

# C-Spine Trauma in Children <10 yo

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# C-Spine trauma

Kids have disproportionately large heads

- $\leq 8$  yrs old, 87% C-spine fractures Occiput-C3



JPO, 2014

Dietrich, J Ped Surg, 1991

# 206 Pediatric Spine Fractures

Dallas Children's

## 0-3 years

- 51% Pure Ligamentous
  - 79% Occiput-C3
- 42% multiple injuries
- 25% Mortality
- 33% Non-Accidental

## 4-10 years

- 34% Pure Ligamentous
  - 76% Occiput-C3
- 48% multiple injuries

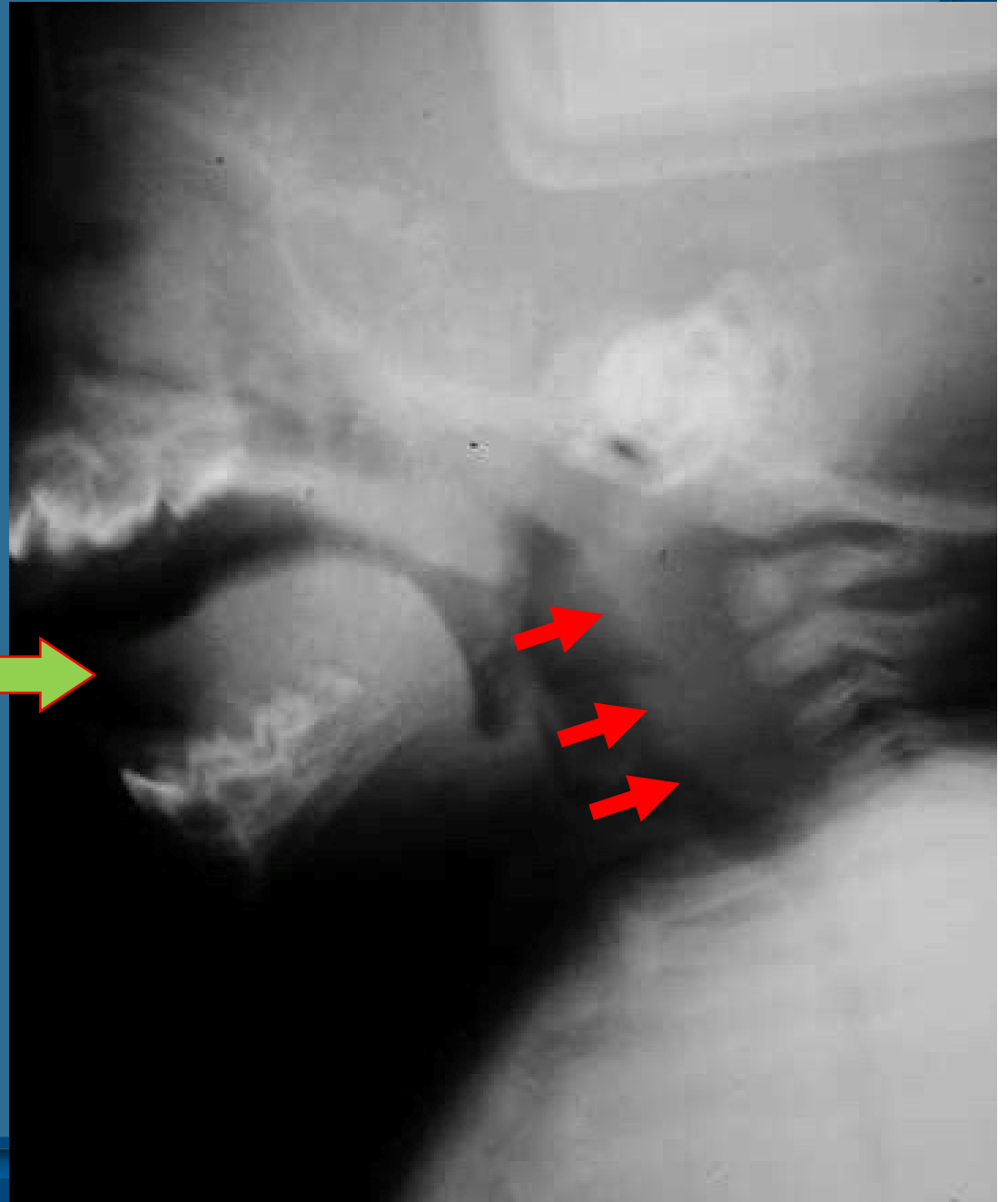
Look for the  
second injury!

JPO, 2014

# Anterior Soft Tissue Swelling

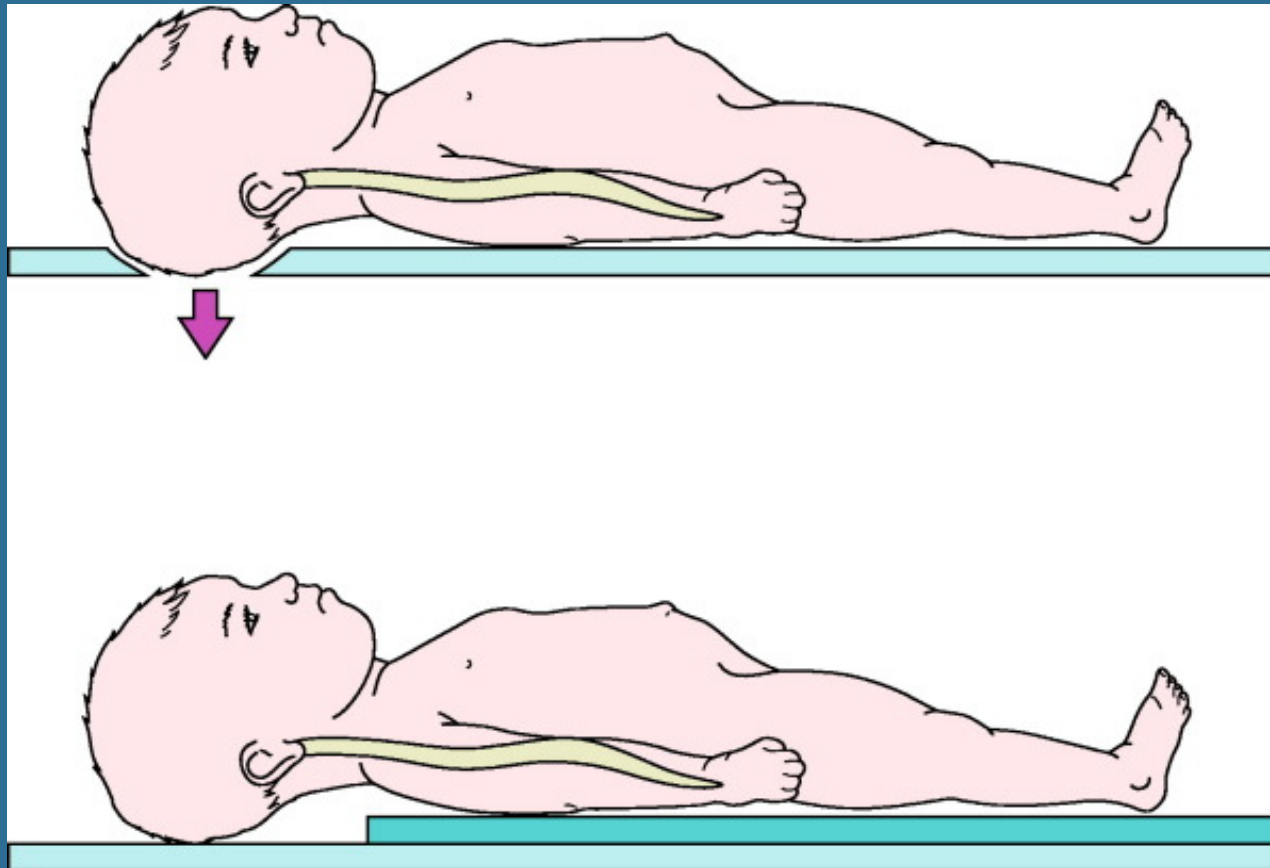
May be normal in kids from crying

Adult rule  
7mm at c2  
22mm at C7

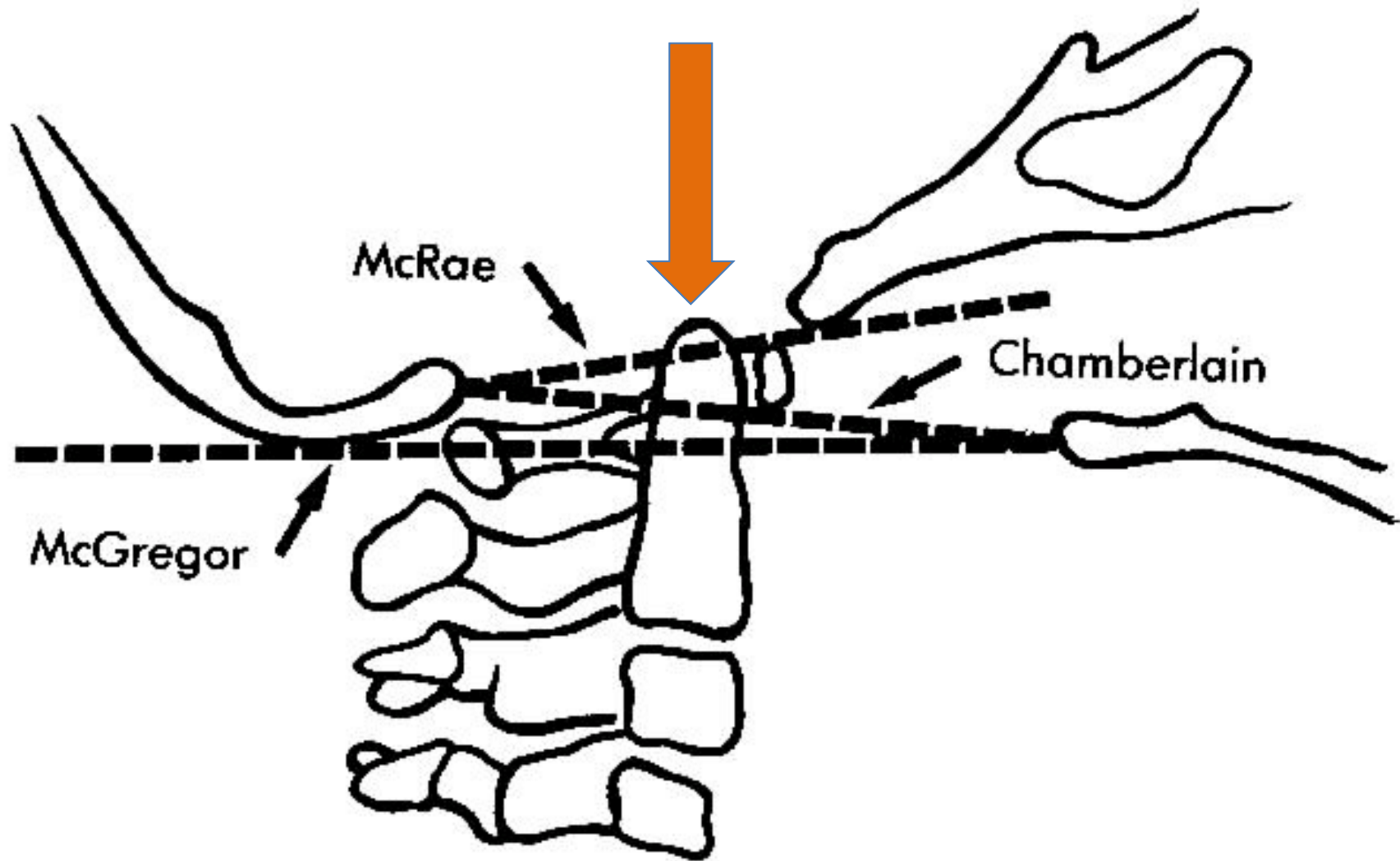


# Avoid Cervical Flexion During Transport

Test ?

