Technique Session 1: Challenges in Management Thoracic Kyphosis with Growth Friendly Implants
Magnetically Controlled Growing Rods

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PEDIATRIC SPINE STUDY GROUP

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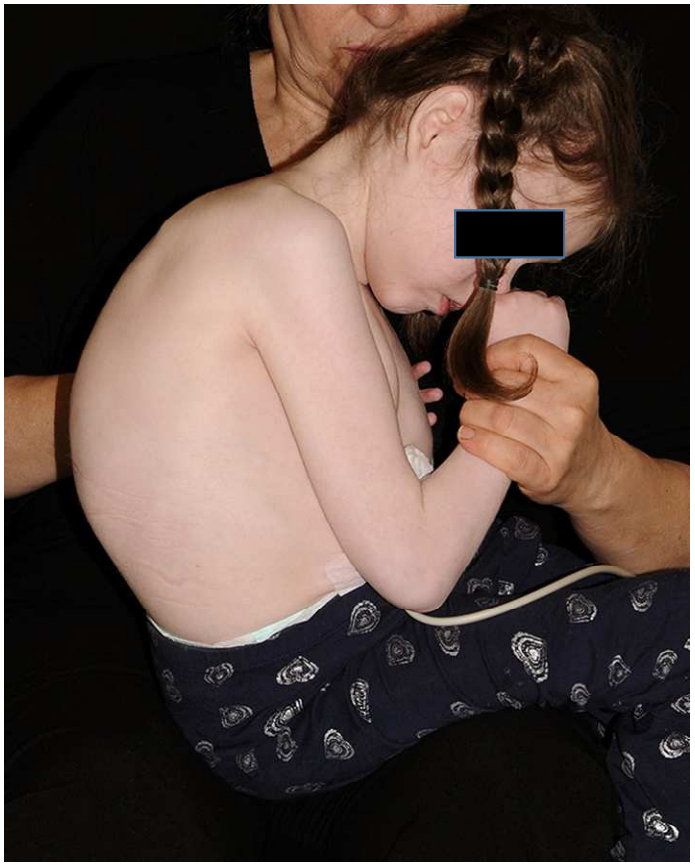
NOVEMBER 21-22, 2019

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

8 yo girl with Cerebral Palsy (2015)



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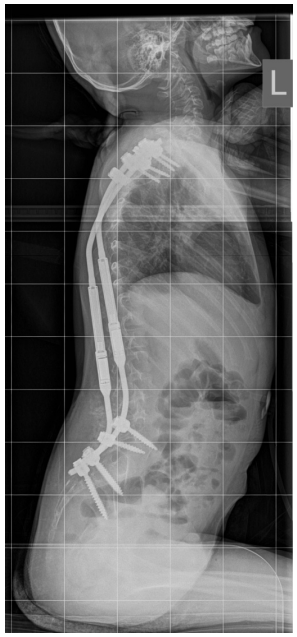
8 yo girl with CP (2015 to 2018)

Pre-Implant

Immediate Post-Op



Most Recent

"Growth" from Insertion

True Growth Phase

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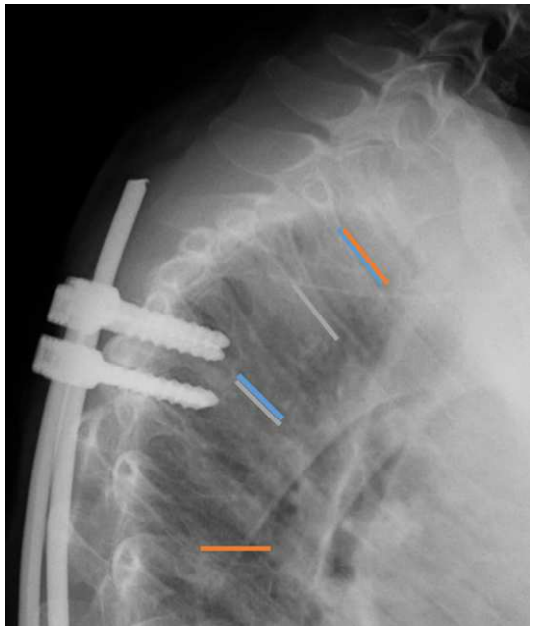
How Does Kyphosis Affect Outcomes?

- Proximal Junctional Kyphosis
- Rod Breakage

General Definition of PJK

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



Yagi et al., Spine, 2011

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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††*

- Maintain Sagittal Alignment
  - Spine vs. Rib Based Sagittal Alignment
  - 27.5 % risk of PJK (31% vs. 25%)

  - Older kids
  - Higher pre-op thoracic kyphosis (45 vs 29 degrees; $p<0.05$)
  - Higher pre-op pelvic incidence
  - Higher post-op positive sagittal balance

JPO 2015

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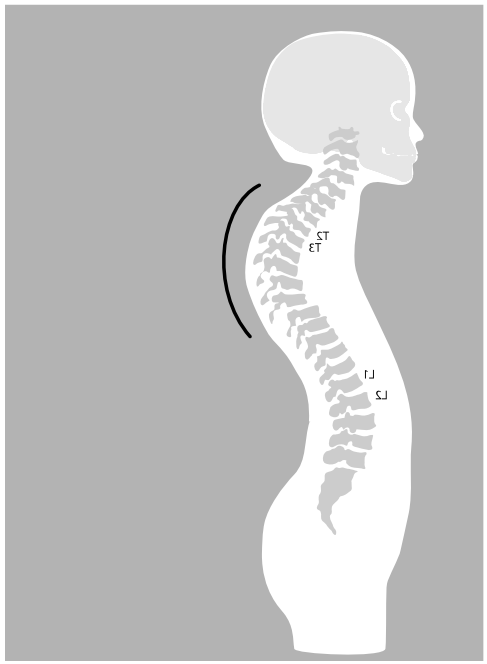
- Subjects with PJK (Pre-Insertion)
  - Older Age
  - Higher Thoracic Kyphosis



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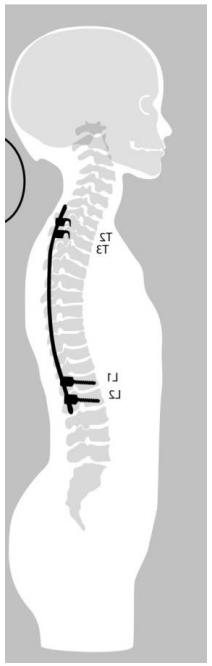
- Subjects with PJK (Post-Insertion)
  - Increased Cervical Lordosis
  - Normal Thoracic Kyphosis



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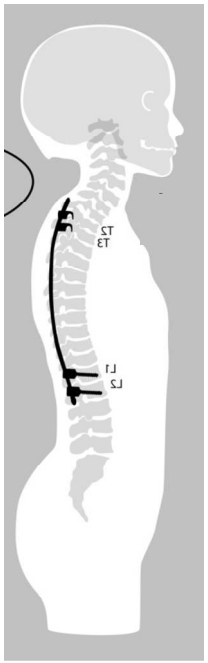
- Subjects with PJK (Final Follow Up)
  - Increased Cervical Lordosis / Increased PJA
  - Normal Thoracic Kyphosis / Increase +SVA



