



# POSTERIOR CV JUNCTION FUSION IN ELDERLY FOR C2 FRACTURES

TECHNIQUES, ANALYSIS OF SINGLE SURGEON OUTCOMES AT A LEVEL 1 TRAUMA CENTER

**Dr Gazanfar Rahmathulla**

Associate Professor of Neurosurgery, Mayo Clinic Health System  
Associate Professor Neurosurgery (Courtesy), University of Florida , Jacksonville, Fl  
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- Cervical 2 (C2) fractures in the elderly are common
- Incidence of these fractures has been increasing
- Surgical and nonoperative treatments are associated with high complication and mortality rates
- Type II dens fractures have pseudoarthrosis rates of >50% (Harrop JS, Hart R, Anderson PA. Spine 2010 - Optimal treatment for odontoid fractures )
- Type II odontoid fractures are associated with 3-month mortality of 20% and 40% at 2 years. Chapman J, Vaccaro AR, Arnold P, Shaffrey CI, Fehlings MG. The AOSpine North America Geriatric Odontoid Fracture Mortality Study) & Schoenfeld AJ, Bono CM, et al - Type II odontoid fractures of the cervical spine: do treatment type and medical comorbidities affect mortality in elderly patients? Spine (Phila Pa 1976). 2011

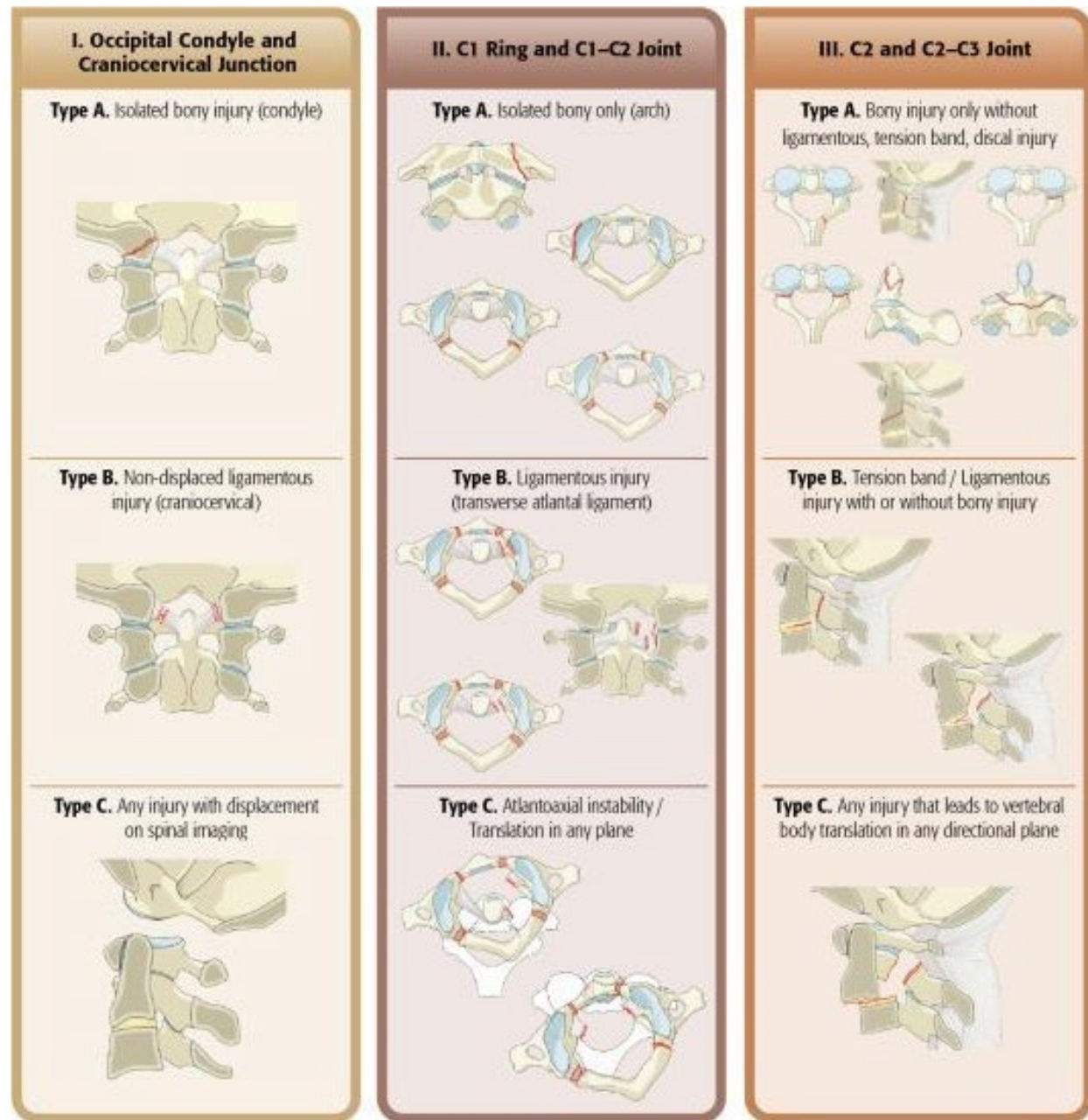
# AO SPINE UPPER CERVICAL SPINE INJURY CLASSIFICATION SYSTEM

## B. Neurologic status modifiers

- N0: neurologically normal
- N1: Transient neurologic deficit
- N2: Radiculopathy or cranial nerve injury
- N3: Incomplete spinal cord injury
- N4: Complete spinal cord injury
- N5: Unexaminable patient
- N+: Ongoing spinal cord compression

## C. Case-specific modifiers

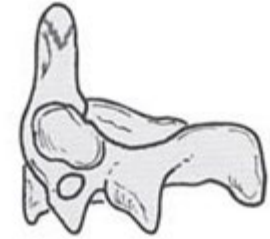
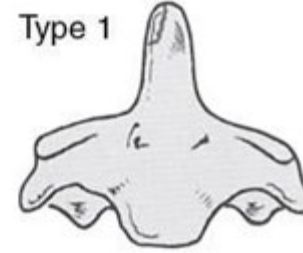
- M1: Injuries at high risk of nonunion with nonoperative treatment
- M2: Injury with significant potential for instability
- M3: Patient-specific factors adversely affecting healing potential
- M4: Vascular injury or abnormality affecting treatment



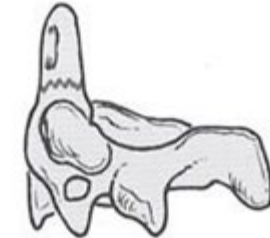
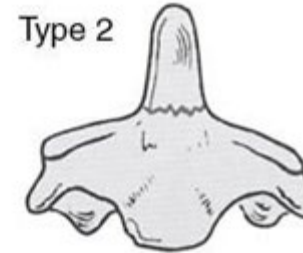
# DENS FRACTURE CLASSIFICATIONS

- Anderson and D'Alonzo's classification of odontoid fractures

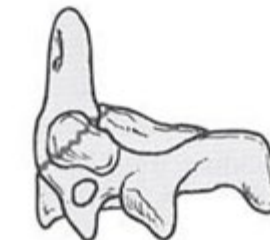
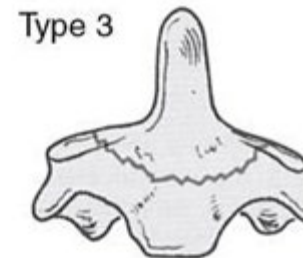
Type 1