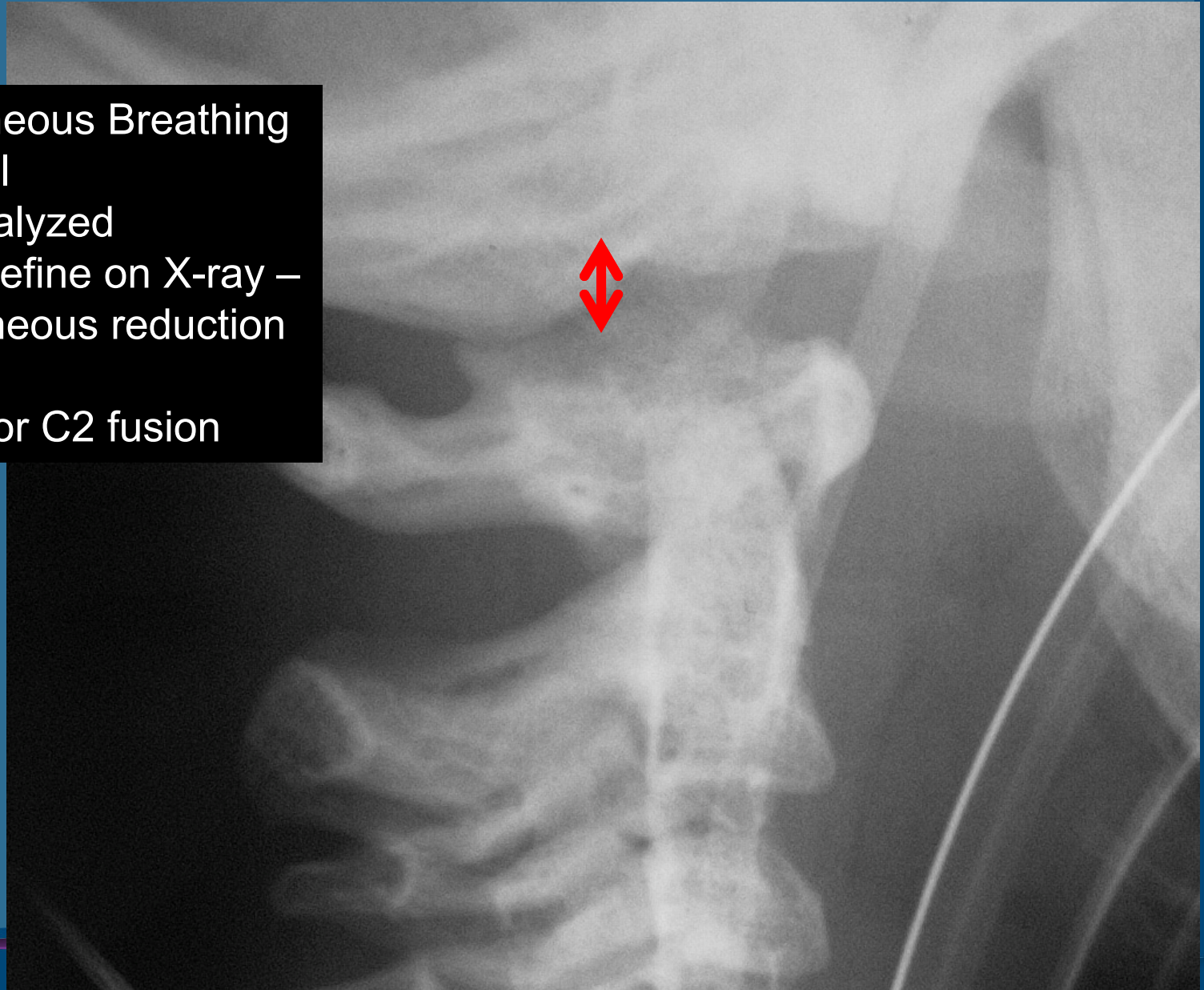


# Position of Dens Vs. Skull



# Occipital Cervical Disassociation

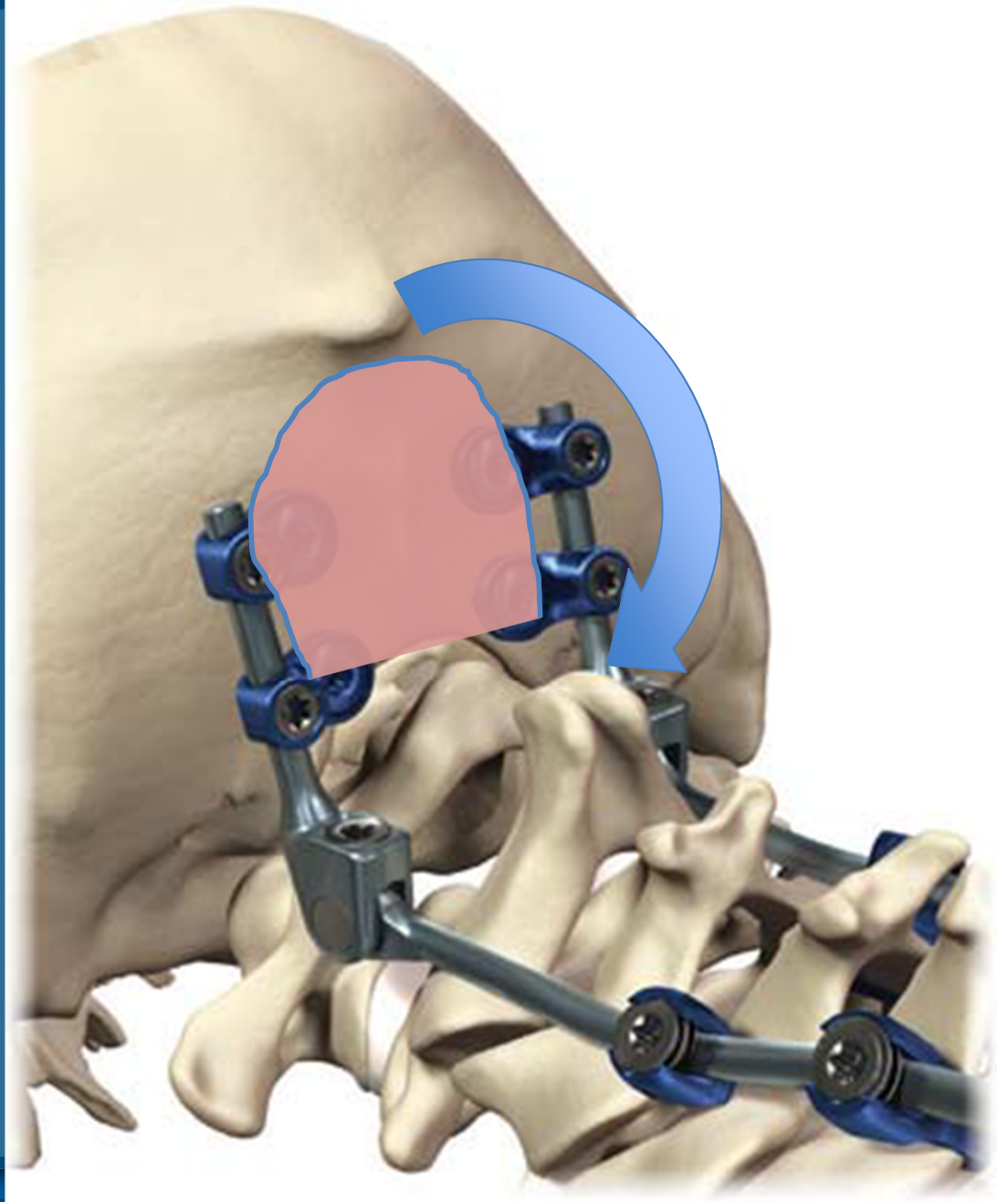
No Spontaneous Breathing  
Usually fatal  
Usually paralyzed  
Difficult to define on X-ray –  
spontaneous reduction  
MRI  
Occiput-C1 or C2 fusion



## Periosteal turndown flap

Occiput - C1 or C2  
fusions

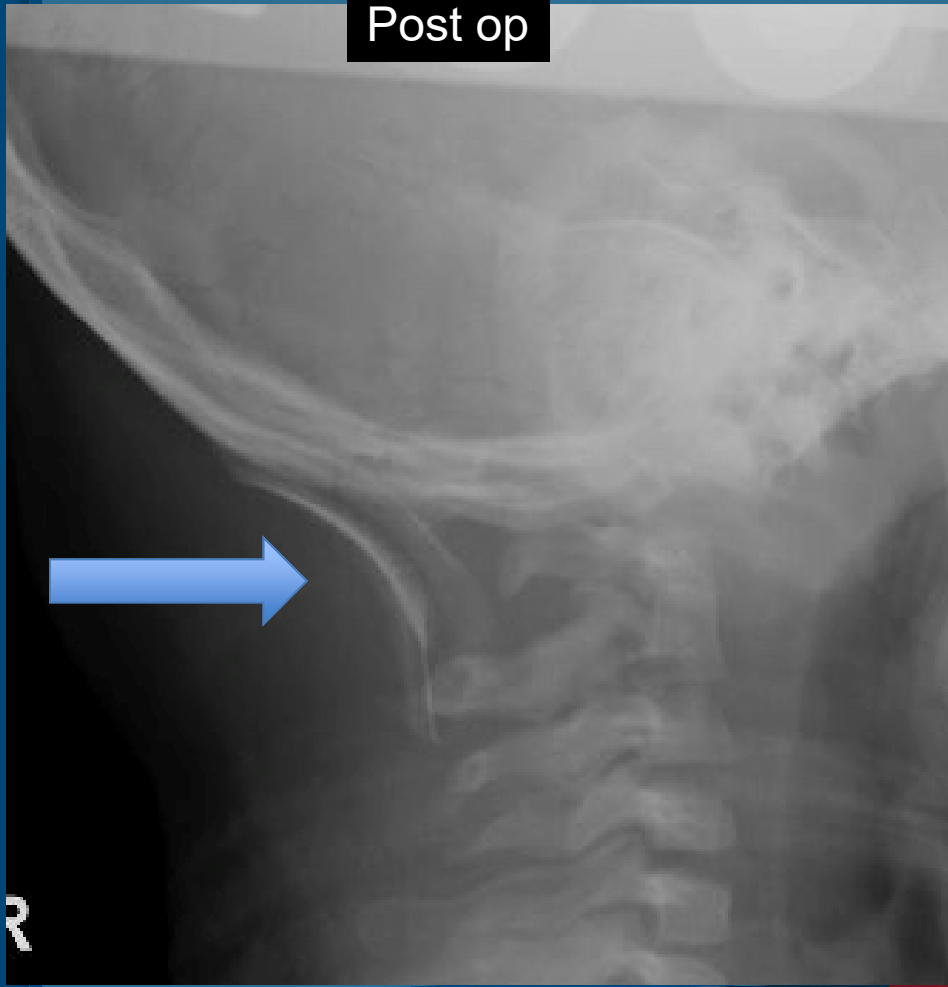
\* Great when posterior  
arch of C1 is absent





# Periosteal Turndown Flap

Post op



4 months

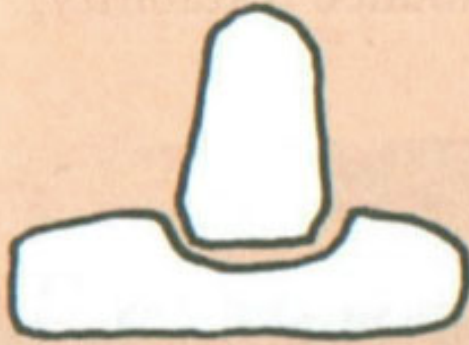


R

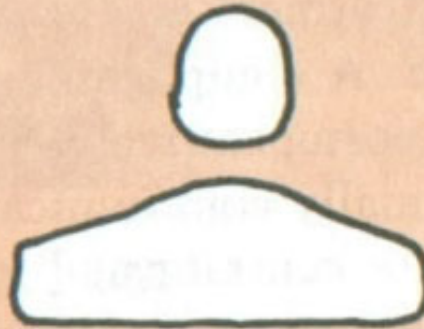
ORTHODONTIC CENTER

# Dens Anatomy (C2)

Normal physis  
(Below facets <6yrs)



