

# Cervical Spine Deformity Treatment: Positioning, Imaging, and Navigation

12<sup>th</sup> International Congress on  
Early Onset Scoliosis

Matthew E. Oetgen, MD, MBA

*Chief, Division of Orthopaedic Surgery and Sports Medicine  
Children's National Health System  
Washington, DC*



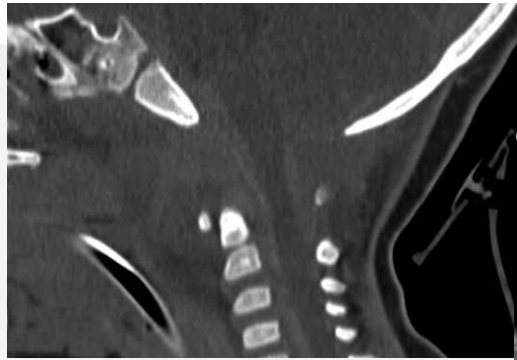
# DISCLOSURES

- No financial disclosures
- No conflicts of interest related to this talk



# WHERE TO START

- Patient
  - Big or small
  - Anatomic considerations
- Surgeon
  - Technical ability, experience, comfort
- Situation
  - Deformity vs. trauma
  - Treatment plan



17 mn – traumatic AAD



17 yo – symptomatic OO



# PRE OP IMAGING – WHICH IMAGING BEST?

- Assess Deformity
  1. Instability – Flex/ext xrays vs MRI
  2. Basilar Invagination – MRI
  3. Static Deformity – Rotational CT
- Anatomic Assessment
  1. Spinal Cord
  2. Vertebral Arteries – position, course, variation
  3. Fixation potential



# PRE OP IMAGING – WHICH IMAGING BEST?

- Flexion – Extension MRI

Flexion-Extension Cervical Spine MRI in Children With Skeletal Dysplasia: Is It Safe and Effective?

*William G. Mackenzie, MD, FRCS(C),\* Arjun A. Dhawale, MD,\* Matthew M. Demczko, BSc,†*

- 6/31 patients showed no cord compression on MRI

- Vertebral Artery Location – CT scan

Location of the Vertebral Artery at C1 in Children:  
How Far Out Laterally Can One Safely Dissect?

Rachel Y. Goldstein, MD, MPH, Caleb D. Sunde, BS, Peter Assaad, MD, MPH, John Grimm, MD,  
David L. Skaggs, MD, MMM, and Lindsay Andras, MD