Type 2



Type 3



# TREATMENT OPTIONS

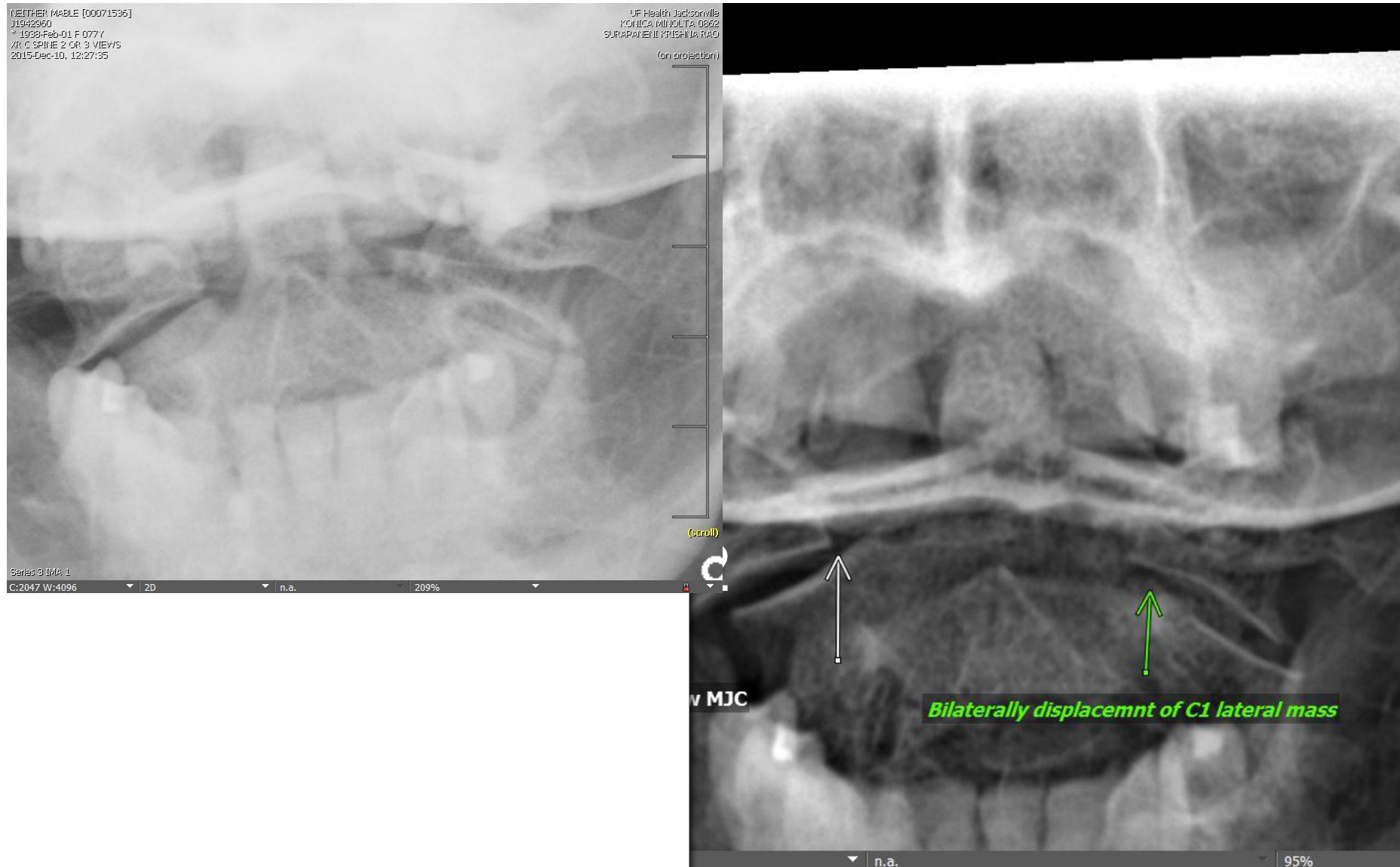
- Cervical orthosis
- Halo vest immobilization
- C1-C2 fusions most commonly
- Odontoid screw (selected cases)
- Occ – C2 / subaxial fusion for more complex CV junction fractures