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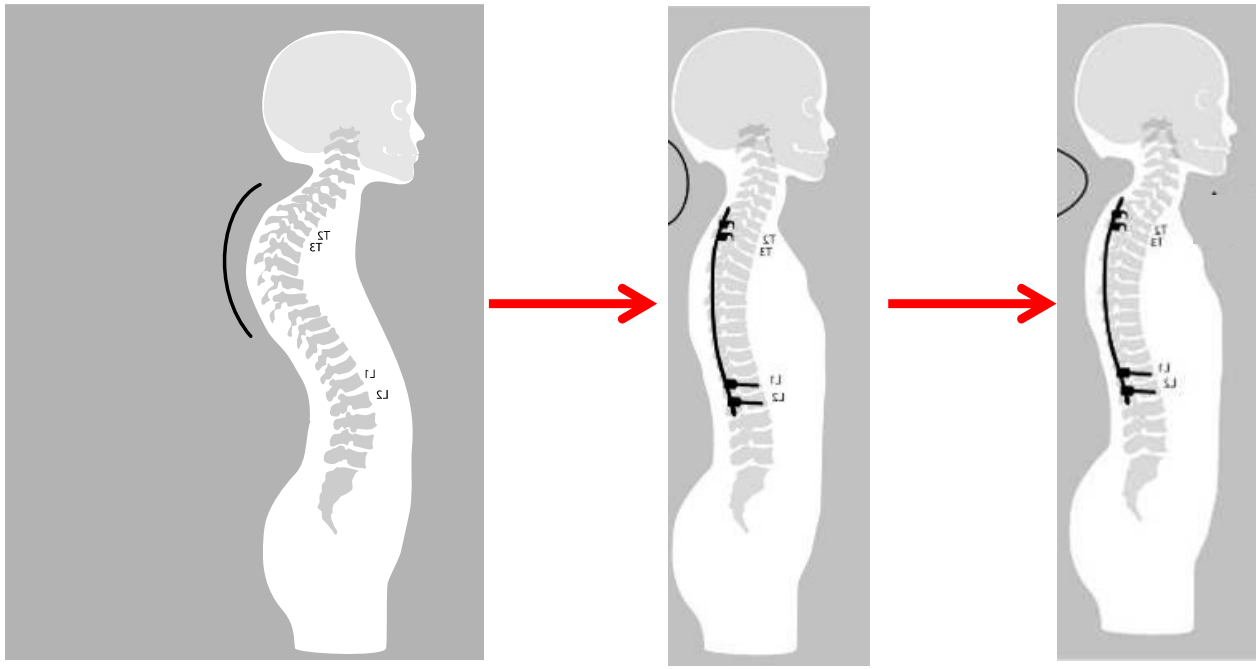
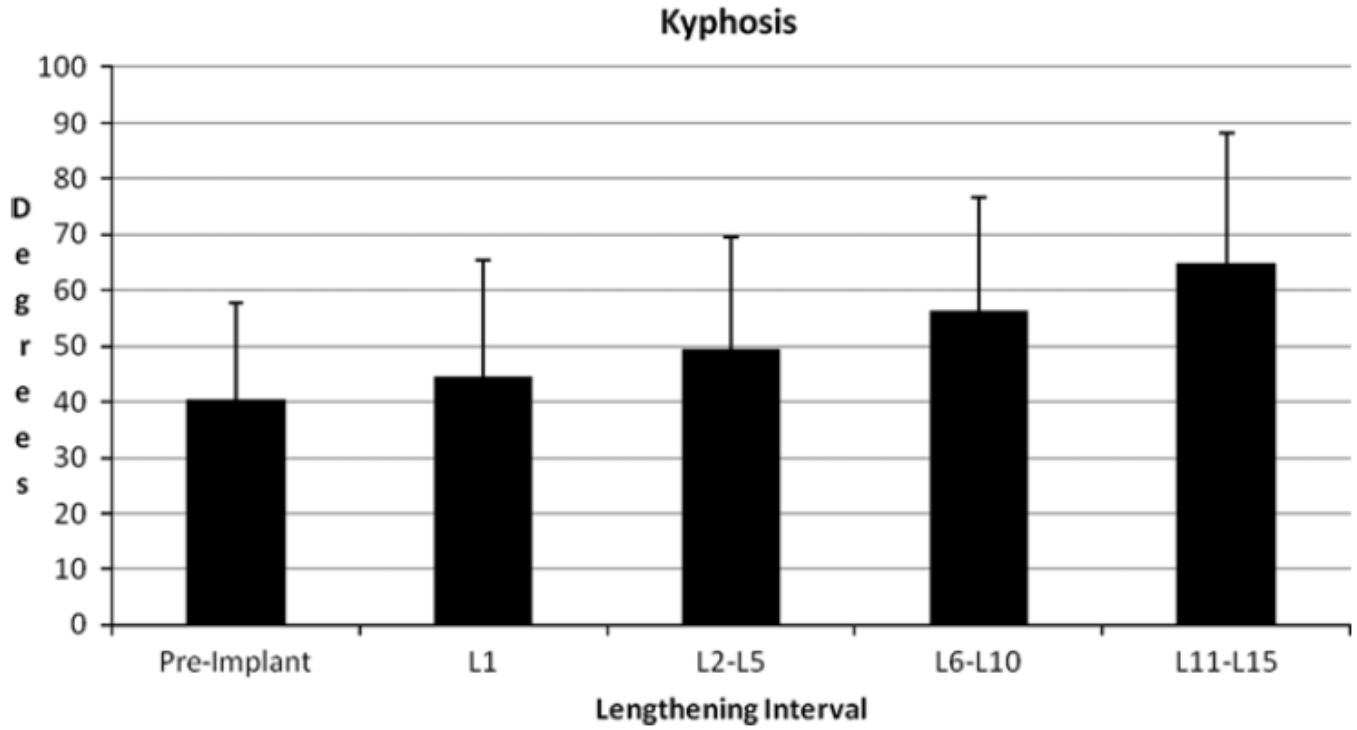
Pre-Operative Hyperkyphosis

- Subjects with PJK



Rib-based Distraction Surgery Maintains Total Spine Growth

Ron El-Hawary, MD, MSc, FRCS(C), Amer Samdani, MD,† Jennie Wade, BS, CCRP,‡ Melissa Smith, NP,‡ John A. Heflin, MD,‡ Joshua W. Klatt, MD,‡ Michael G. Vitale, MD,§ John T. Smith, MD,‡ and Children's Spine Study Group*



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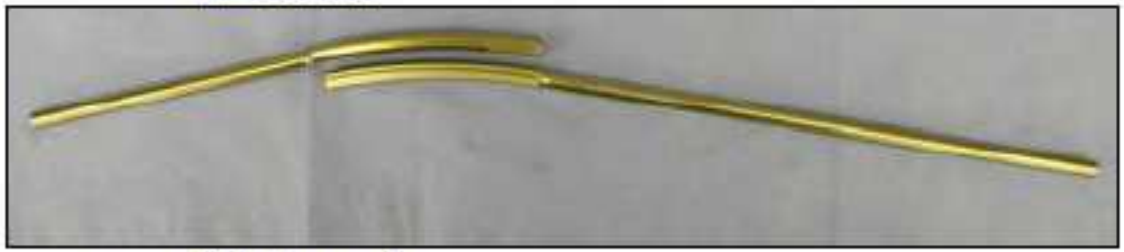
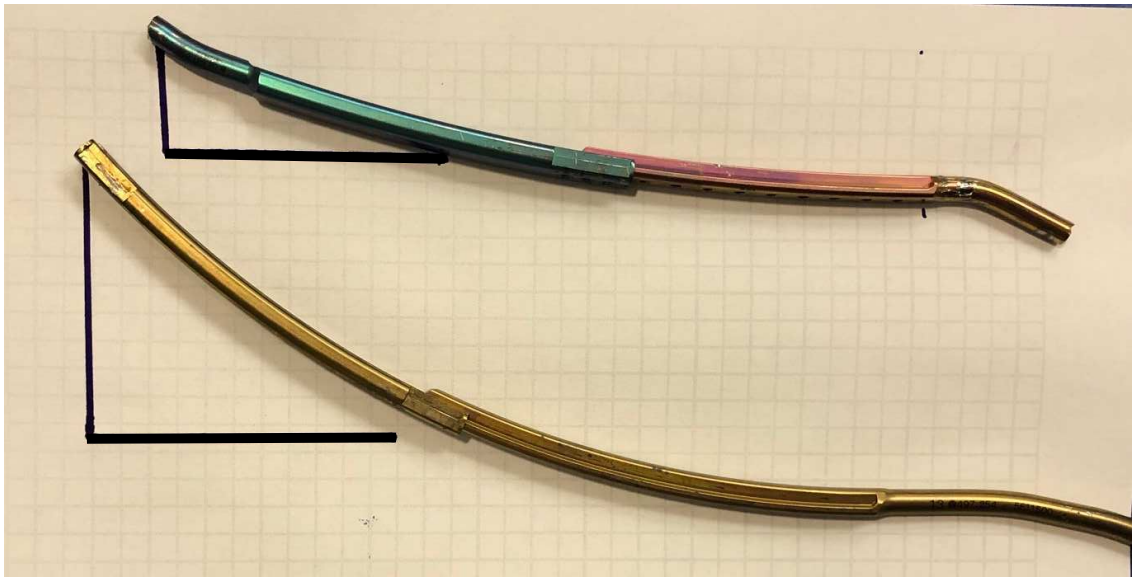
Traditional Growth Friendly