- < 8 yo → VA < 1.5cm from midline

TABLE I Mean Distance of the Vertebral Artery from the Midline by Age Group

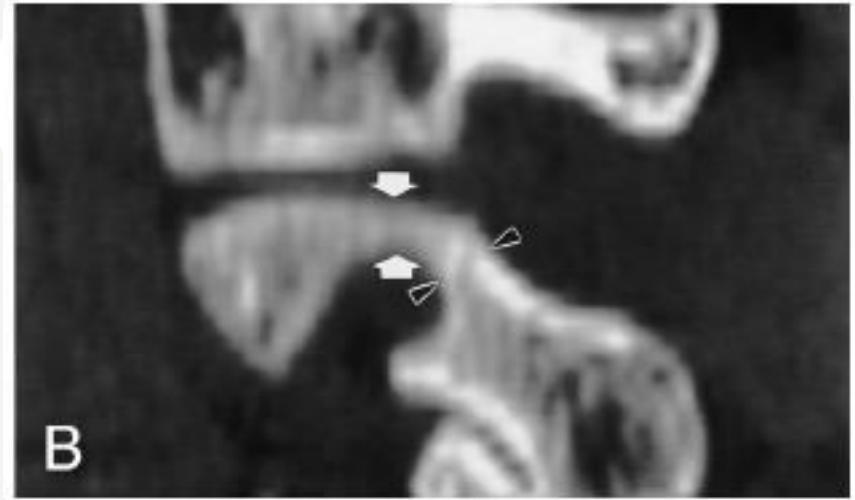
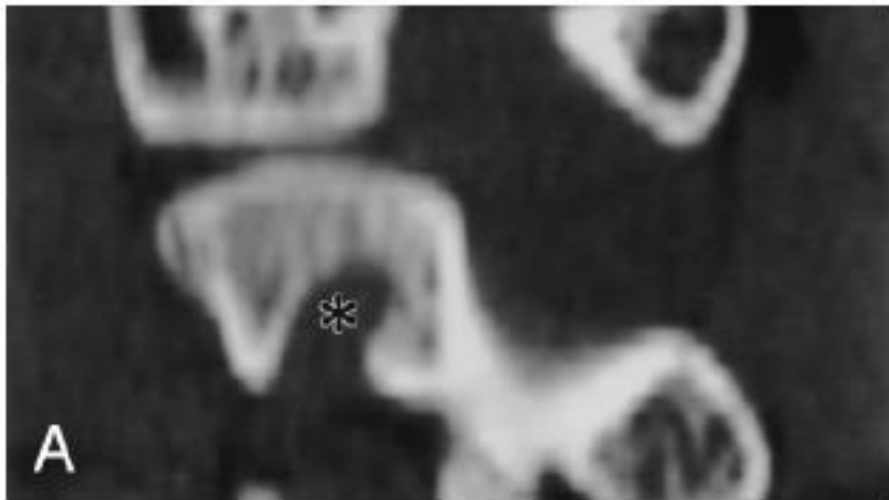
Age Group (yr)	Mean Distance from Midline (Range) (mm)
<2	11.94 (8.14 to 16.24)
2 to <4	13.80 (10.00 to 18.87)
4 to <6	14.28 (10.40 to 18.00)
6 to <8	14.40 (10.30 to 18.50)
≥8	15.54 (11.80 to 20.80)
Total	13.97 (8.14 to 20.80)

# PRE OP IMAGING – WHICH IMAGING BEST?

- High riding vertebral artery

## Atlantoaxial Transarticular Screw Fixation for a High-Riding Vertebral Artery

- 7/27 patients showed high riding VA



# PRE OPERATIVE PLAN

- Approach – depends on deformity
  1. Anterior
  2. Posterior

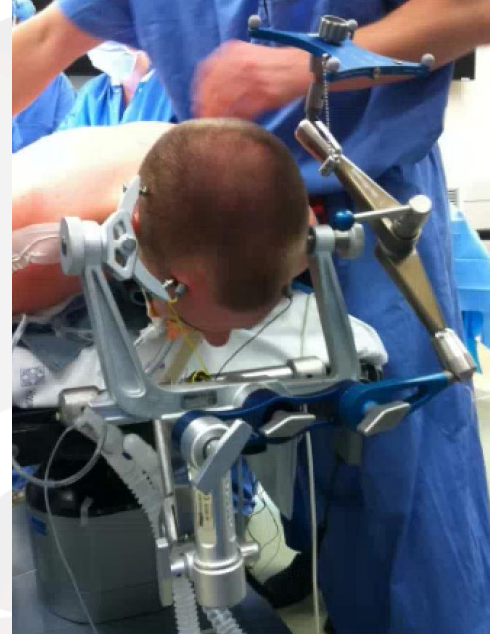
- Head Fixation

1. Horseshoe
2. Mayfield
3. Halo

Advantage	Disadvantage
Ease of positioning	Less stable head fixation
Stable head positioning	No post-op immobilization
Stable head position; post-op immobilization	Bulky posteriorly; awkward to attach to bed