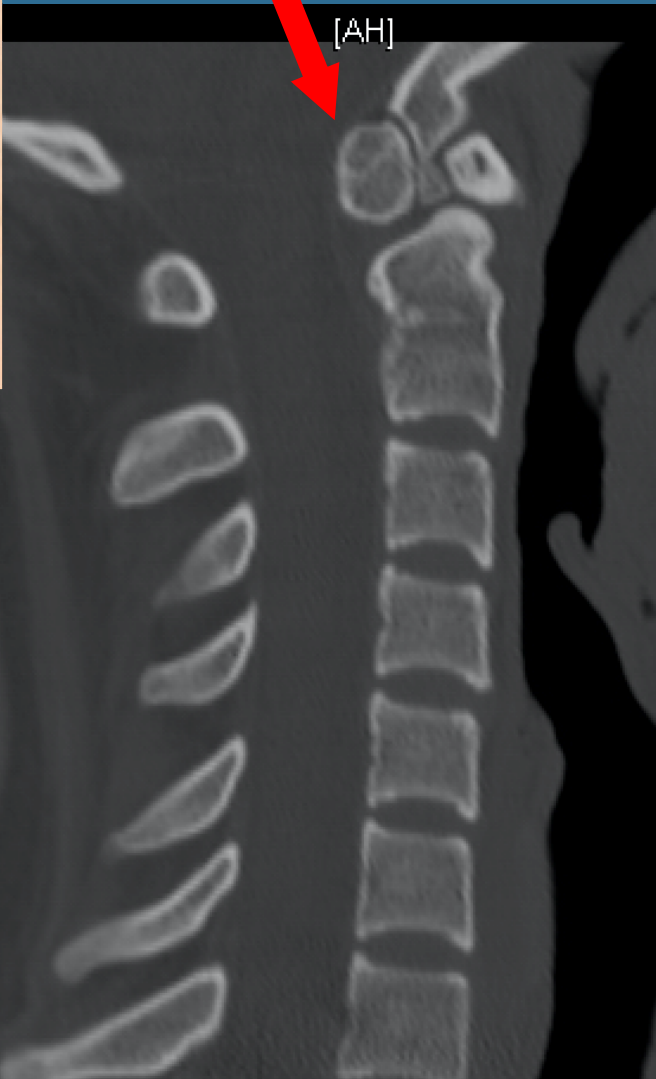
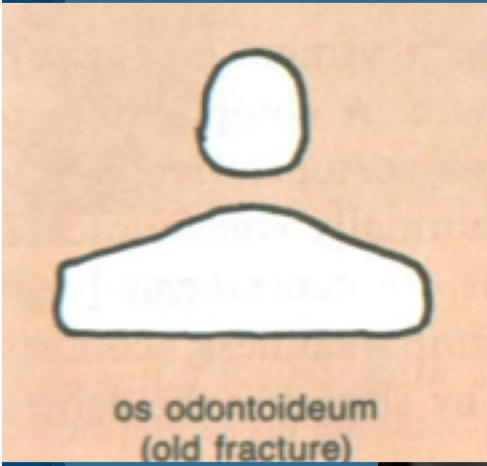
Os Odontoideum  
(Old Fracture)



Os Terminale  
(25% of kids)



# Os Odontoideum



# Dens Fracture

## Halo placed with Neuromonitoring

Injury



Halo  
Pre Reduction



Halo – neck extended  
Good reduction



Southern California

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CHILDREN'S  
ORTHOPAEDIC CENTER

## 4 yo boy s/p fall on head while jumping on trampoline

- Initial CT read as negative
- Neuro intact
- Sent home



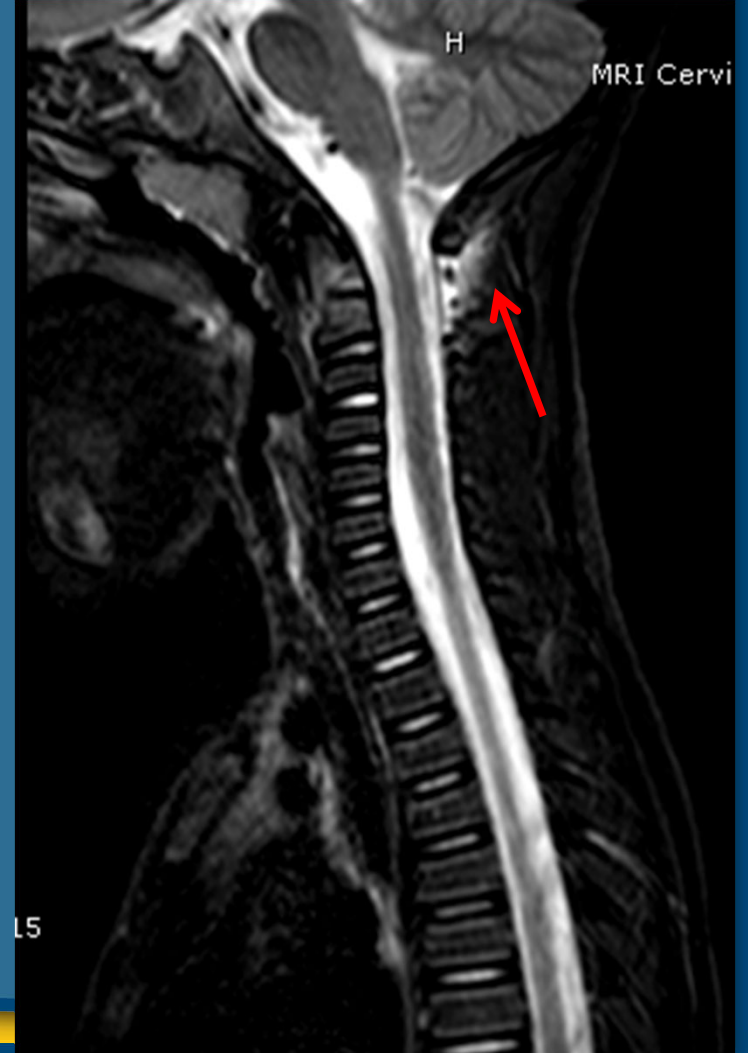
Note: Little Anterior Soft Tissue Swelling

**2 weeks later**  
**Continued pain**

- F/U x-rays showed displacement.



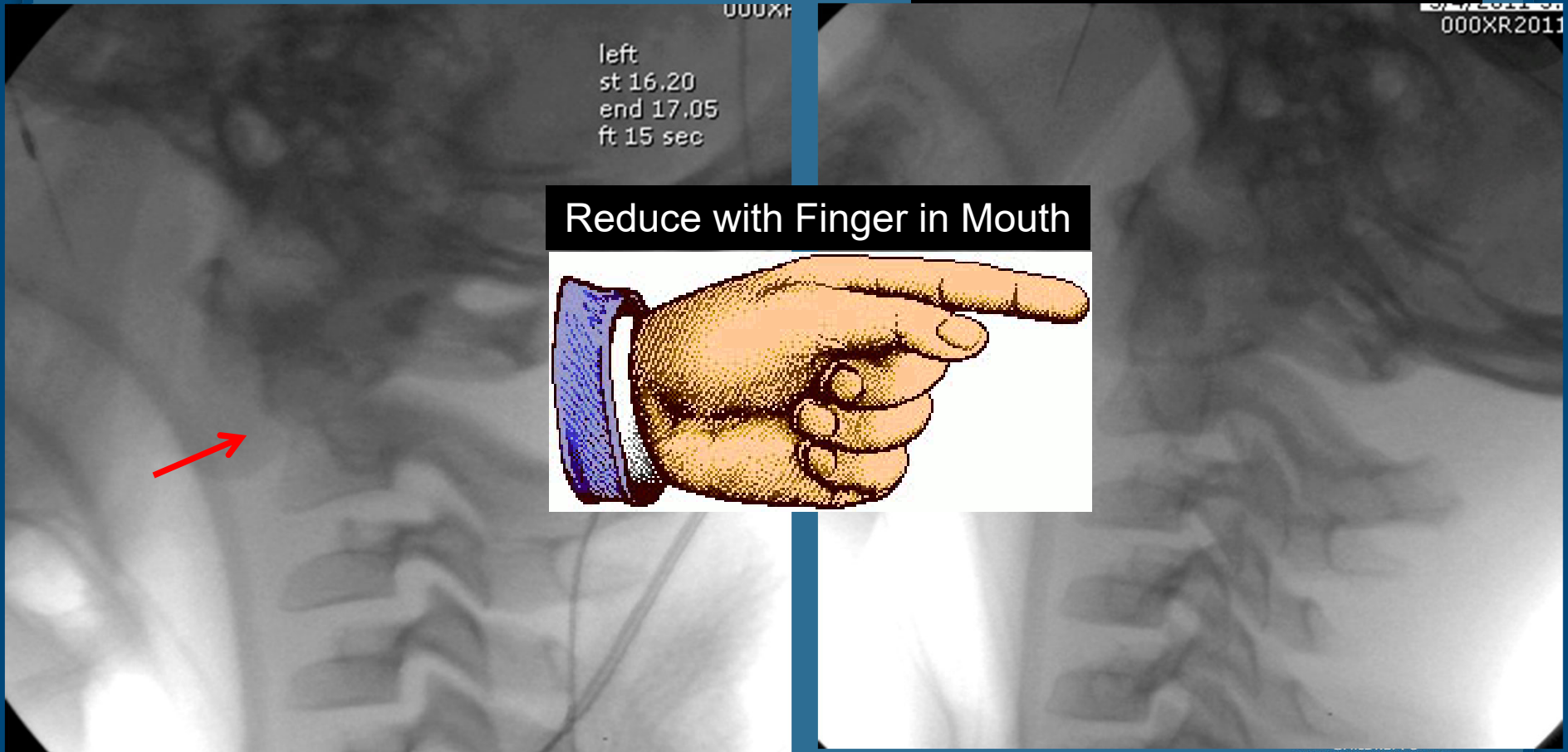
# MRI: Posterior Soft Tissue Injury ? How unstable?