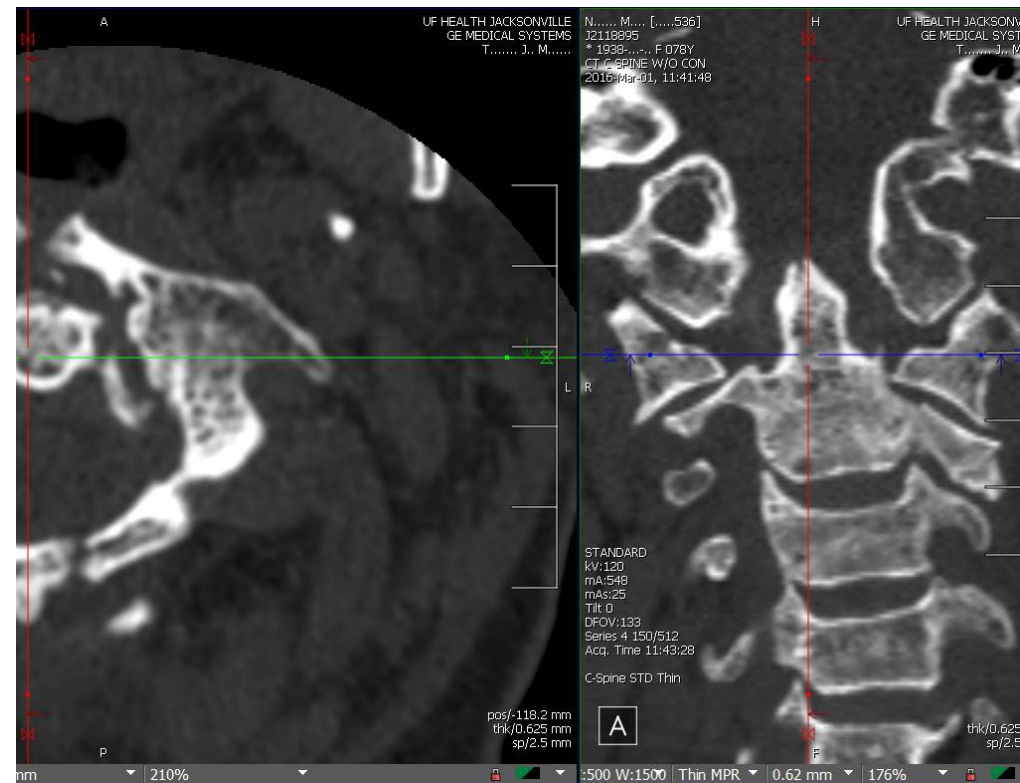
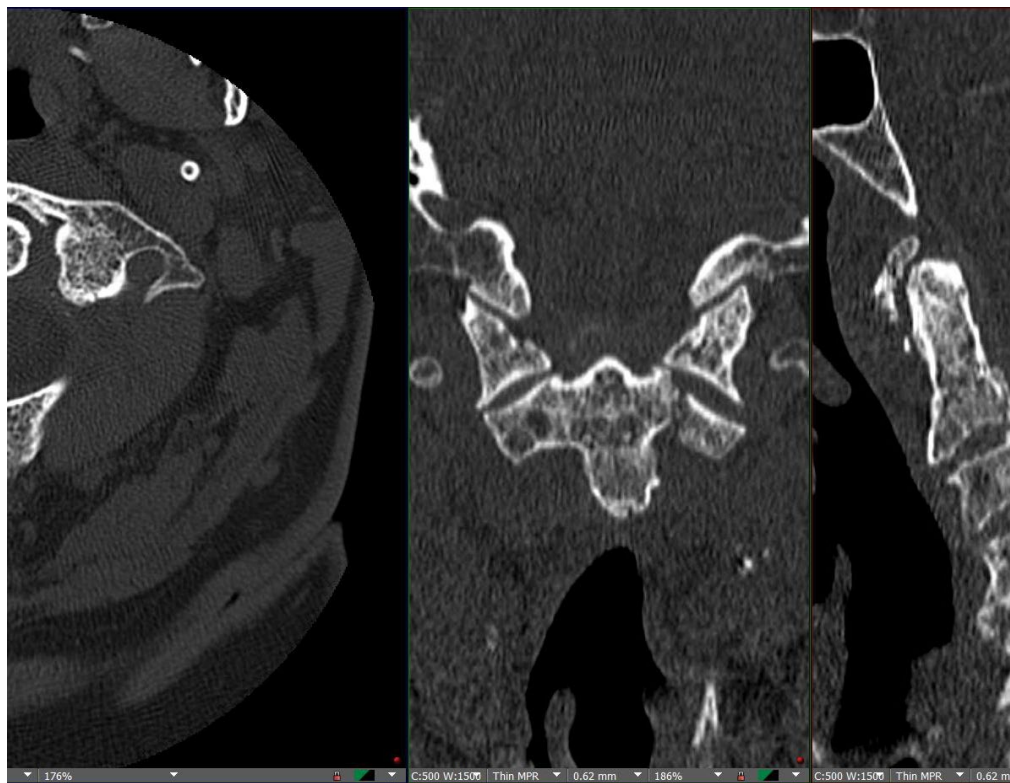
## CERVICAL ORTHOSIS WITH BONE GROWTH STIMULATOR