# PRE OPERATIVE PLAN

- Head Fixation





# PRE OPERATIVE PLAN

- Head Fixation - 11yo symptomatic OO



# PRE OPERATIVE PLAN

- Implants

1. Segmental

- Size appropriate
- Occiput

2. Wiring options

- Bone Graft

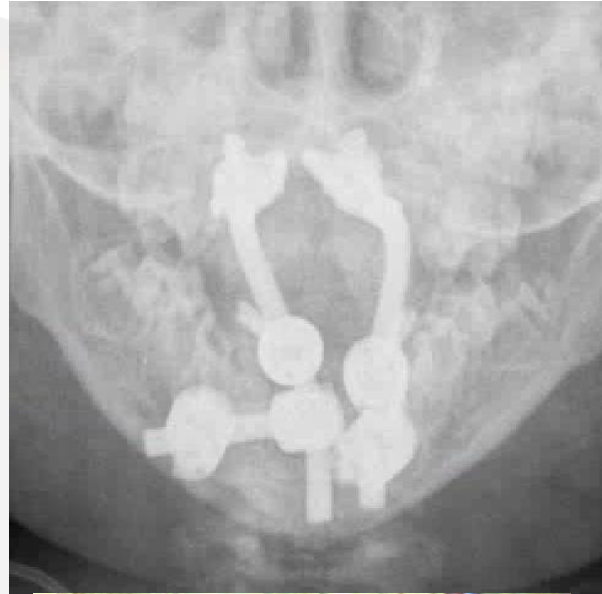
1. Autograft ICBG

- Positioning and draping consideration

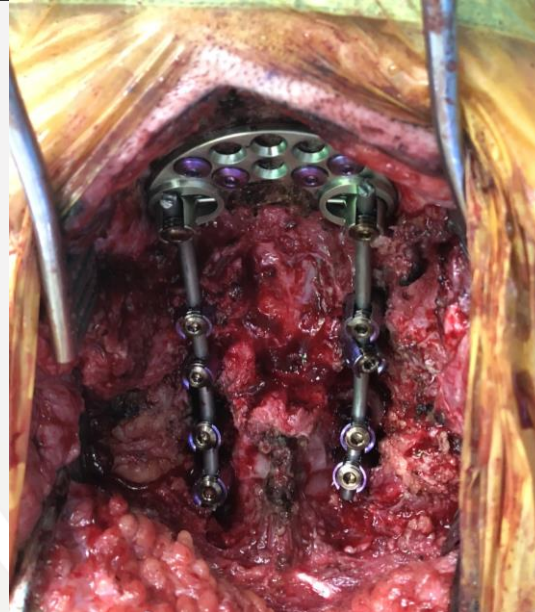
2. Allograft

3. BMP?

- Consent



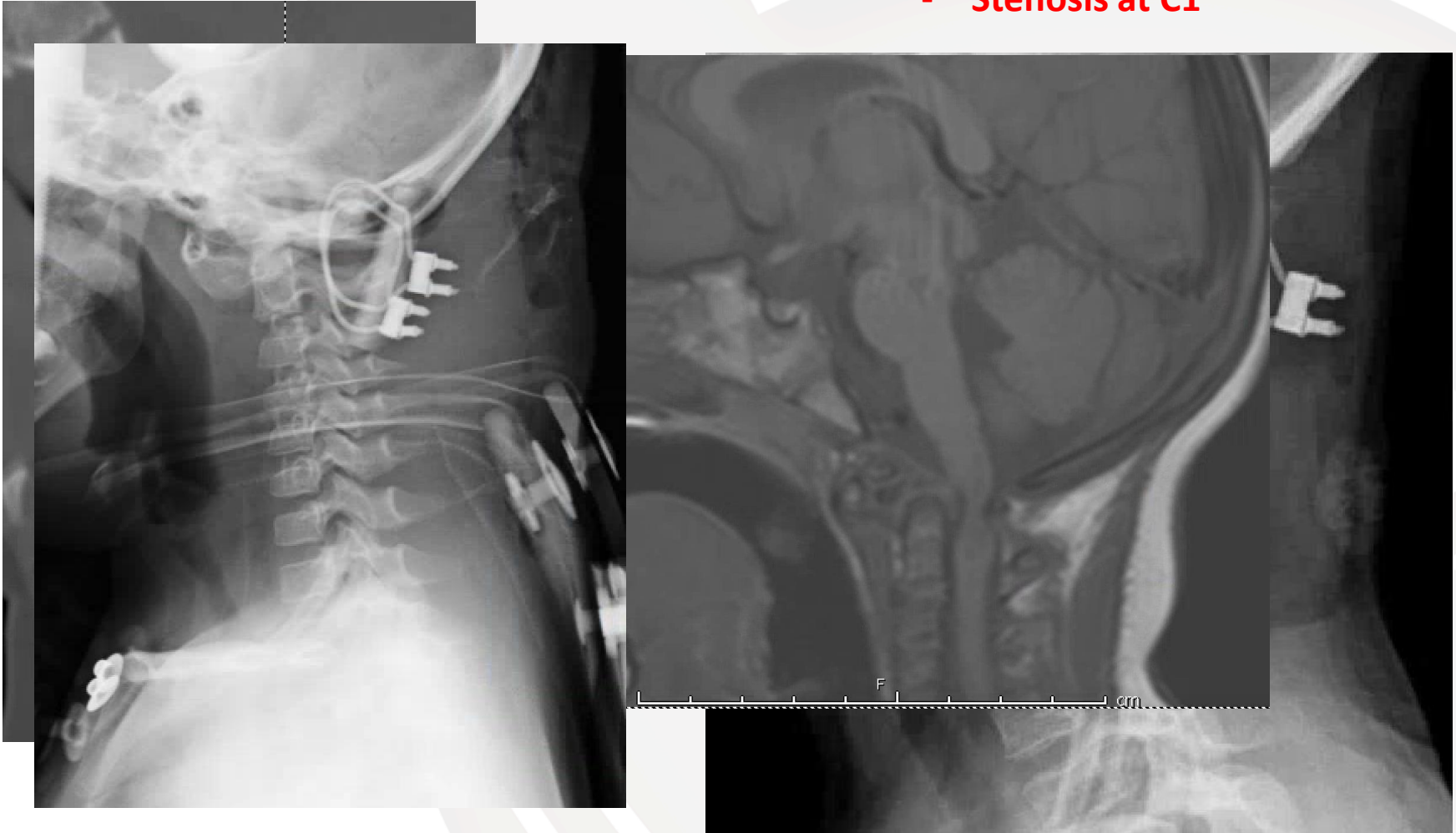
- plate-rod vs.  
occipital plate



# PRE OPERATIVE PLAN

- Implants

- 3 yo - Down's Syndrome