# Halo Vest under Anesthesia with Neuromonitoring

Pre-Reduction

Post-Reduction  
Gentle Extension and Traction

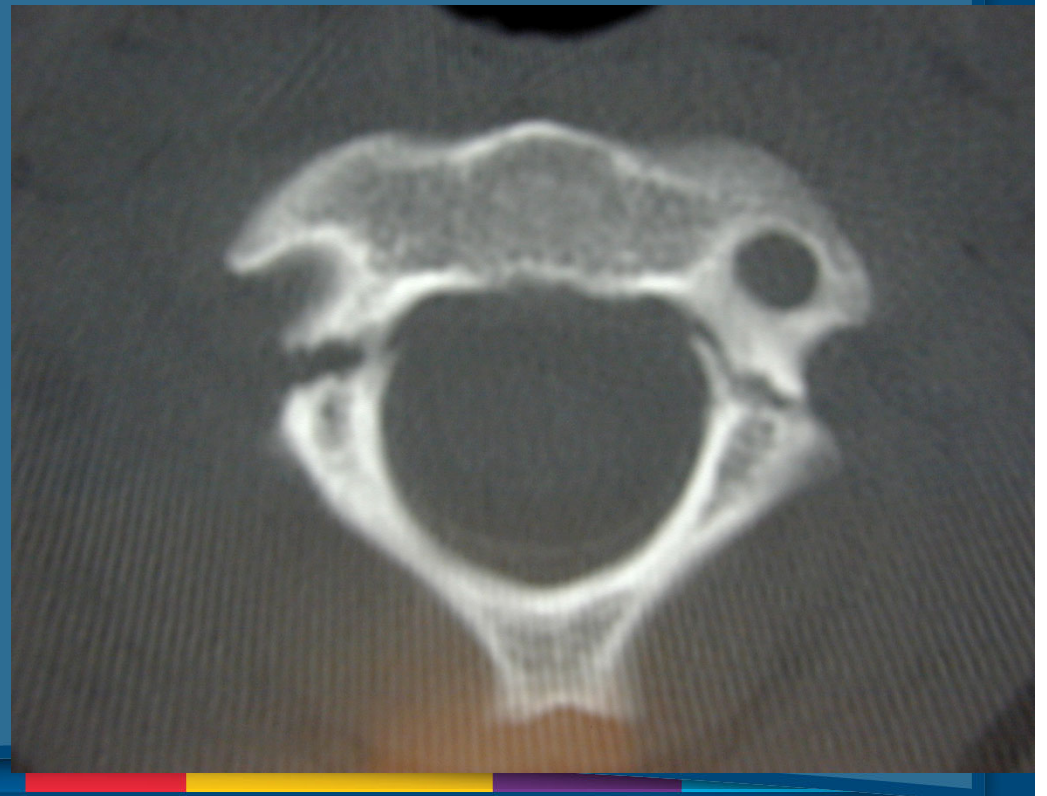




# 8 yo C2 Fracture - Hangmans

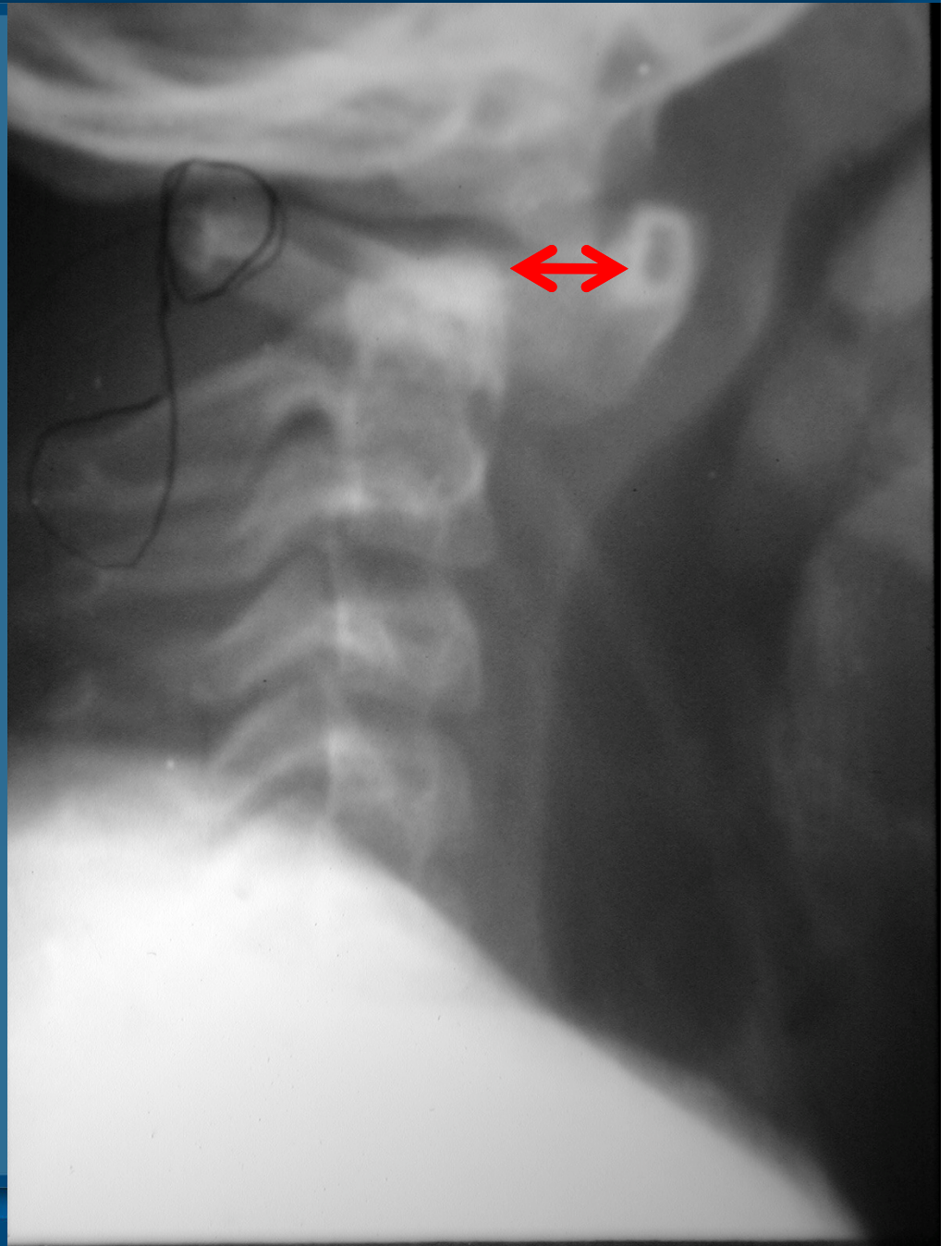
Halo 6-8 weeks

CT to assess healing

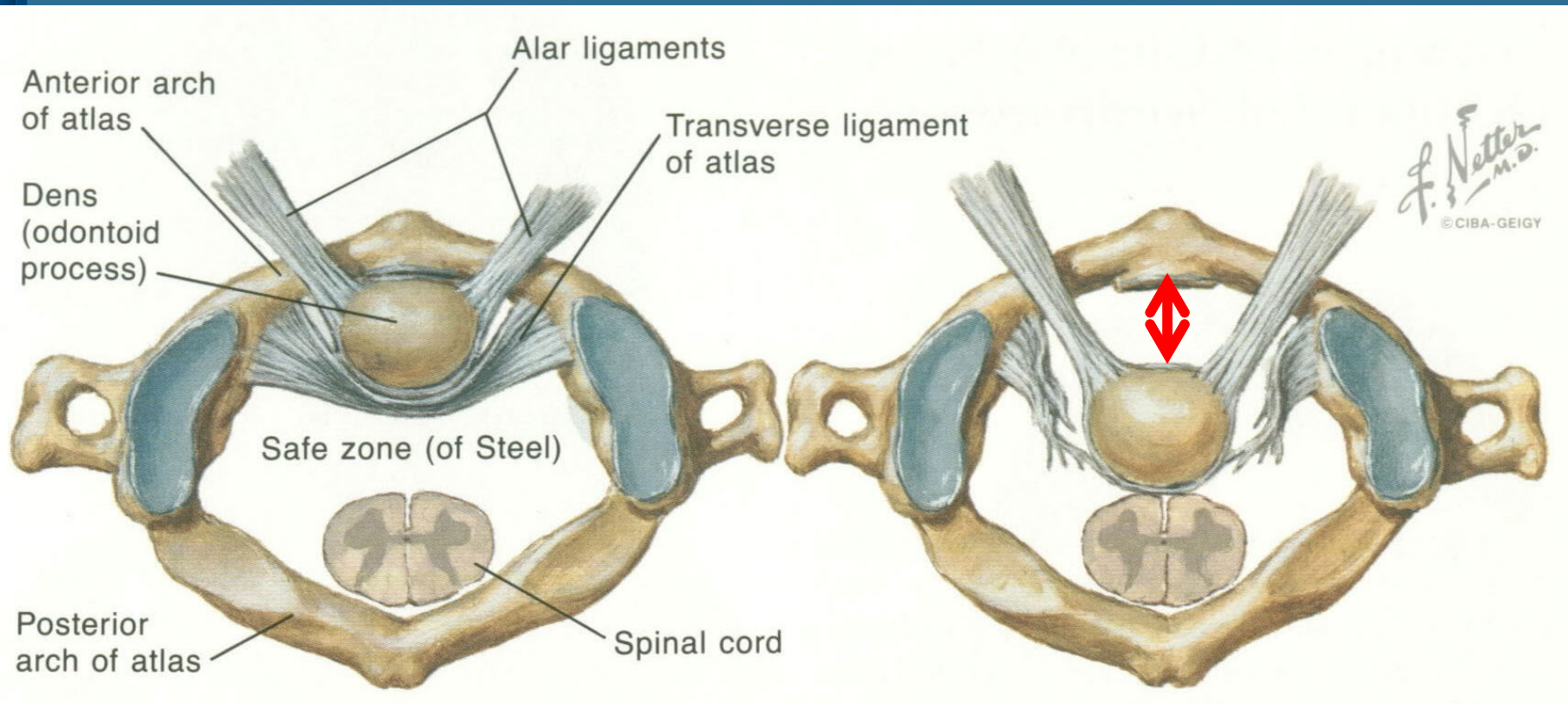


## Atlanto Dens Interval ("ADI")

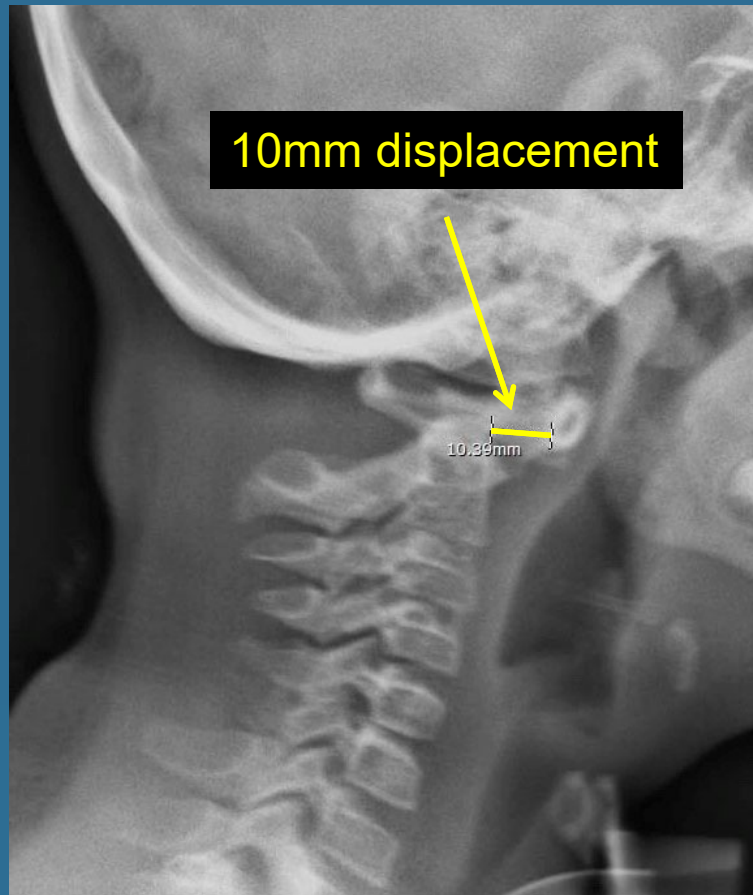
$\leq 5\text{mm}$  children  $< 8\text{yrs}$