- Radius of Curvature
  - **220mm**



  - **500mm***

*designed to address Kyphosis found with 220mm implants



Magnetically Controlled Growing Rods: Sagittal Plane Analysis and the Risk of Proximal Junctional Kyphosis

Purnendu Gupta, M.D., Felix Brassard, M.D., Kevin Morash, M.D., Jennifer Schottler, MPT, Alicia January, PhD., Ron El-Hawary, M.D., Ben Roye, M.D. MPH, Jeff Sawyer, M.D., Kim Hammerberg, M.D., Children's Spine Study Group

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ICEOS 2018

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Introduction/Methods

- Hypothesis:
  - MCGR insertion may have increased risk of proximal junctional kyphosis (PJK) due to actuator geometry

- Methods:
  - Multi-center, retrospective, CSSG registry data
  - Radiographic analysis pre-op, immediate post-op and 24 month follow up

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Results

Data:

- N=67
- 34 (51%) male, 33 (49%) female
- 2-13 years of age
  - Idiopathic (n=28)
  - Neuromuscular (n=23)
  - Syndromic (n=10)
  - Congenital (n=6)

- M=7.4 (±2.7) years at initial implantation
- Pre-op curves: (M= 70.5±18.7 degrees)
- 443 lengthenings (M = 6.6/patient)

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Results

Sagittal analysis data:

- Thoracic kyphosis (not significant)
  - Pre-op to Post-op (28.9 vs. 25.8, p=.289)
  - Pre-op to 24 months (28.9 vs. 32.1, p=.278)

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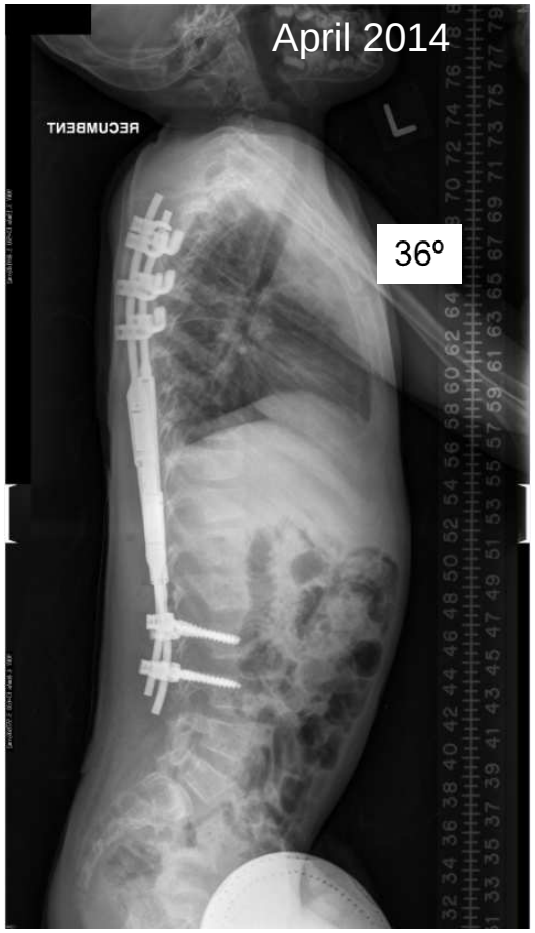
- At 24-month evaluation, PJK developed in 4 of 33 (12%) patients



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Results

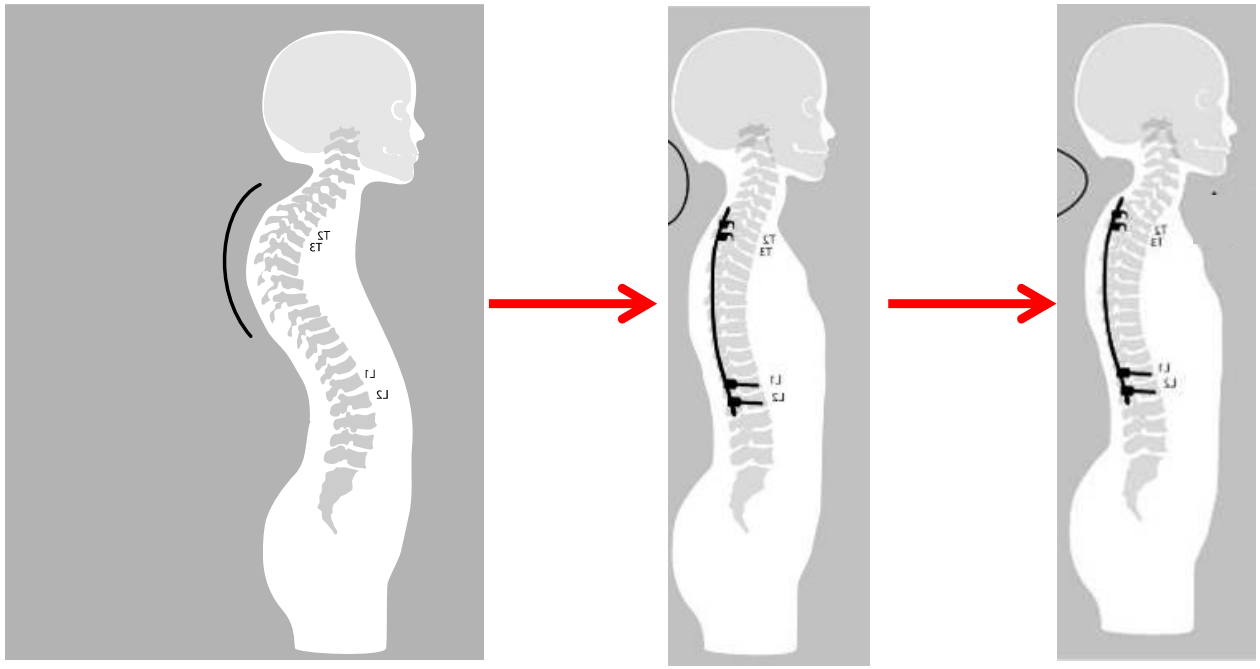
- 3 of 4 (75%) with PJK had pre-op max kyphosis > 50º (vs. 36% in those without PJK)
- 2 of 4 (50%) had a pre-op PI-LL mismatch >30 (vs. 19% in those without PJK)
- Patients with PJK had a higher average pre-op SVA than those who did not develop PJK (62mm. vs. 13mm.)
- Centroid of actuator slightly higher in those with PJK

What is Unique about MCGR?