- C1 decompression
- Weakness and hyperreflexia
- O-C2 fusion with fib allo
- OO with instability
- Unilat VA injury during dissection
- Stenosis at C1

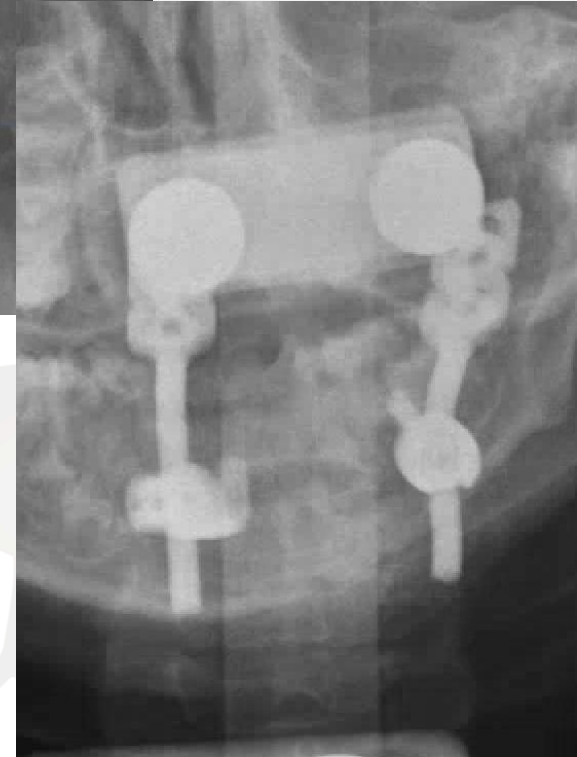


# PRE OPERATIVE PLAN

- Implants

6 months post-op

- Progressive neuro compromise to quadreparesis
- Nonunion, cont instability, basilar invagination
- Revision C1 decom, O-C2 with ICBG



# PRE OPERATIVE PLAN

- Navigation / Imaging
  1. Positioning of bed
  2. Positioning of equipment
  3. What imaging systems needed and order of need
  