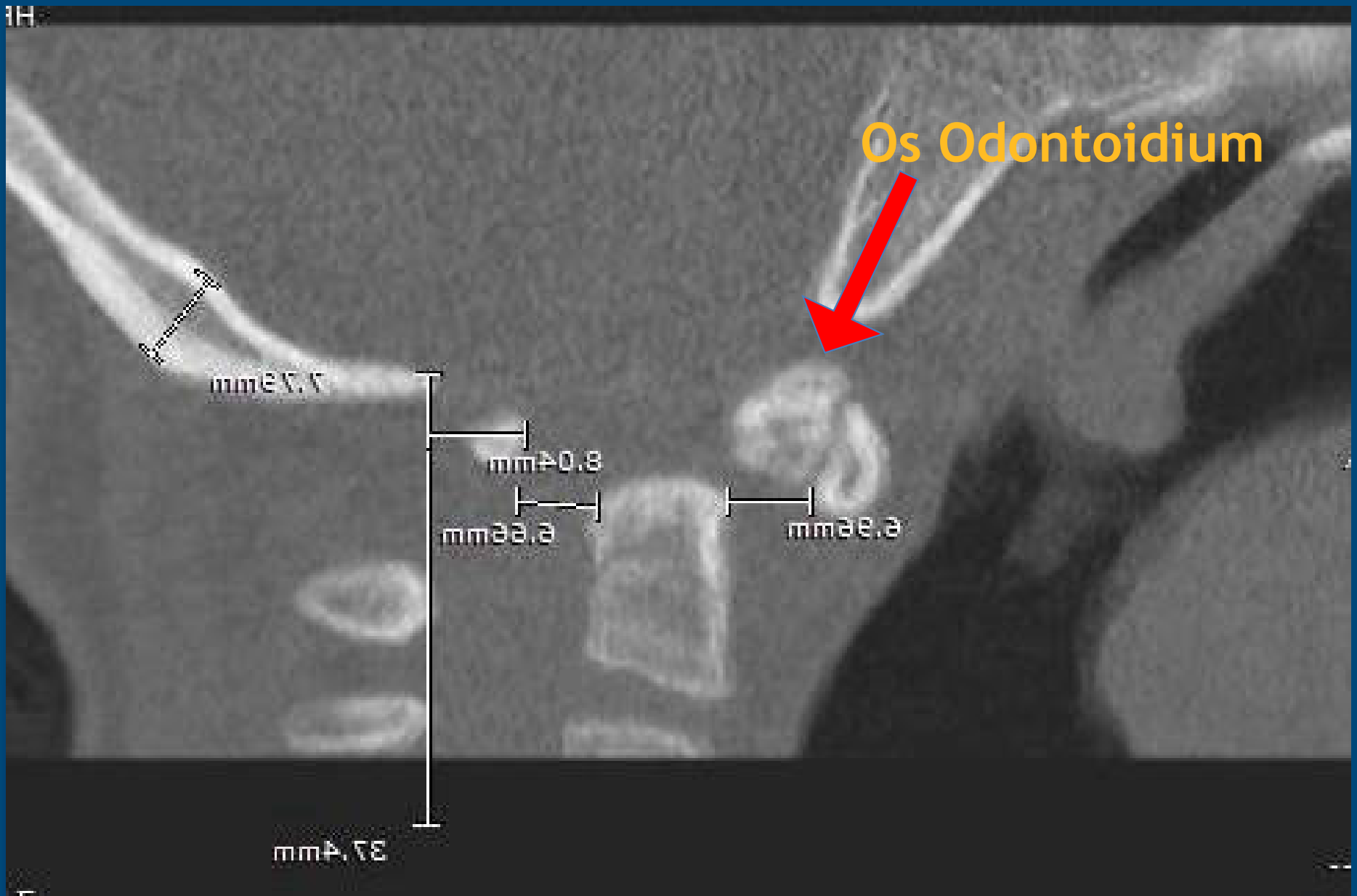


# Atlanto-Dens Interval



## 8 y/o C1-C2 instability, Os Odontoidium



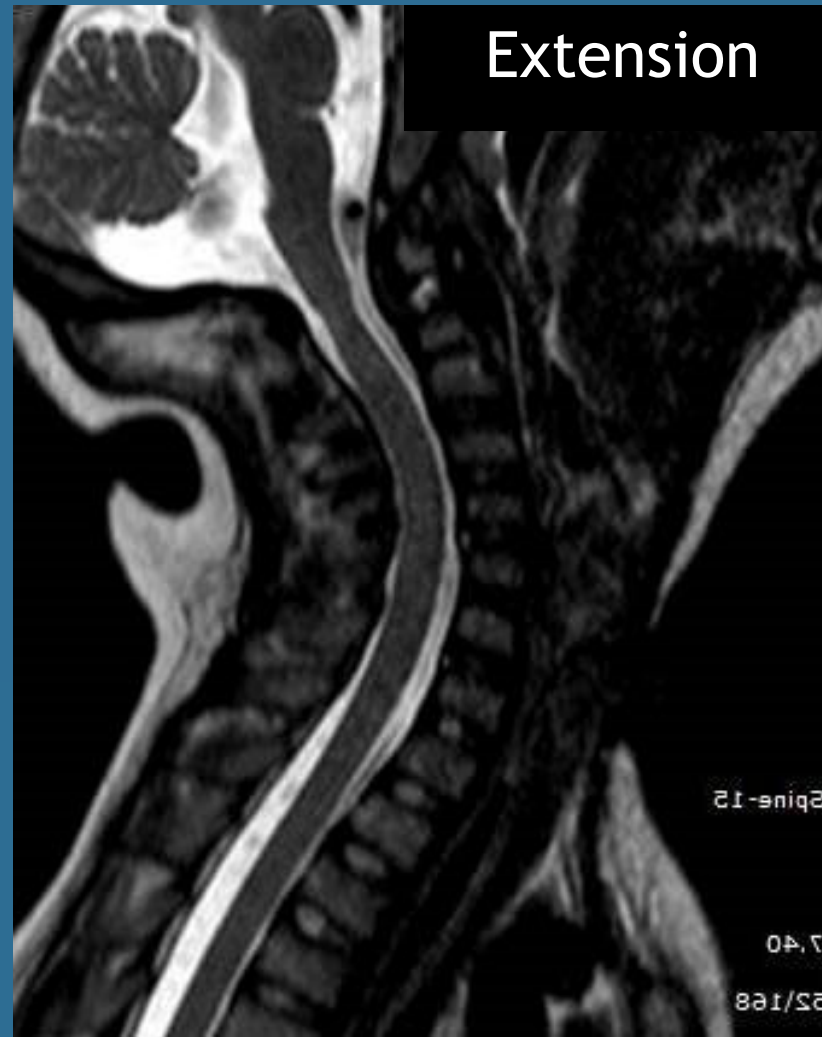


# Dynamic MRI Cord Pinched in Flexion

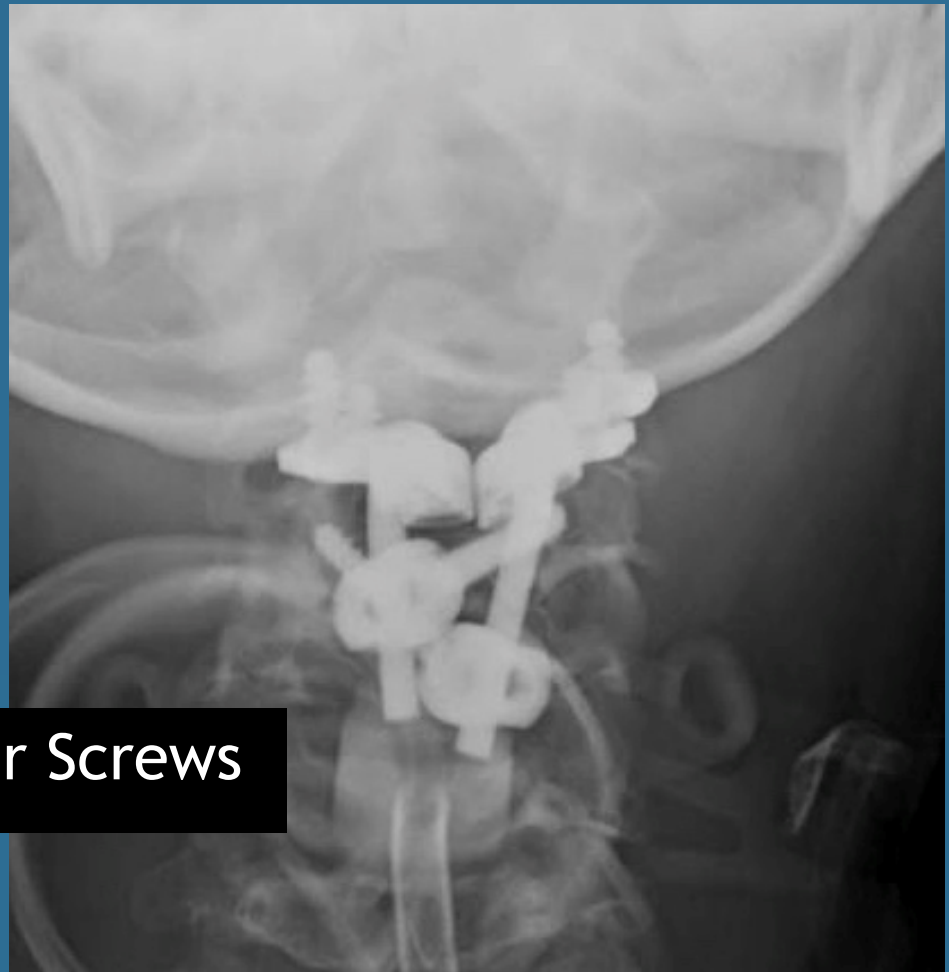
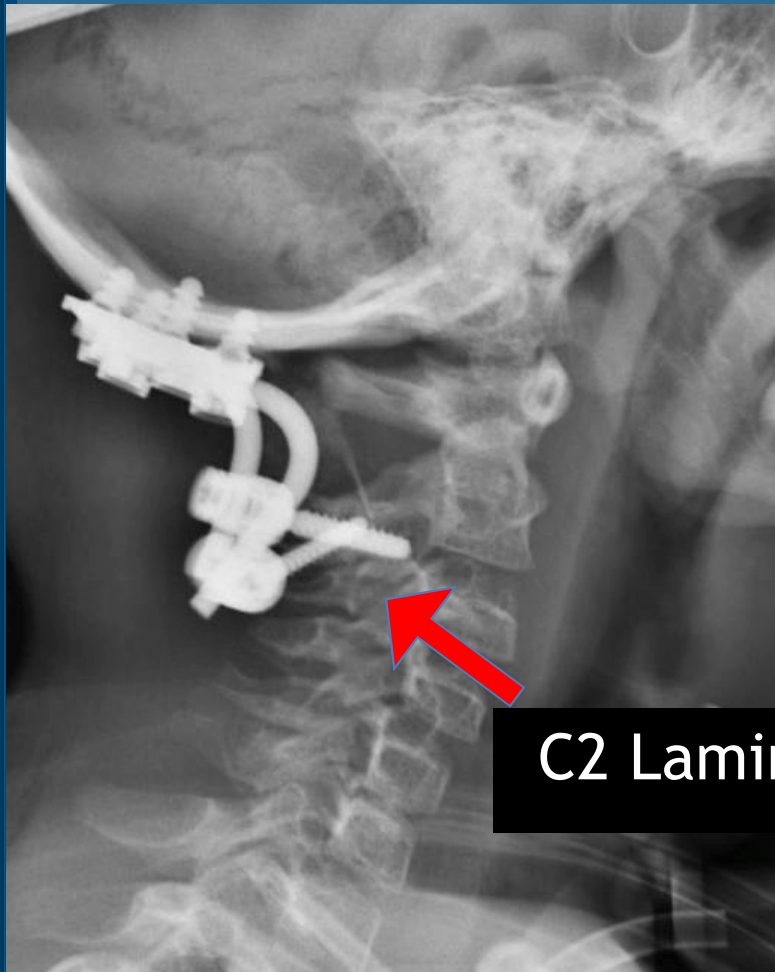
Flexion