- Actuator Geometry – Cannot Contour
  - By default, will decrease kyphosis

Pre-Operative Hyperkyphosis

- Subjects with PJK

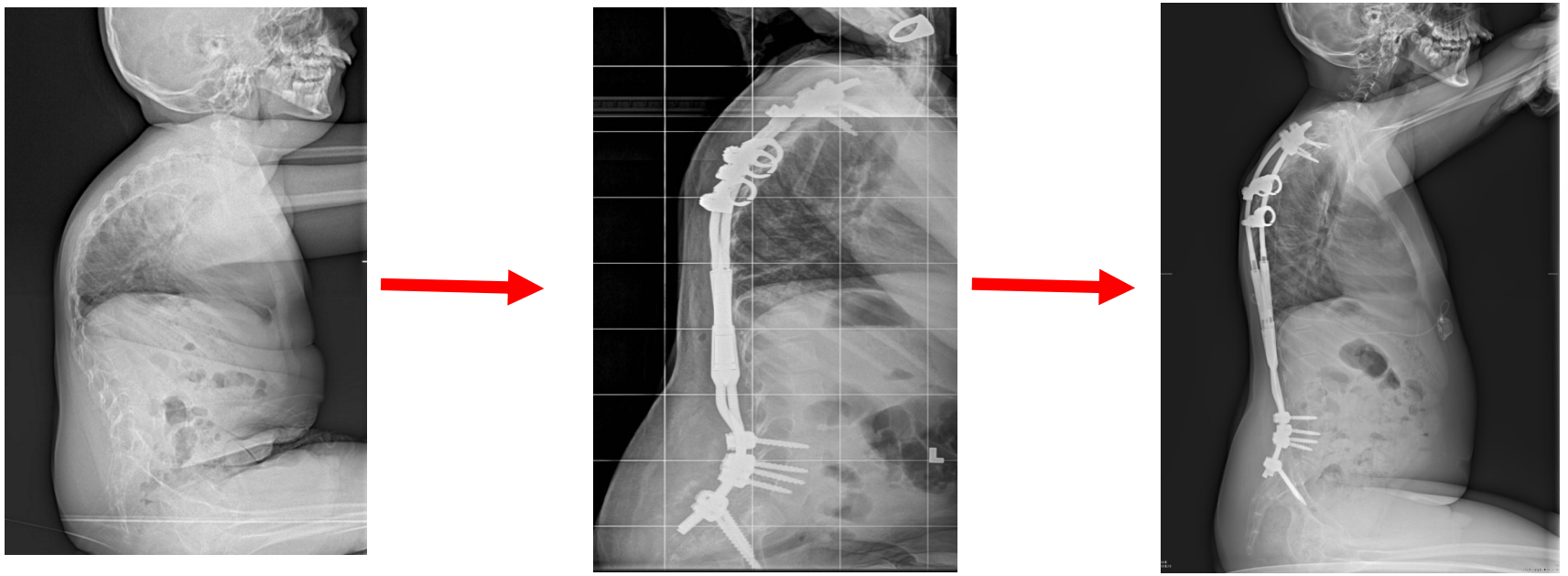


8 yo boy with SMA II (2016 to 2019)

Pre-Implant

Immediate Post-Op

Most Recent



"Growth" from Insertion

True Growth Phase

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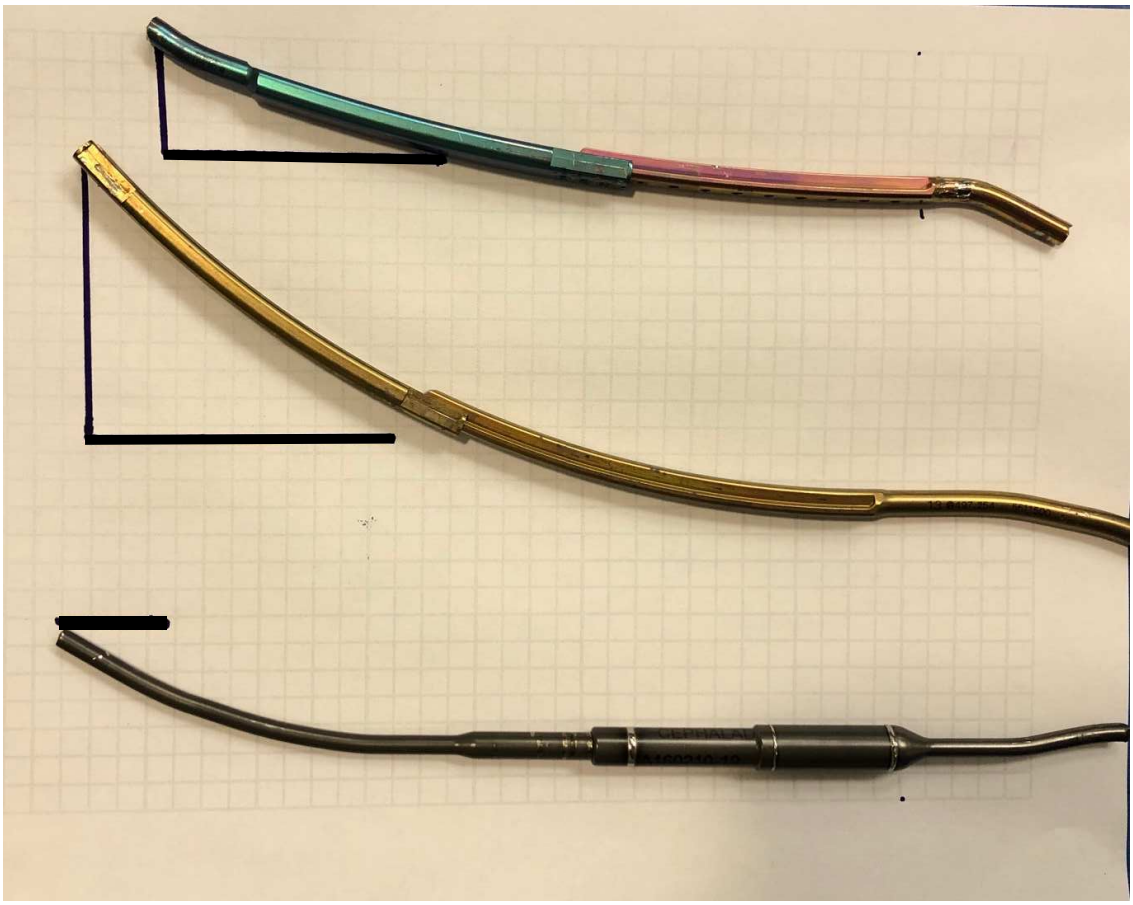