- Neuromonitoring
  1. When
    - Pre and post flip?
  2. Positioning of wires



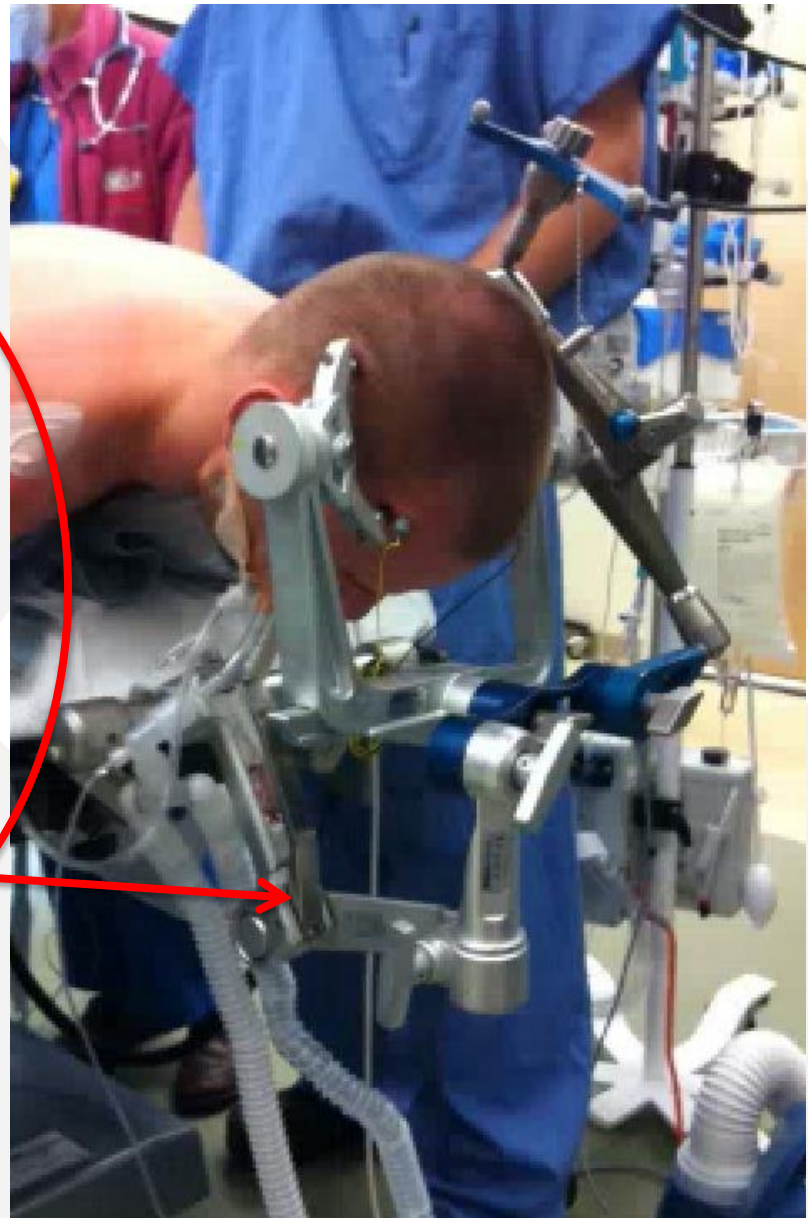
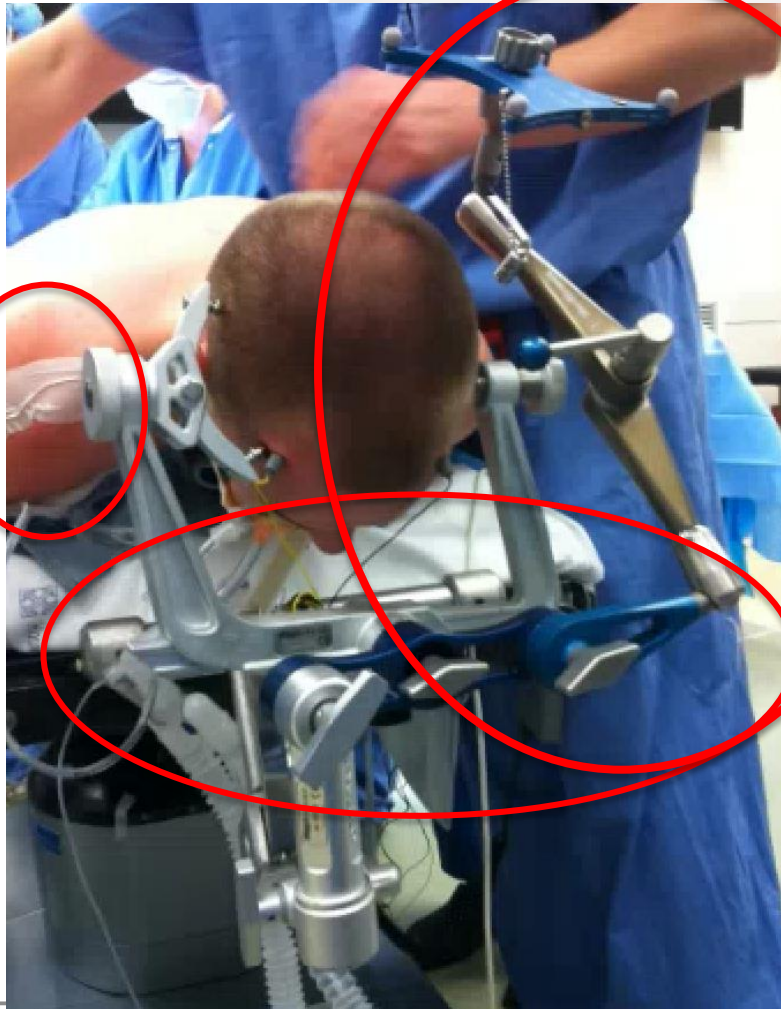
# INTRA-OP