Extension

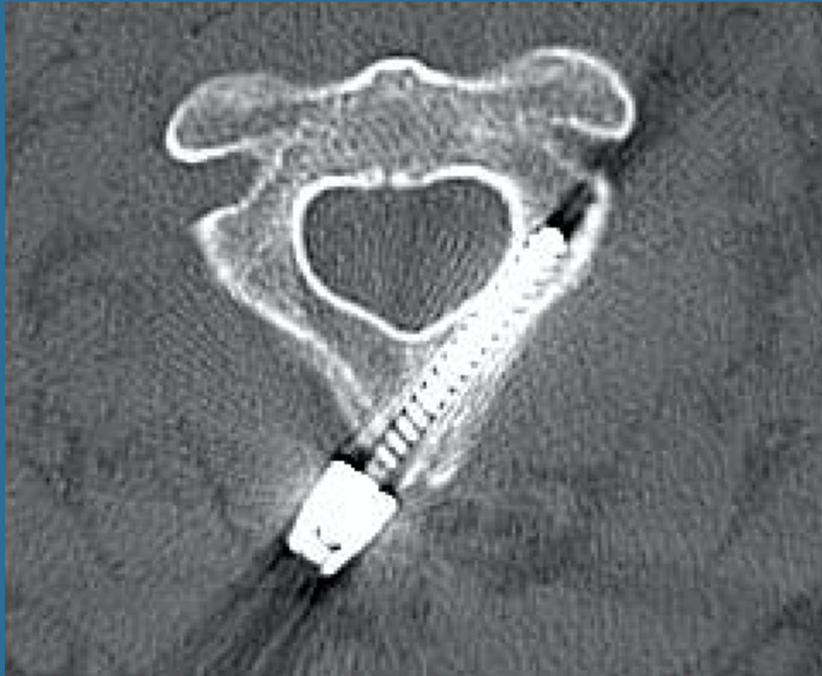


# Treatment Unstable Dens Fx in Wild 6 yo with Downs: PSF Occiput to C2



C2 Laminar Screws

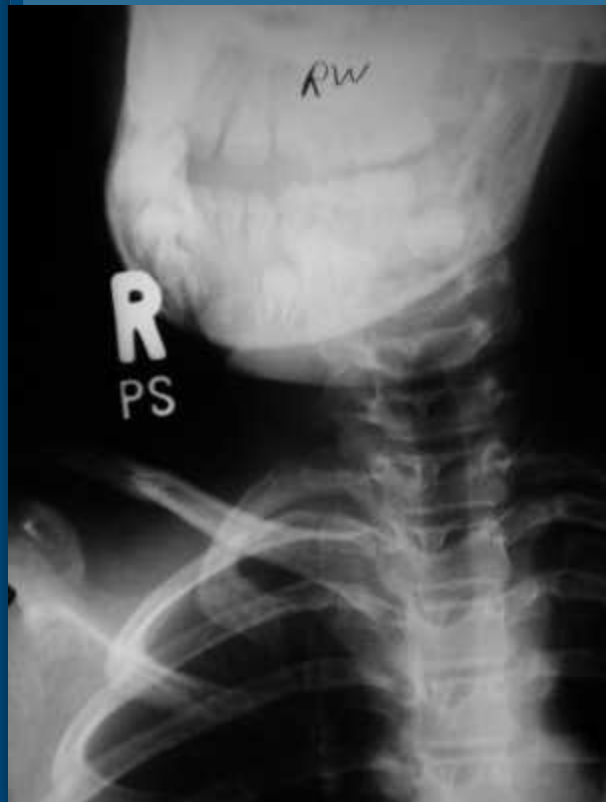
## C2 Laminar Screws (4.0 x 26-30mm)



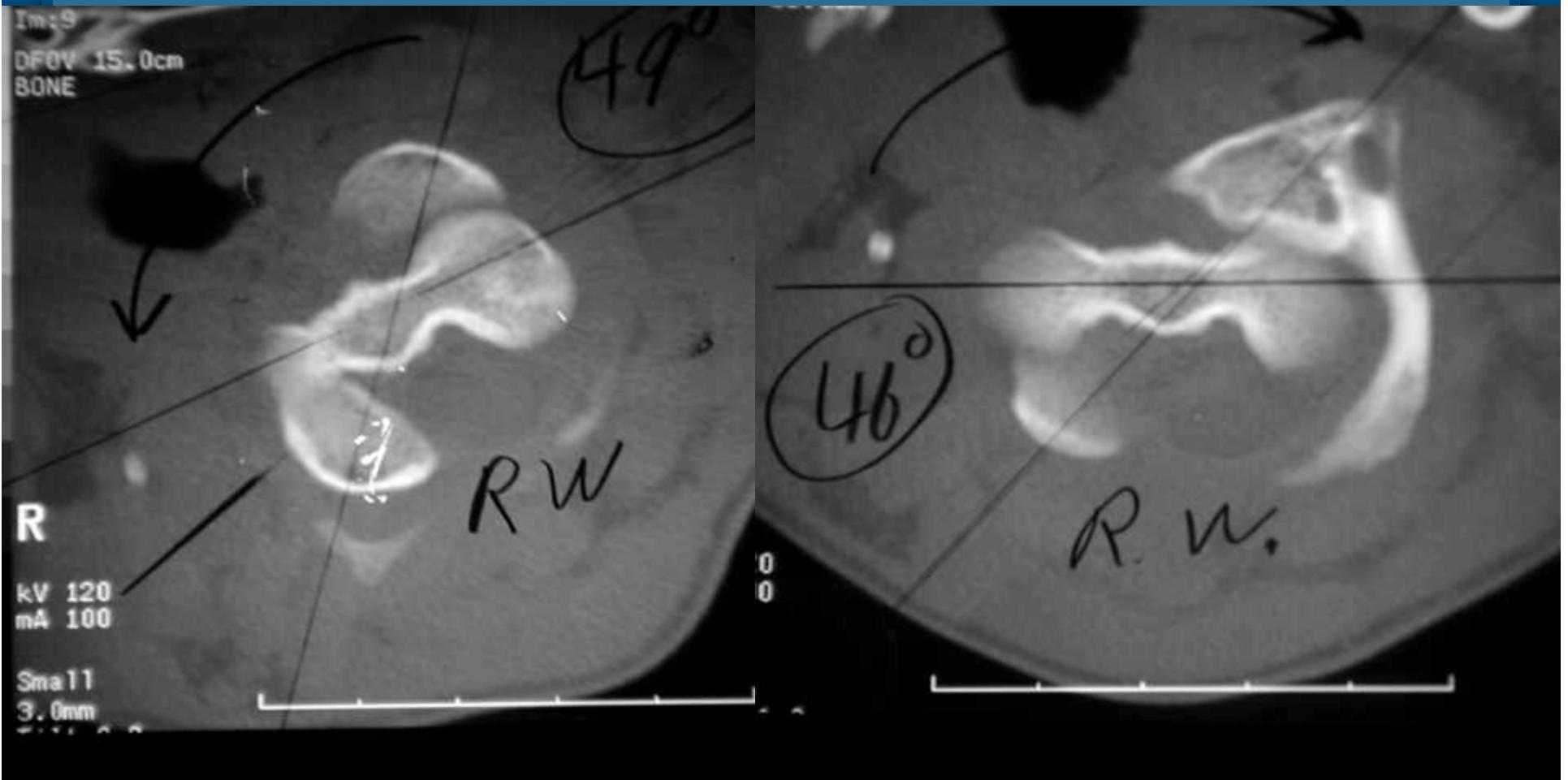


# Acute Torticollis C1-C2 Rotatory Subluxation

Head does not rotate past midline

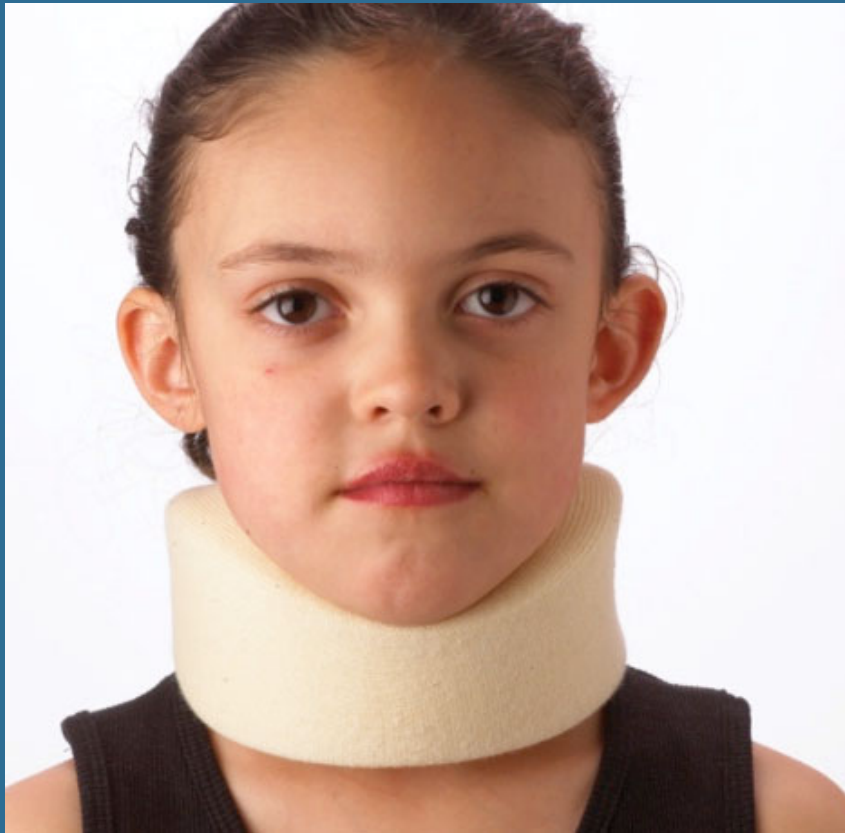


# C1-C2 Rotatory Subluxation Dynamic CT

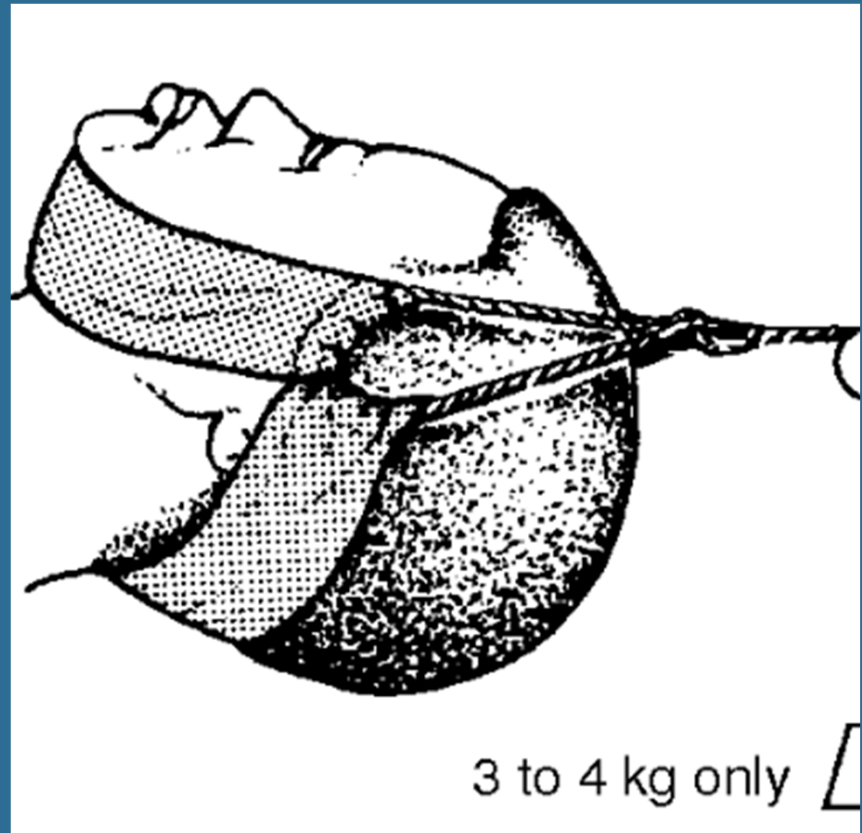


# C1C2 rotatory subluxation - Treatment

Presenting 1-2 days



Presenting  $\leq 7$  days  
Halter Traction + Valium



3 to 4 kg only

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# Next Step: Closed Reduction Pinless Halo