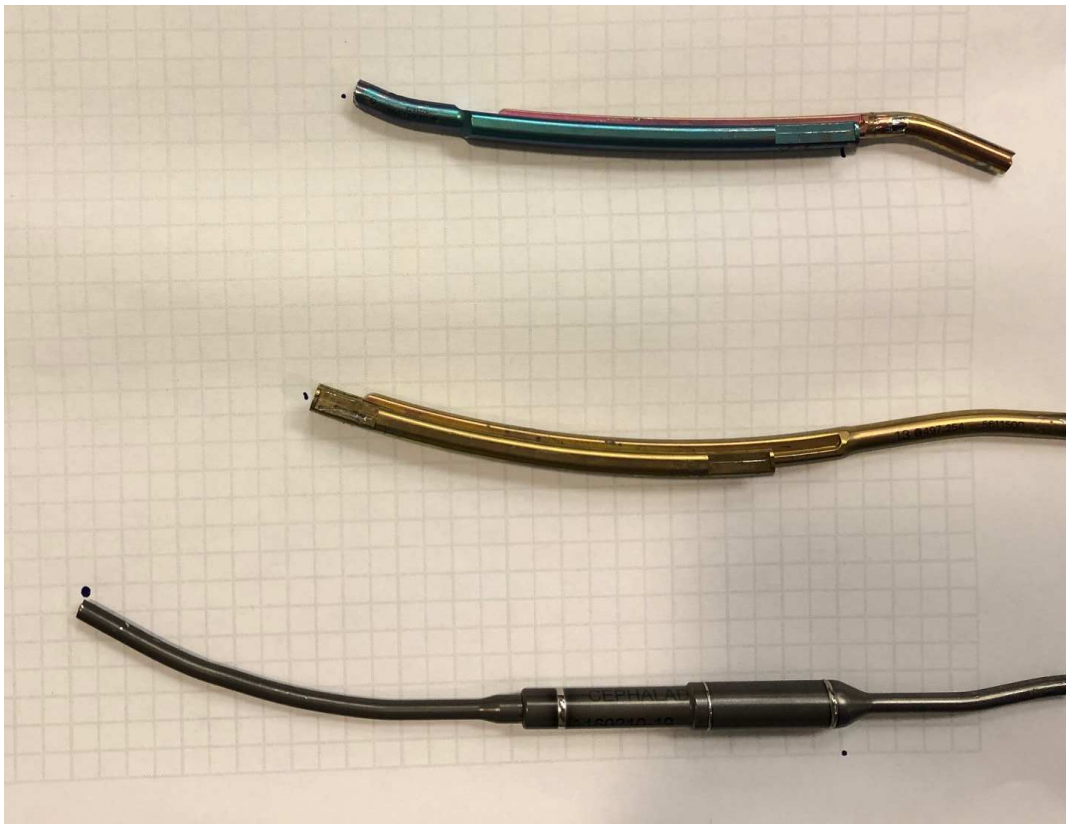

Strategies for Managing Hyperkyphosis

- Avoid acutely correcting the hyperkyphosis
  - Contour the rods into kyphosis
  - Take advantage of the straight actuator

- Anchors
  - Number of anchors
  - Shorten the working length

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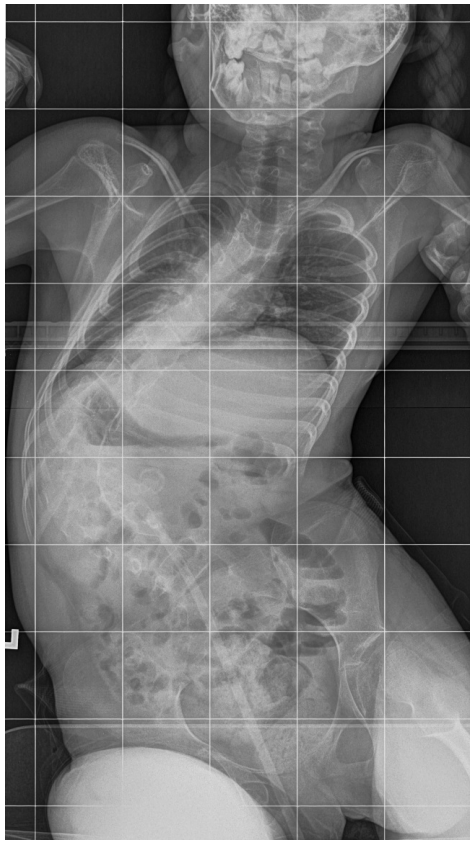
8 yo Girl with Cerebral Palsy



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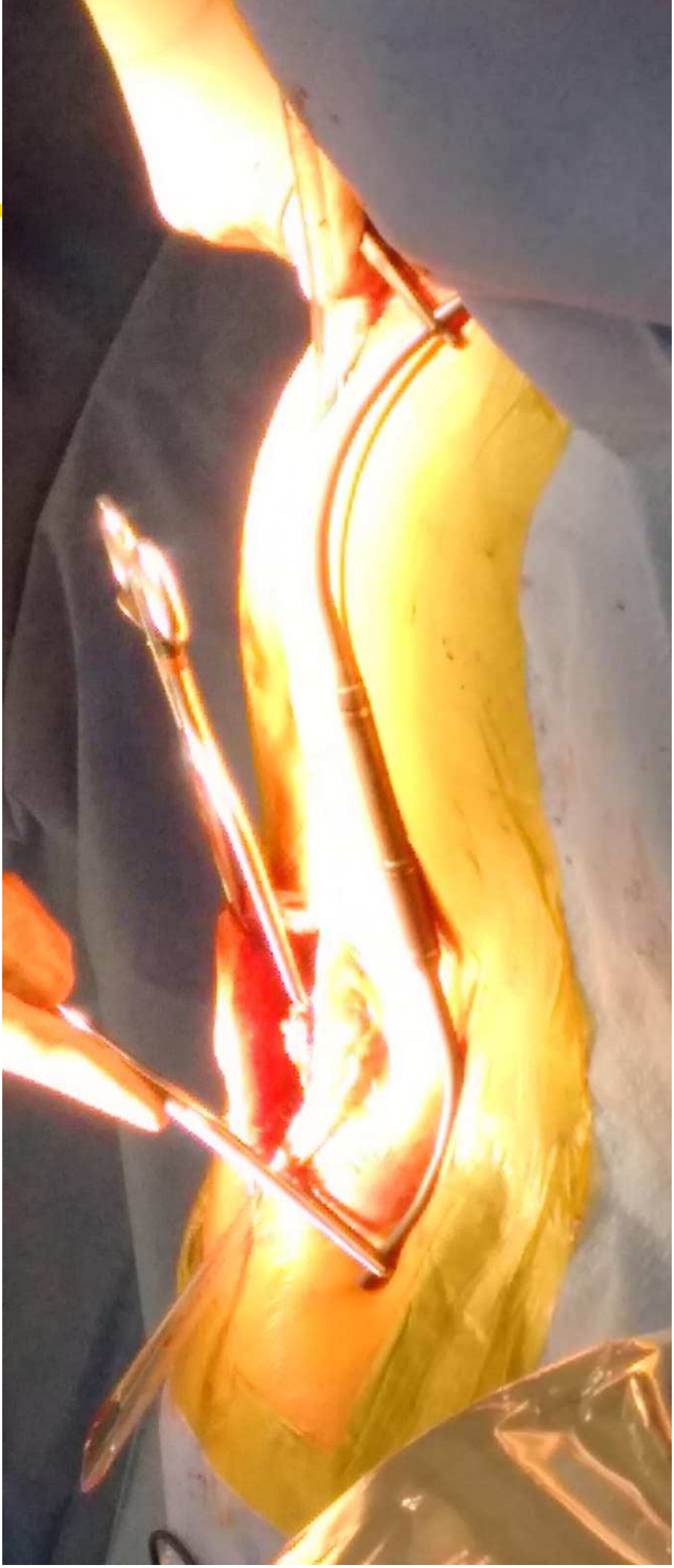