- Patient Positioning
  1. Arms
  2. Iliac Crest
  3. Head fixation and positioning
    - Imaging
    - Navigation
  4. Room Set up



# INTRA-OP

- Patient Positioning



# INTRA-OP

- Imaging
  1. Depends on plan
  2. C-arm → O-arm → C-arm
  3. O-arm management
    - a) How to drape
      - Free
      - Circular drape
    - b) Post implant scan
    - c) Saving images





# INTRA-OP

- Implants

1. Occiput

- Size of occiput vs implants
- Plates vs plate-rods

2. C1 fixation

- Lateral mass screws
- Occipital wiring

3. C2 fixation

- Options based on size of posterior elements
- Vertebral artery – position and condition



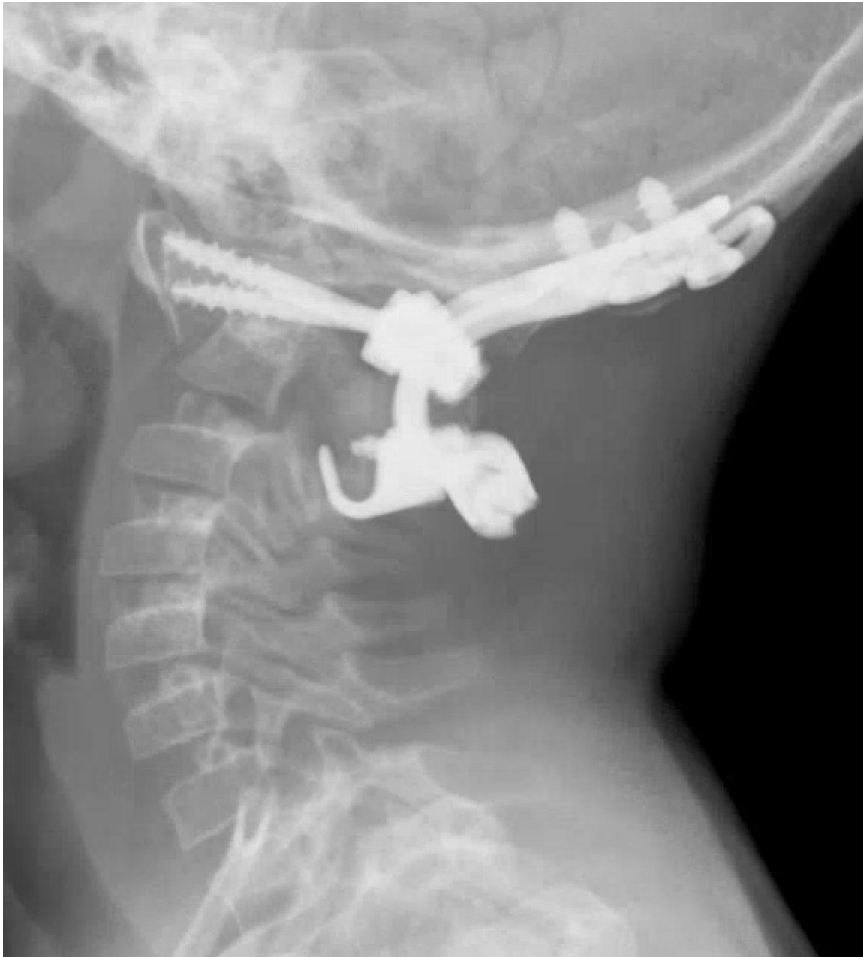
# INTRA-OP



6 year old girl  
- Downs Syndrome  
- Myelopathic on exam

## O-C2 fusion

- C1 lateral mass
- C2 laminar hook
- C2 intralaminar screw



# INTRA-OP

- Implants
  4. Subaxial cervical spine