- CT confirms reduction
- Halo 6 weeks
- If recur, then C1-C2 fusion

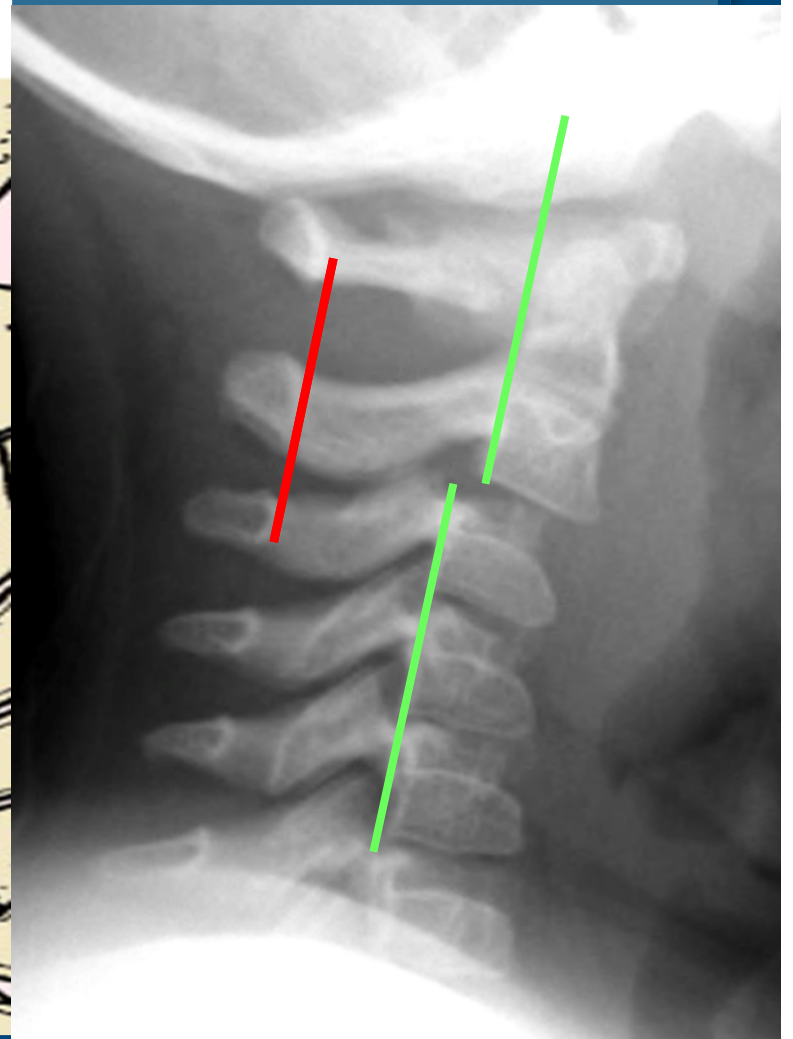
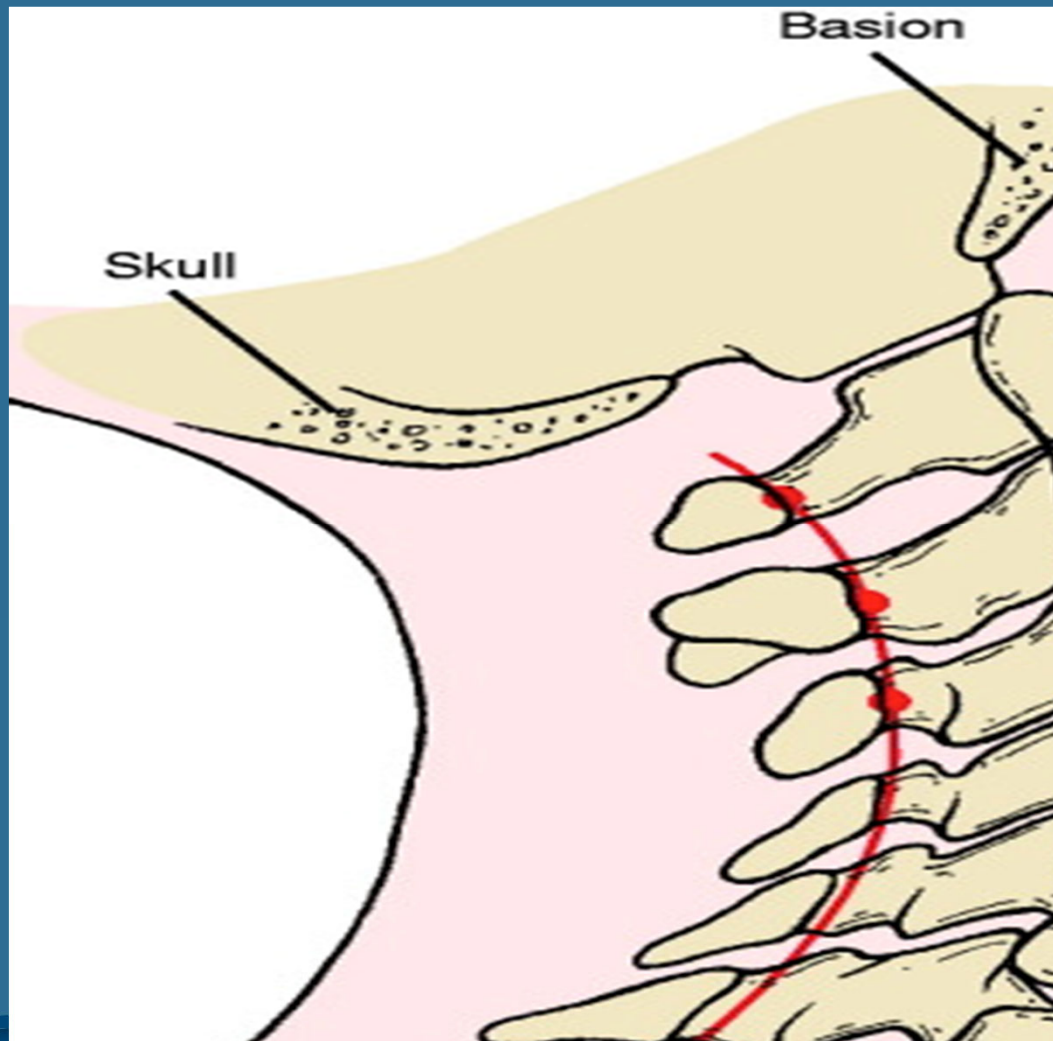
# C1-C2 Posterior Fusion