- Pros
  - Avoid major surgical procedure
- Cons
  - Long duration of follow up could be over 6 months
  - Patient needs to be active at self surveillance
  - Diligent at utilization
  - If fails – will require surgery

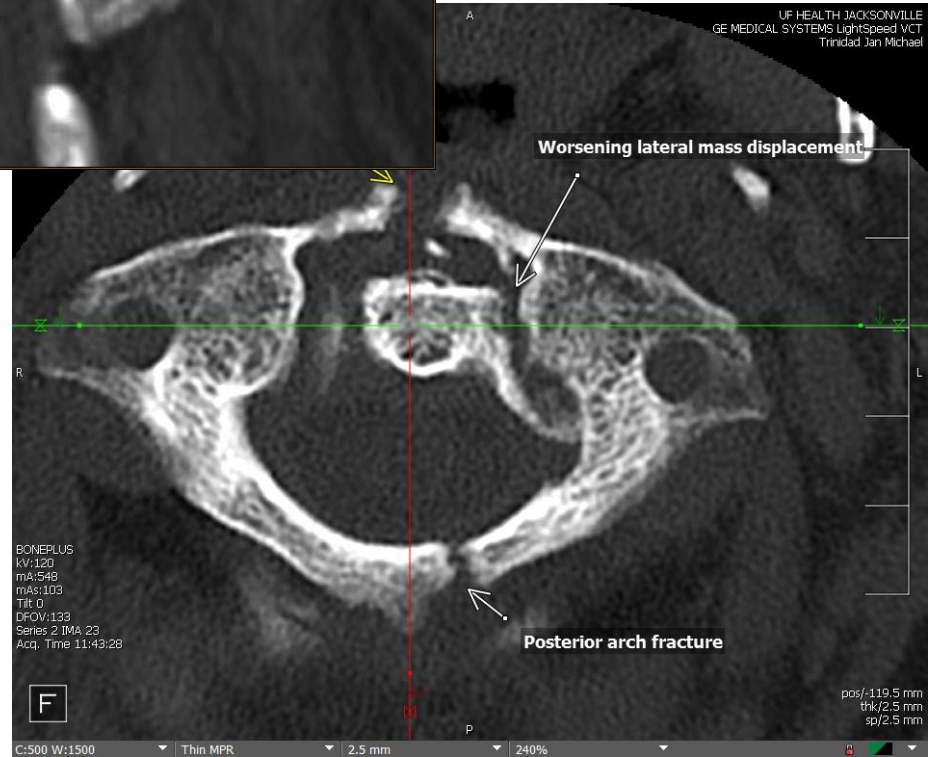