    - size
    - imaging
  5. Bailout plan
- Bone grafting
  1. Placement of graft
    - facet grafting
    - O-1 grafting



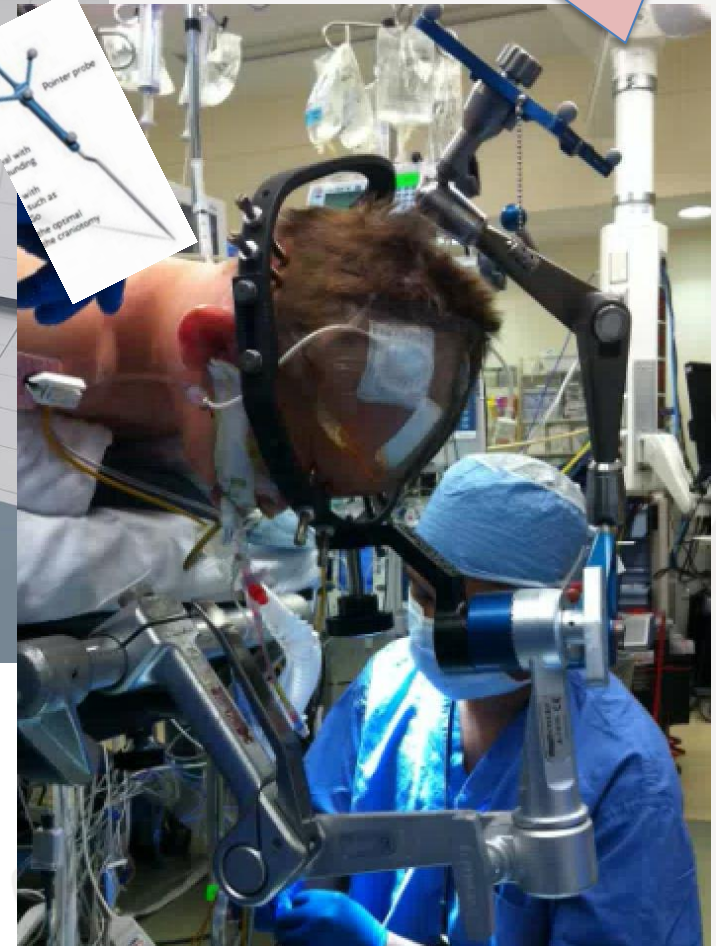
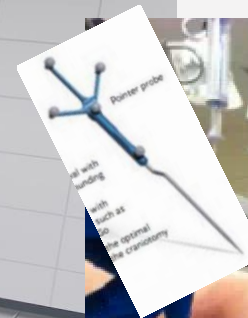
# INTRA-OP

- Navigation
  1. Room set up
  2. Reference frame planning and positioning
  3. Turn bed 90 degrees
  4. What to navigate
    - cactus, drill, screw
  5. Bailout plan



# INTRA-OP

- Navigation



# POST-OP

- Immobilization
  1. Halo vest
  2. Pin-less halo
  3. C-collar



# CONCLUSIONS

1. Many challenges in cervical spine work
2. Not traditionally our “wheel house”
  - Repetition builds confidence and expertise
  - Help from a partner or neurosurgery colleague is ok!
  - Pre-op planning is key to success
3. Know the anatomy and goal
  - Patient specific variables
  - Room set up
  - Positioning
  - Implants
4. Navigation is helpful but not perfect!

