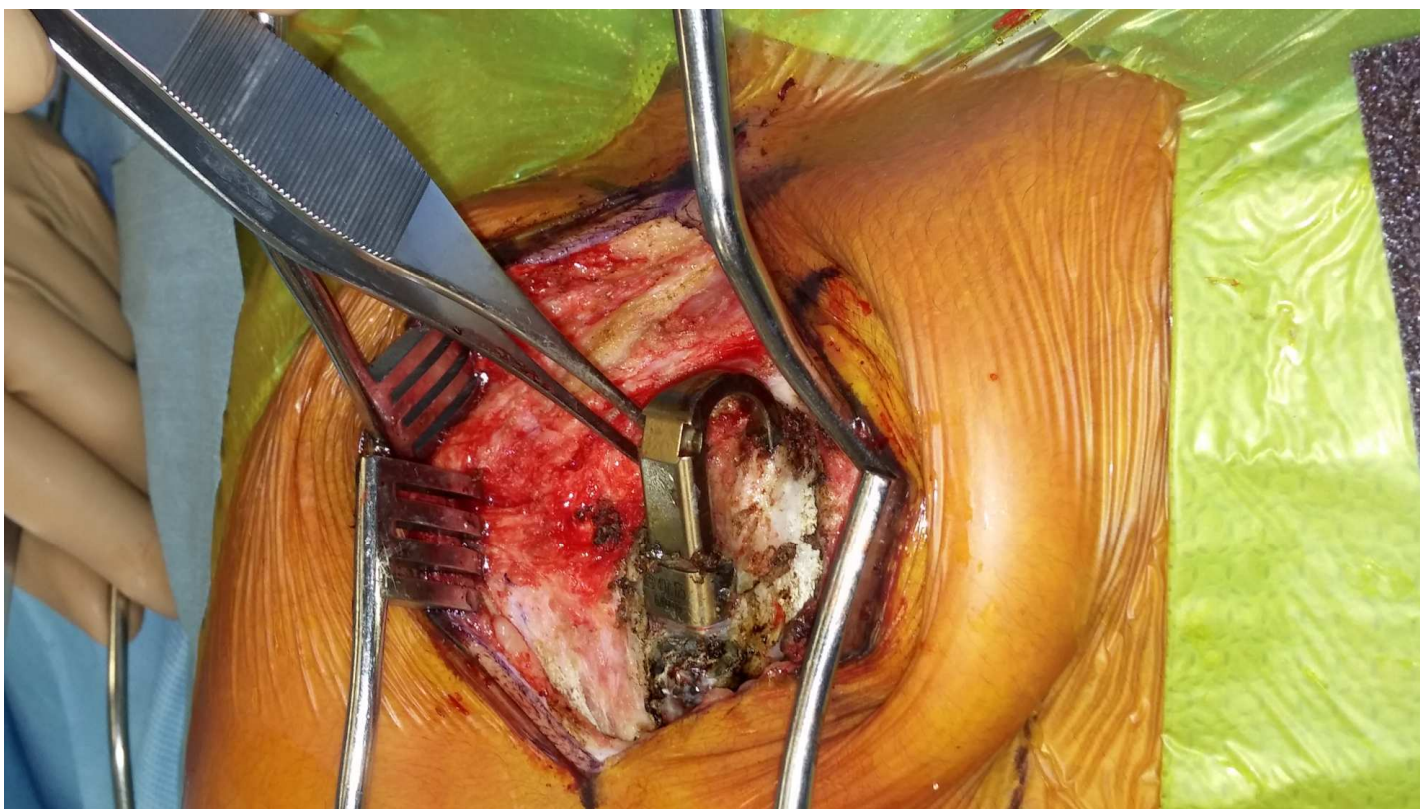
August 2014



2008 - 2014



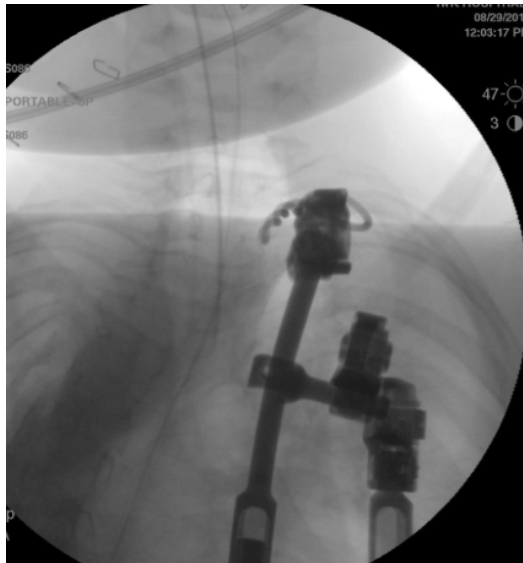
August 2014 – Surgery (Not UPROR)