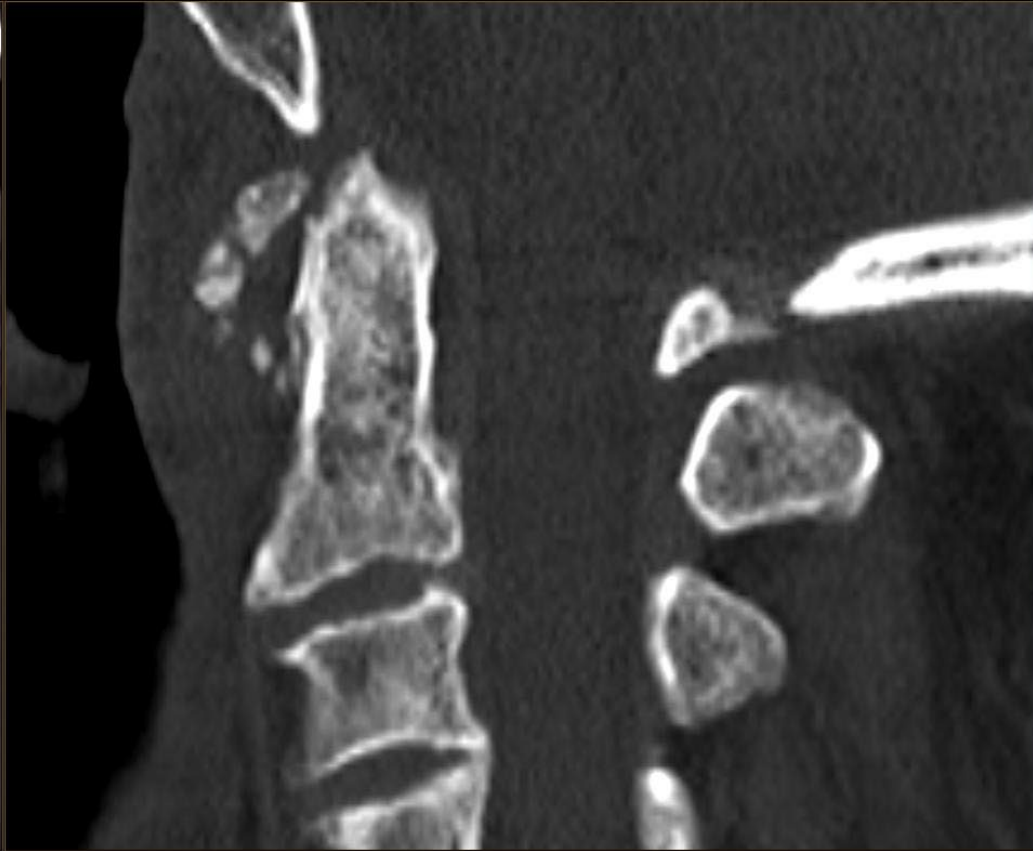




- ▶ 78 yo female
- ▶ Trauma 12/2015
- ▶ Interval worsening of C1-2 fracture
- ▶ Med h/o – HTN, asthma, OSA, morbid obesity, osteoporosis
- ▶ HALO vest 3/2016 and bone growth stimulator
- ▶ Removed 9/2016