# Following C1-C2 Posterior Fusion



## Swischuk's Line - Assess C2-C3 Alignment



# Pathology

Hoffman, Dana  
1458767  
11/9/1995  
F

X/R SPINE  
10/27/2002  
E-00791053

>1.5mm



# C2-C3 Pseudosubluxation Normal

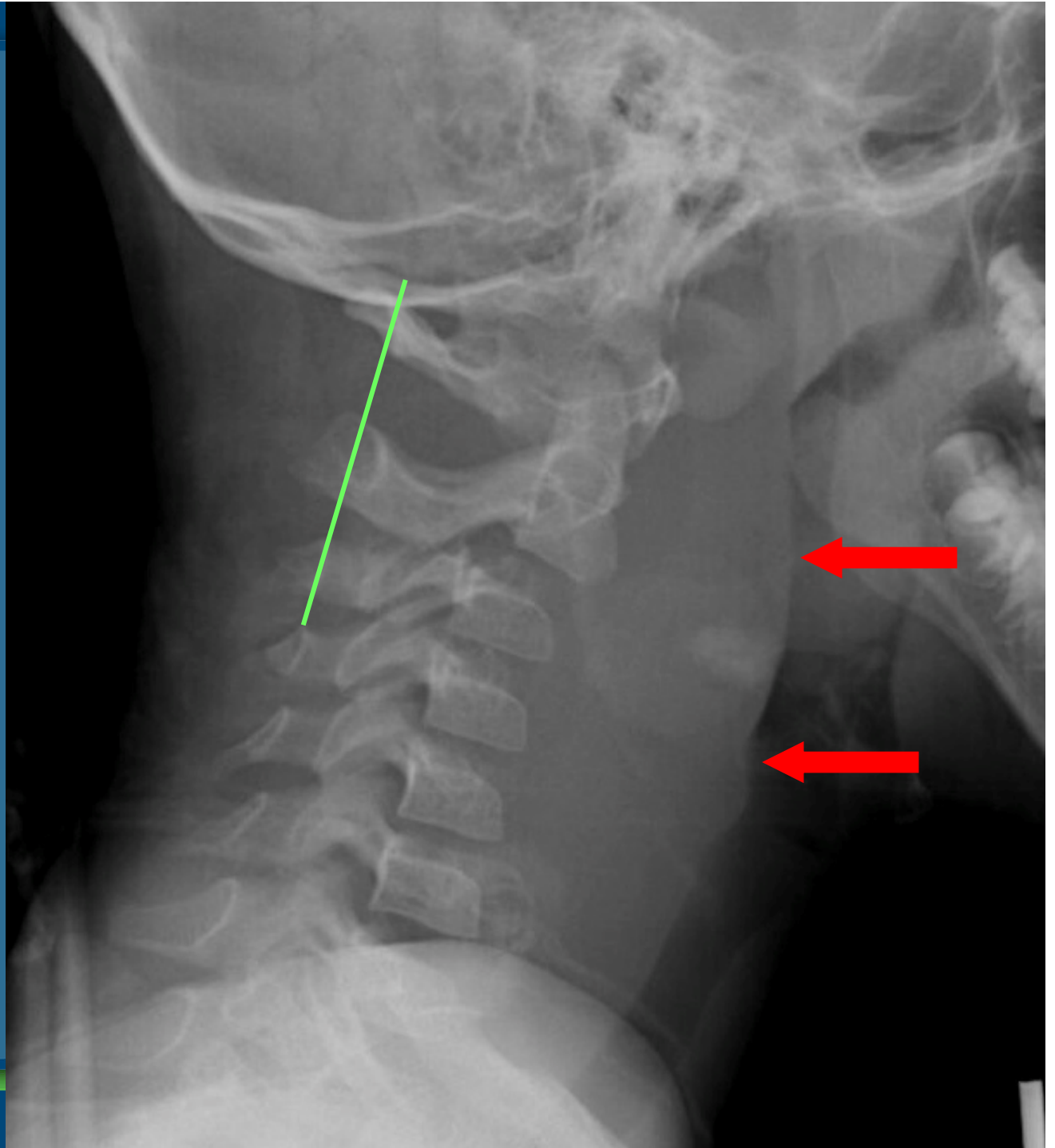




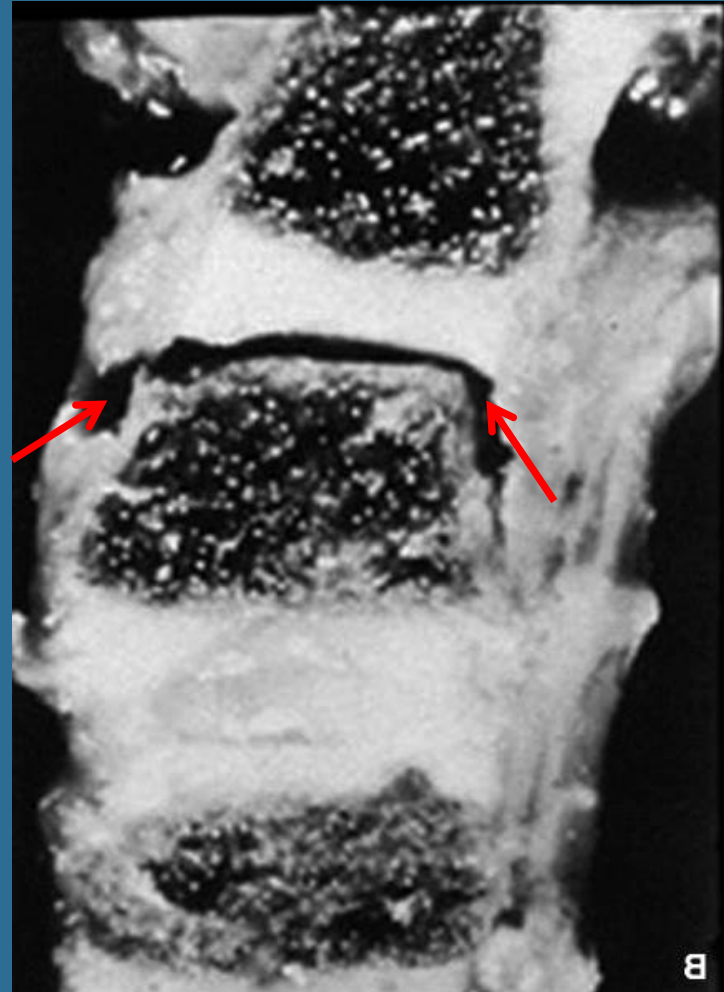
**6 yo girl**

**MVA**

**Neck  
Hurts**



# Endplate Fracture



# Endplate Fracture



# Dens Endplate Fracture

6 yo girl – MVA

Hoffman, Dana  
1458767  
11/9/1995  
F



Treatment:  
Gentle  
Extension +  
Halo Vest

# 6 yo girl – MVA

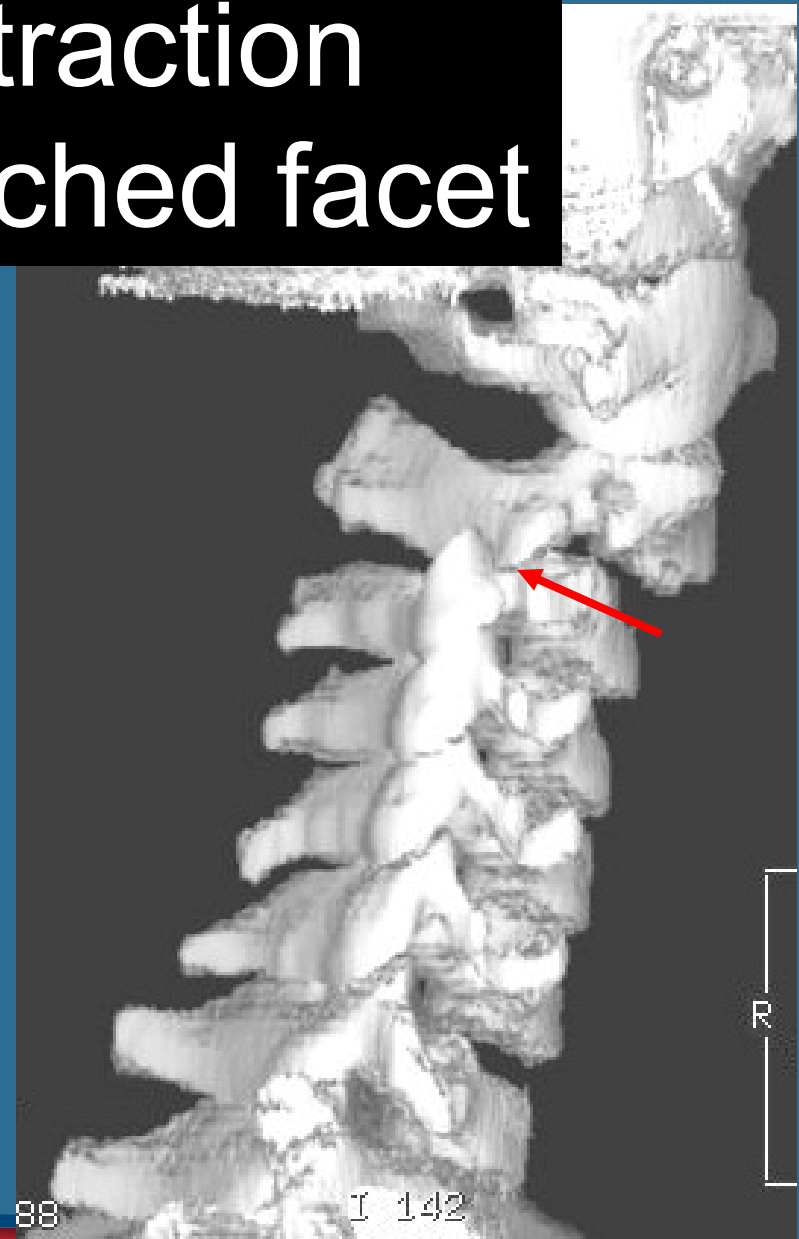
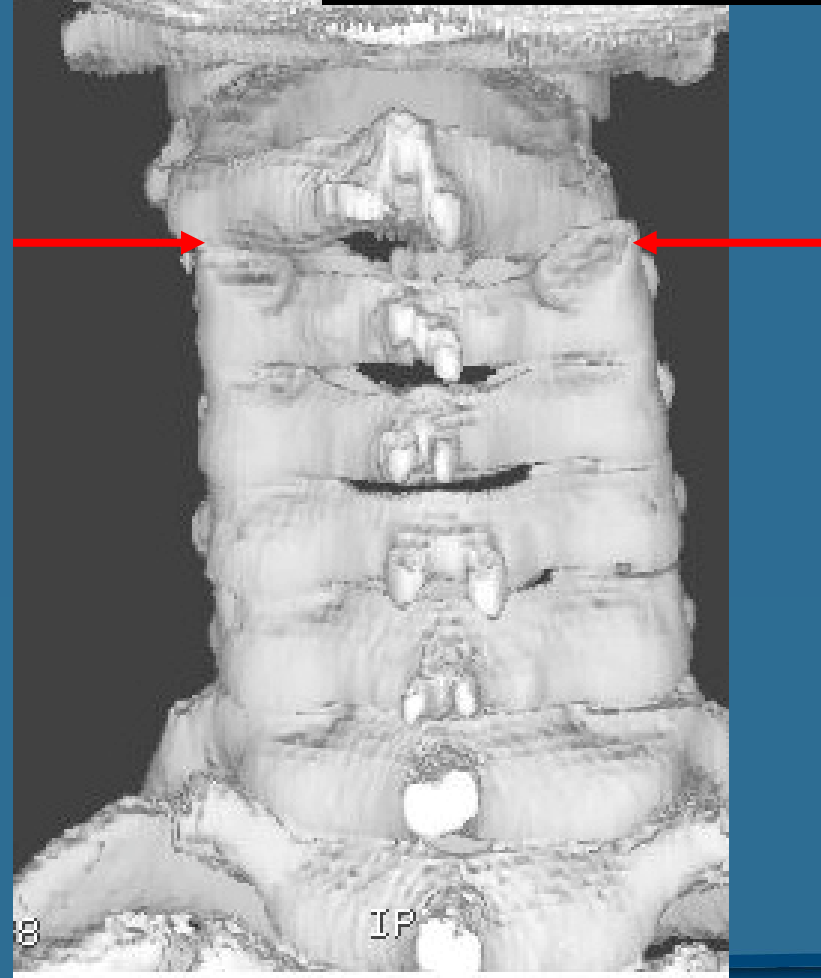
## Presentation



10 lbs halo traction  
not good treatment!



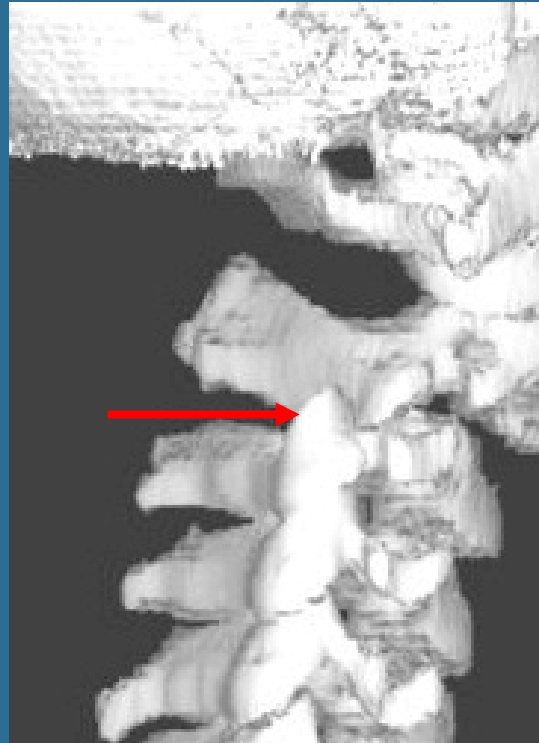
# 10 lbs halo traction Caused perched facet



# Open reduction of perched facet

**Pearl: rongeur superior facet to allow reduction**

- Fusion
- Pinless halo
- Near full ROM



# Summary

- Kids <8 yo most trauma occiput-C3
- Often pure ligamentous
  - MRI + CT
- Look for the second fracture
- Not sure
  - Consult colleague
  - Stabilize Halo vest
  - Traction may harm





# Thank you



 USC University of  
Southern California

  
Children's  
Hospital  
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ORTHOPAEDIC CENTER

## Criteria for C-spine Imaging

- neck pain
- neurologic symptoms
- distracting injuries
- altered mental status

• *Special attention <2yrs old*

- xrays - Not sufficient in kids
  - CT - occipital condyle fxs
  - MRI - Flynn, JPO 2002

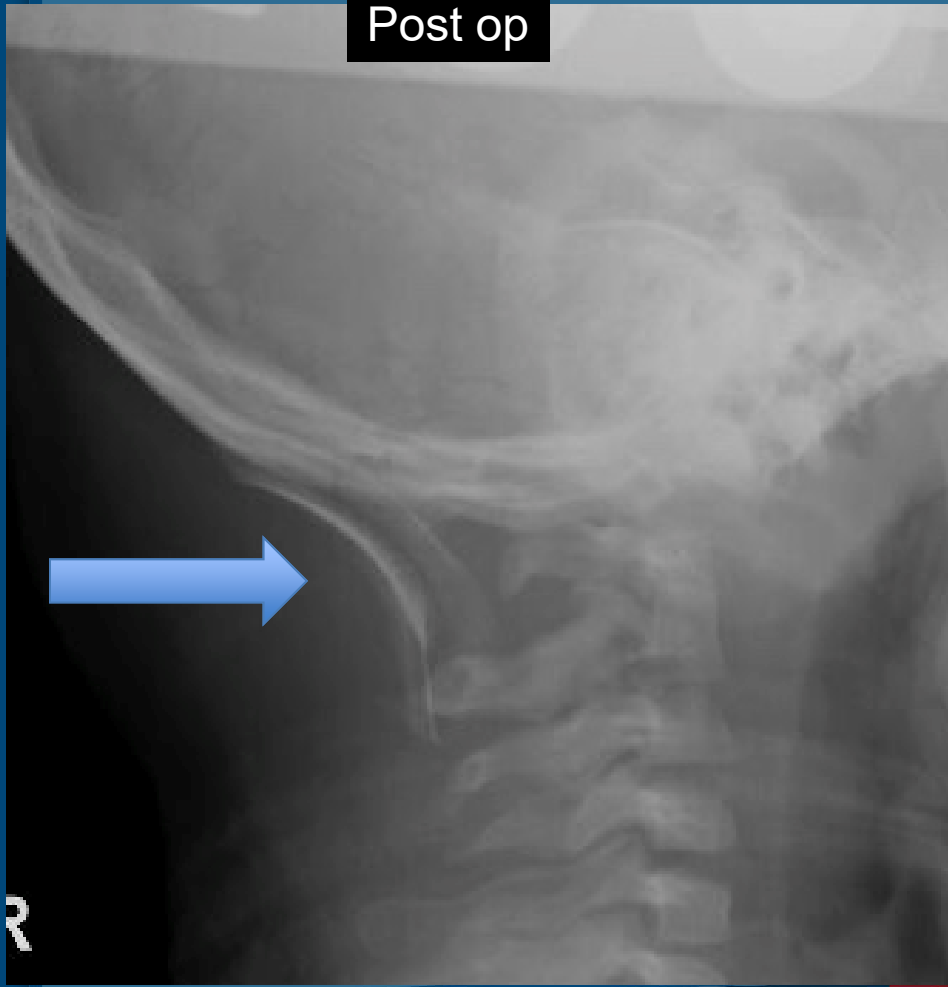
# SCIWORA

## Spinal Cord Injury WithOut Radiographic Abnormality

- Up to 35% of spinal cord injuries in kids!
- MRI normal in 35% of cases
- Repeat MRI in 6-9 days to capture delayed changes in spinal cord
- Delayed presentation up to 24 H after injury

# Periosteal Turndown

Post op



8 months