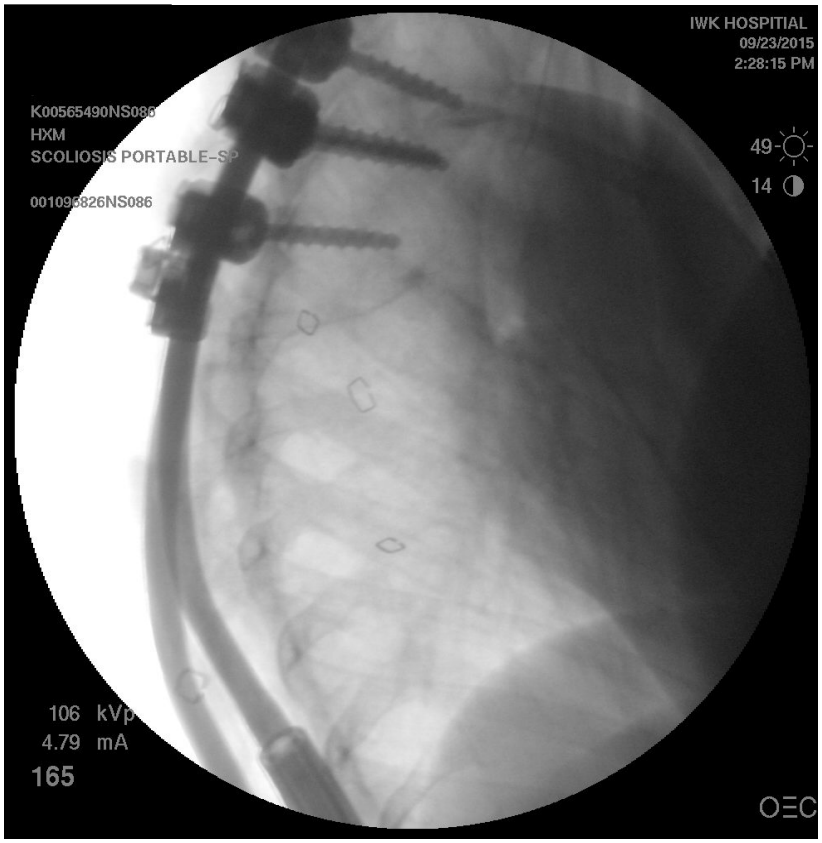

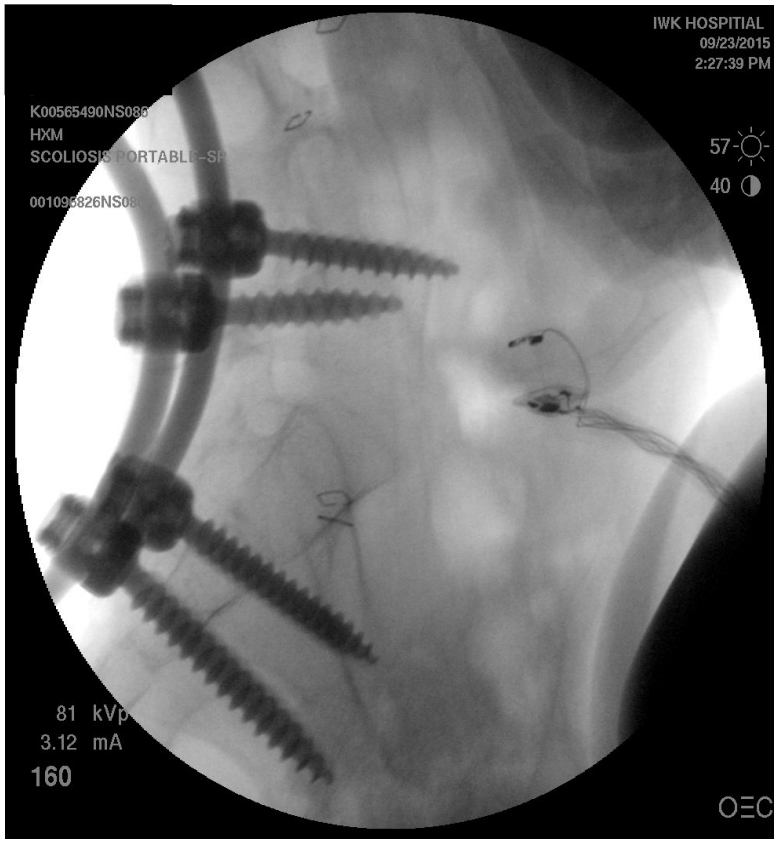

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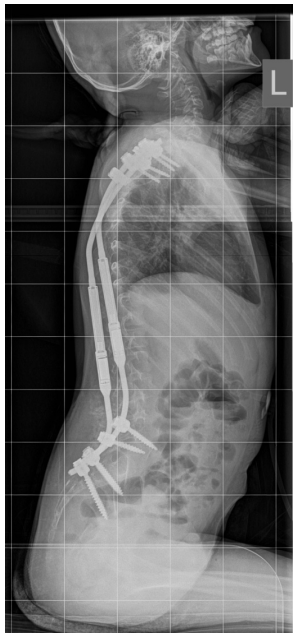
8 yo girl with CP (2015 to 2018)

Pre-Implant

Immediate Post-Op



Most Recent

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True Growth Phase

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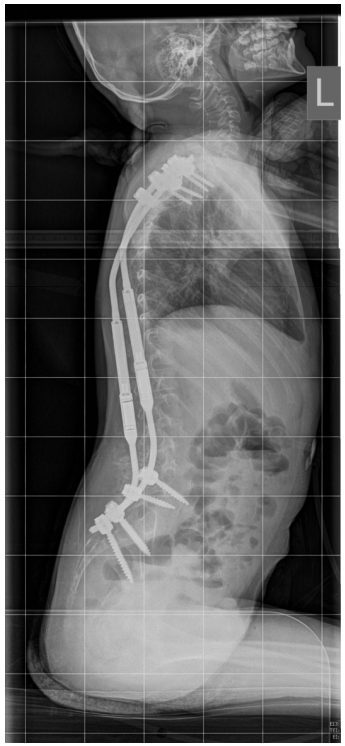
Strategies for Managing Hyperkyphosis

- Anchor Strategy
  - Number of anchors
  - Shorten the working length

Increase the Number of Proximal Anchors



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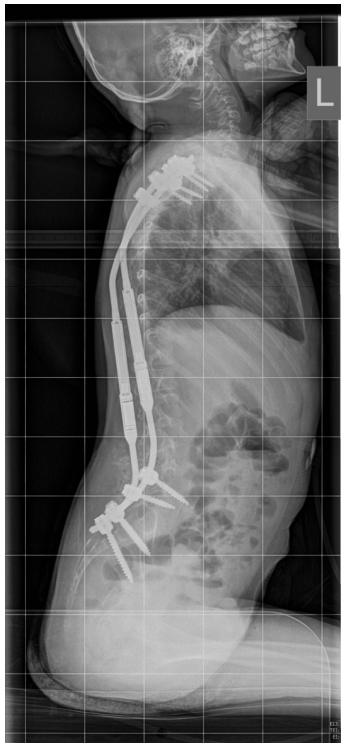
Shorten the Working Length

- Working length: Unsupported spine



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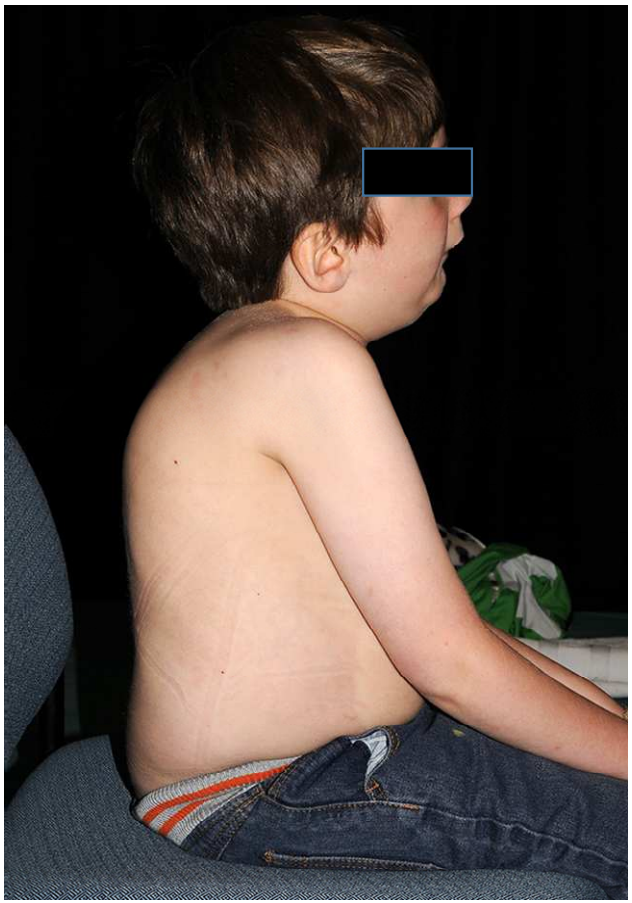
8 yo boy with SMA II (2016)