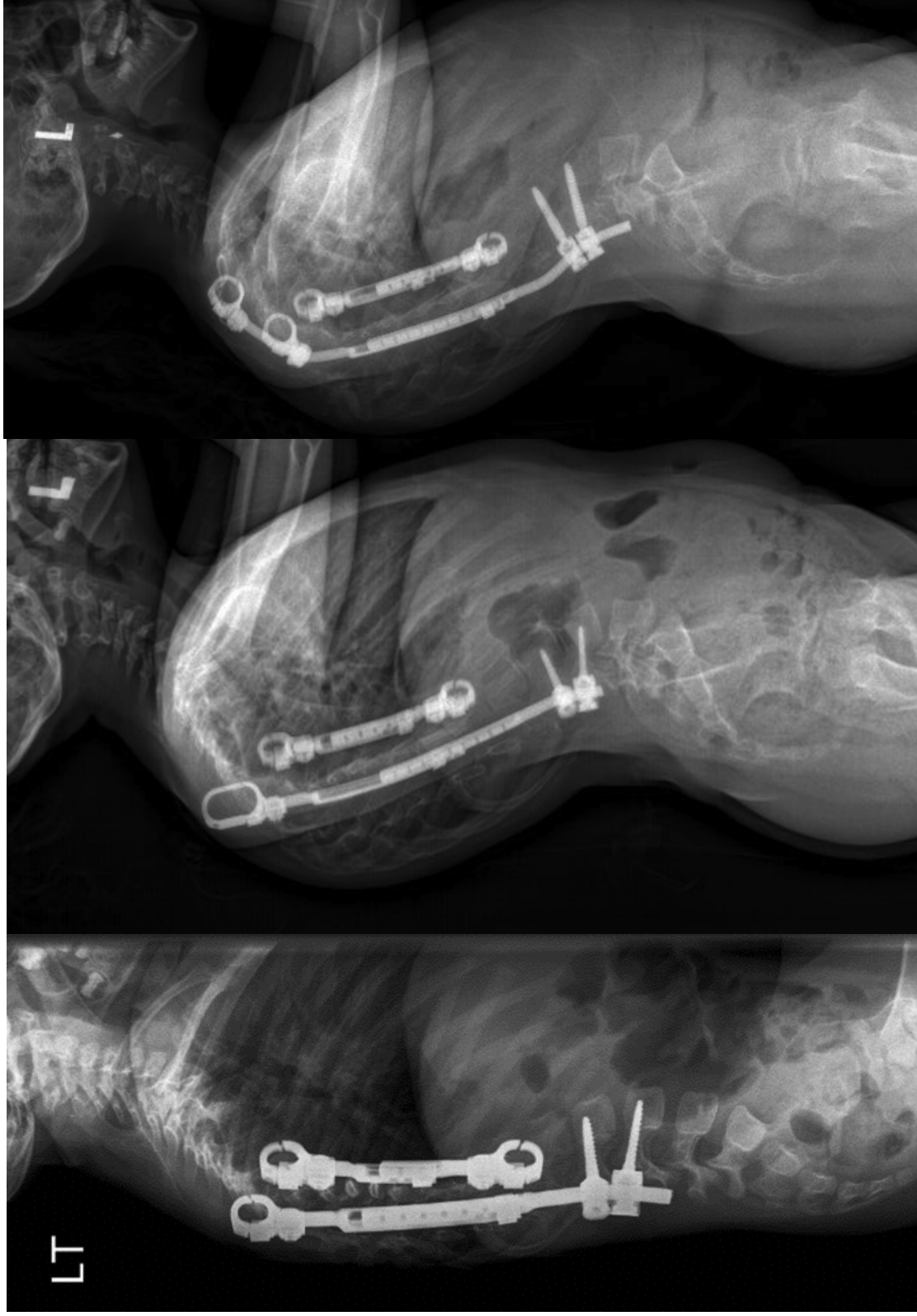


August 2014

- Medial Rod Exchange

- Extended to T2 (wire), T3 rib hook and T5 lateral rib hook
- Distal screws exchanged for larger diameter screws





The Future?



Summary

- PJK can occur during distraction-based surgery.
 - 28% risk with Traditional Growth Friendly
 - 12% risk with MCGR
- Reports of PJK vary depending upon definition
 - In EOS, most reliable definition of PJK/PJA
 - 2 above UIL to 2 below UIL
 - Moderate Inter-Rater Variability
 - Excellent Intra-Rater Variability



Summary

- Consider superior extension of upper instrumented level as surrogate for clinically significant PJK.
- 20% risk of clinically significant PJK with traditional growth friendly implants.



Thank You



- At 24-month evaluation, PJK developed in 4 of 33 (12%) patients



Rib Hook Drift