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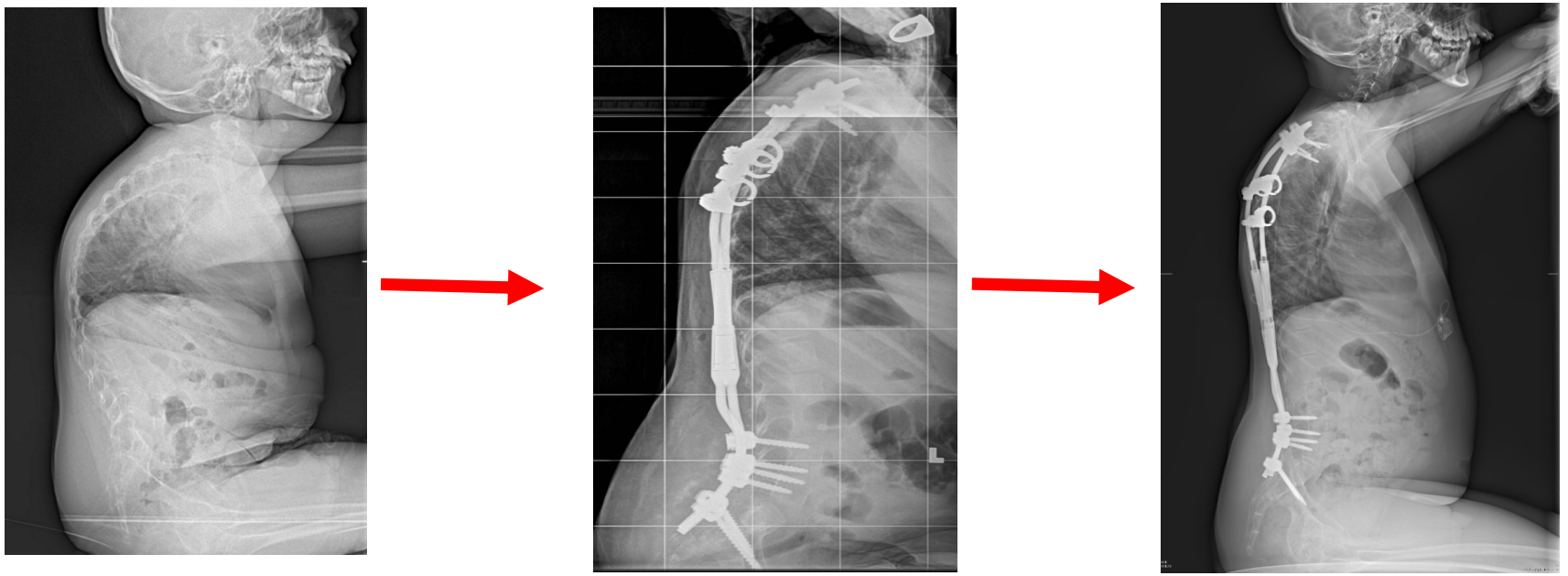

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True Growth Phase

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Conclusions

- Hyperkyphosis can be managed effectively with MCGR

- Avoid acutely correcting the hyperkyphosis
  - Contour the rods into kyphosis
  - Take advantage of the straight actuator

- Anchors to increase rigidity of construct
  - Number of anchors
  - Shorten the working length

Thank You

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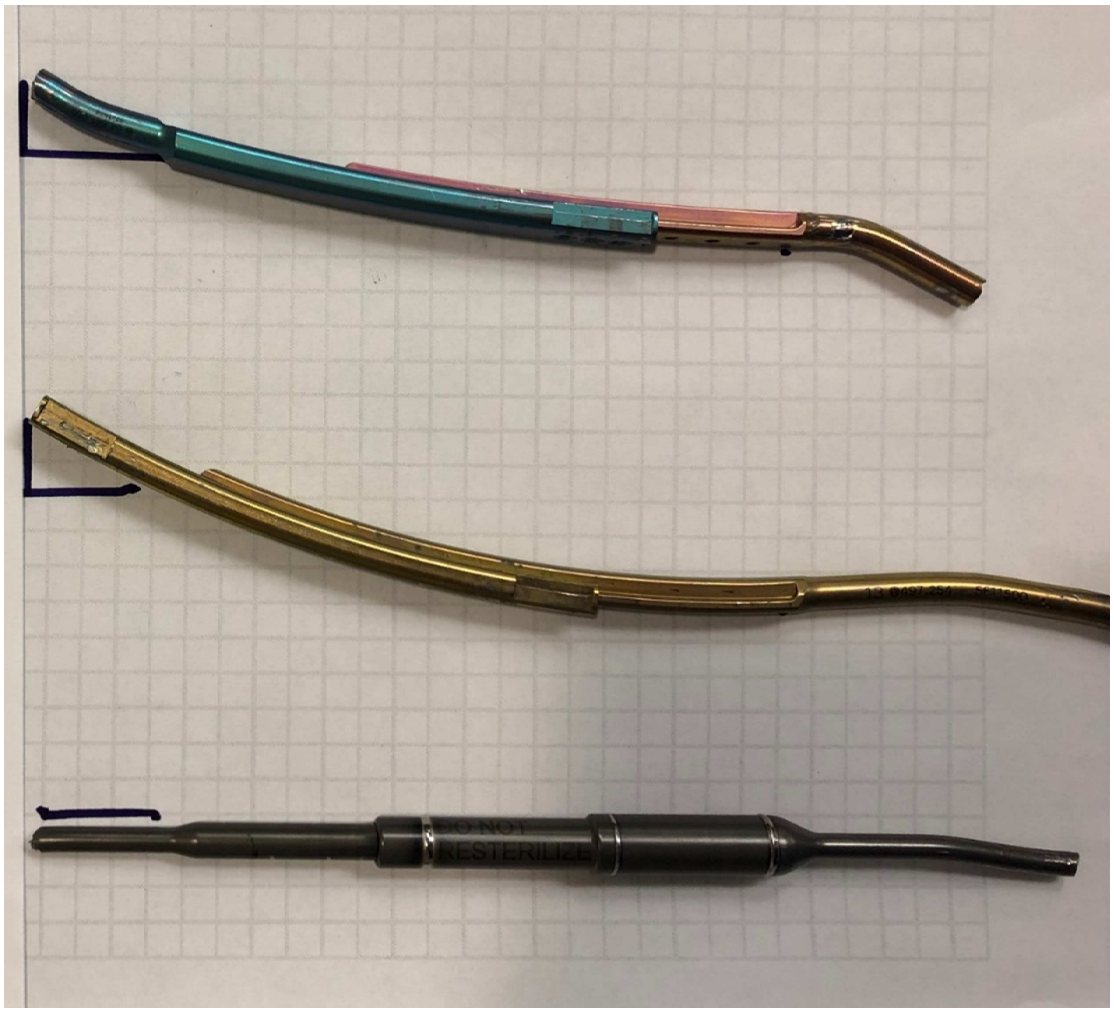
DO NOT
RESTERILIZE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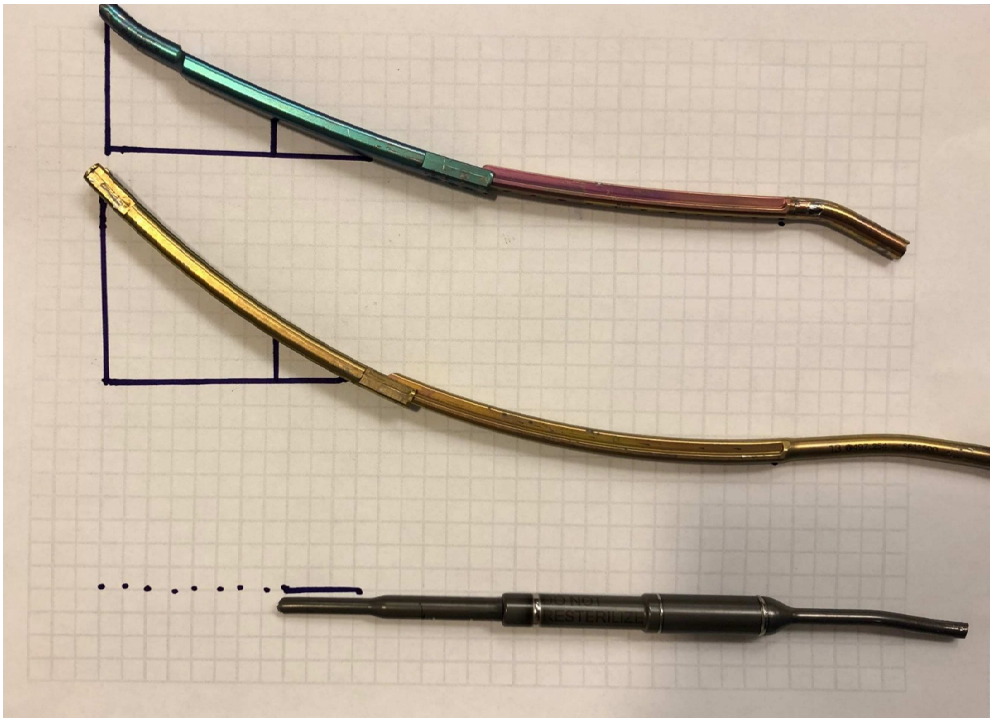
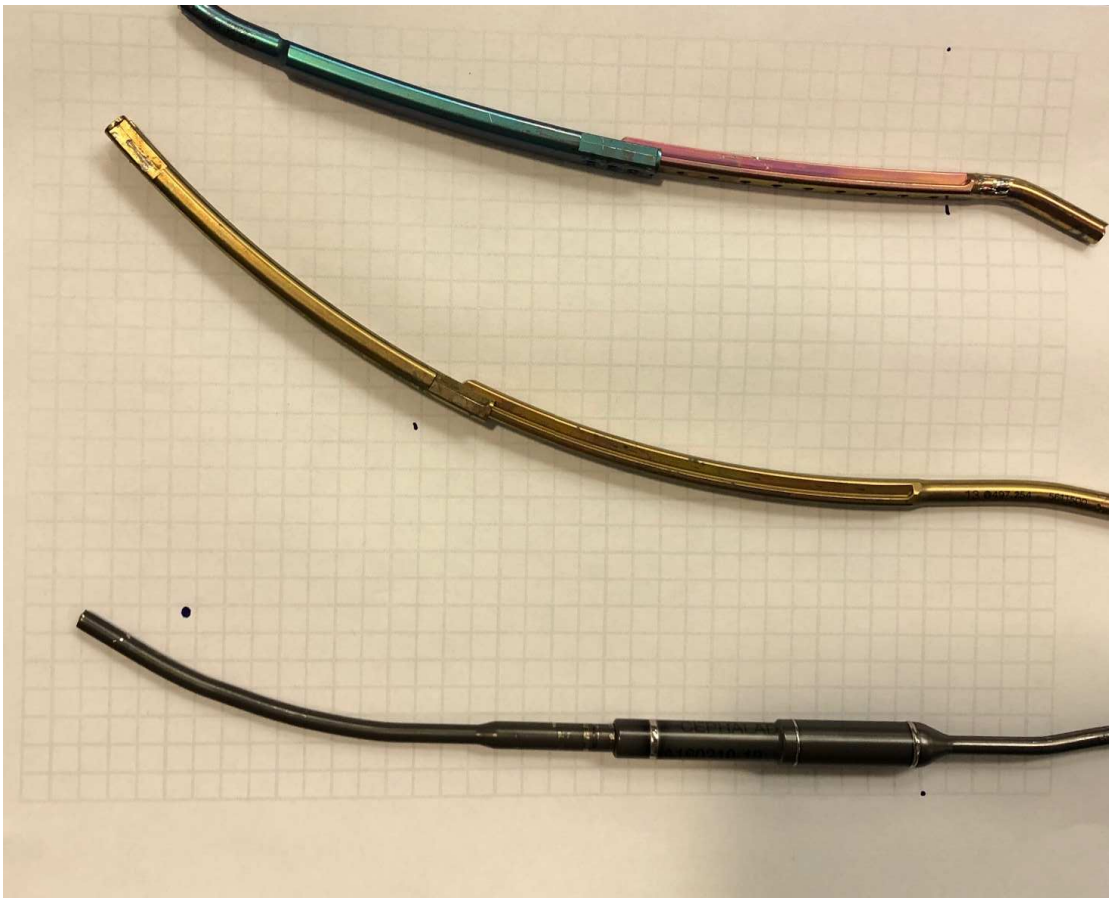
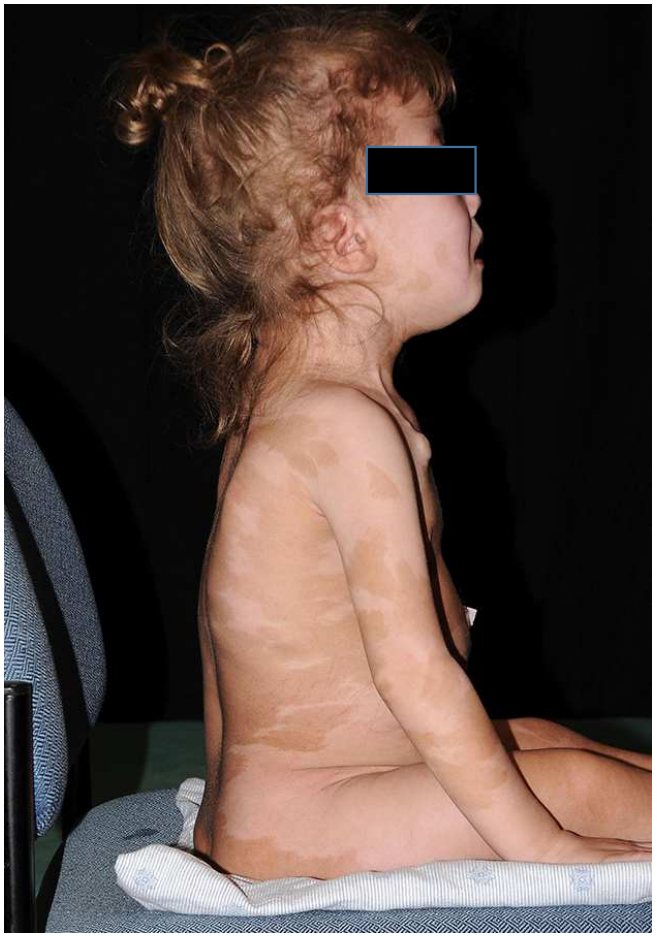

NOT
STERILE



3 yo girl with Fibrous Dysplasia(2016)



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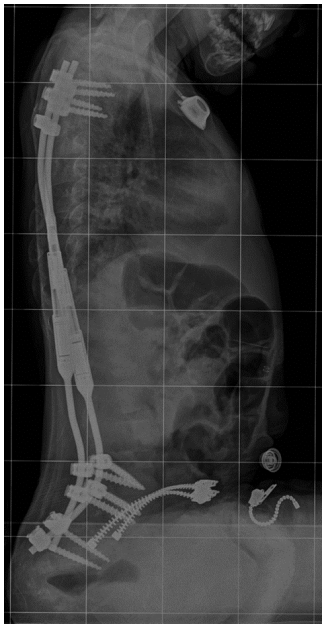
3 yo girl with FD (2016 to 2019)

Pre-Implant

Immediate Post-Op



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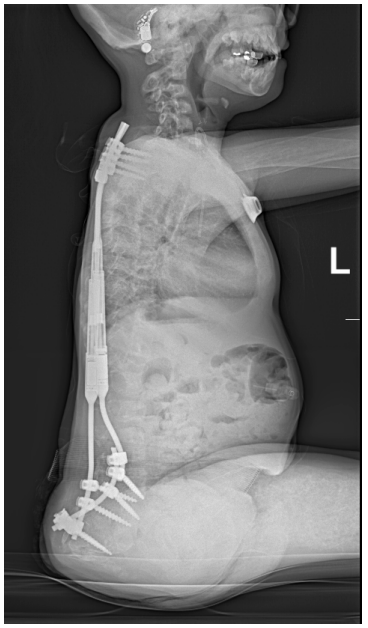

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