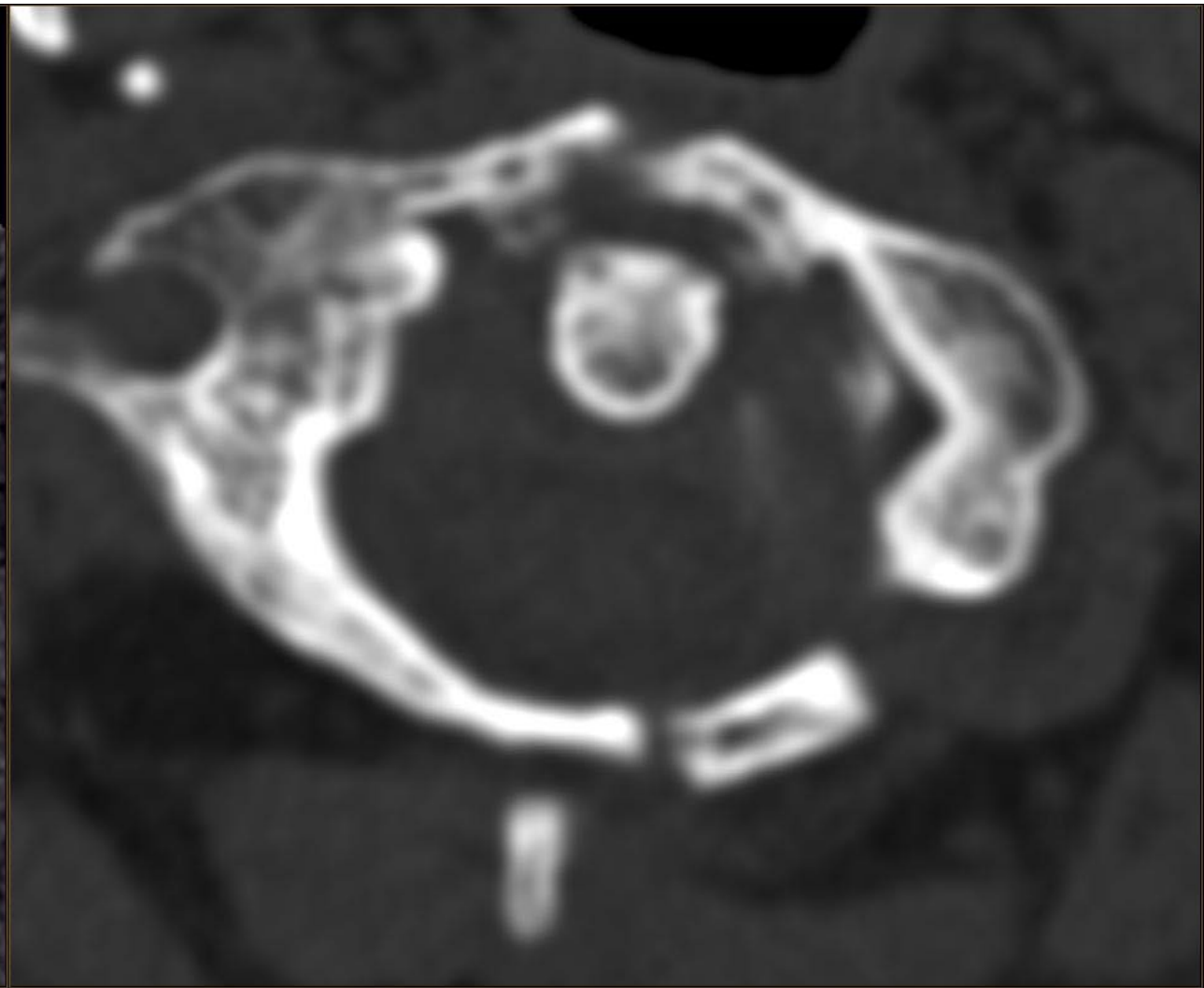












# HALO VEST UF STUDY

- [Halo vest immobilization - an institutional review of safety in acute cervical spine injury from 2013 to 2017.](#)
  - Malnik SL, Scott KW, Kuhn MZ, Alcindor D, Tavanaiepour K, Tavanaiepour D, Crandall M, **Rahmathulla G.**
  - Br J Neurosurg. 2021 Oct;35(5):639-642. doi: 10.1080/02688697.2021.1947976. Epub 2021 Jul 28. PMID: 34319211

# HALO VEST

- We concluded –
  - HVI is a safe and effective treatment modality in a subset of patients with complex cervical junction and subaxial cervical spine pathology
- Pneumonia
- Pin site complications
- Long duration of use
- Conversion to surgery if fails



**75y/o S/p fall on 8/9/16 # anterior arch of C1 Jeffersons**

**Type II dens fracture**

**Initially treated conservatively with MJC**

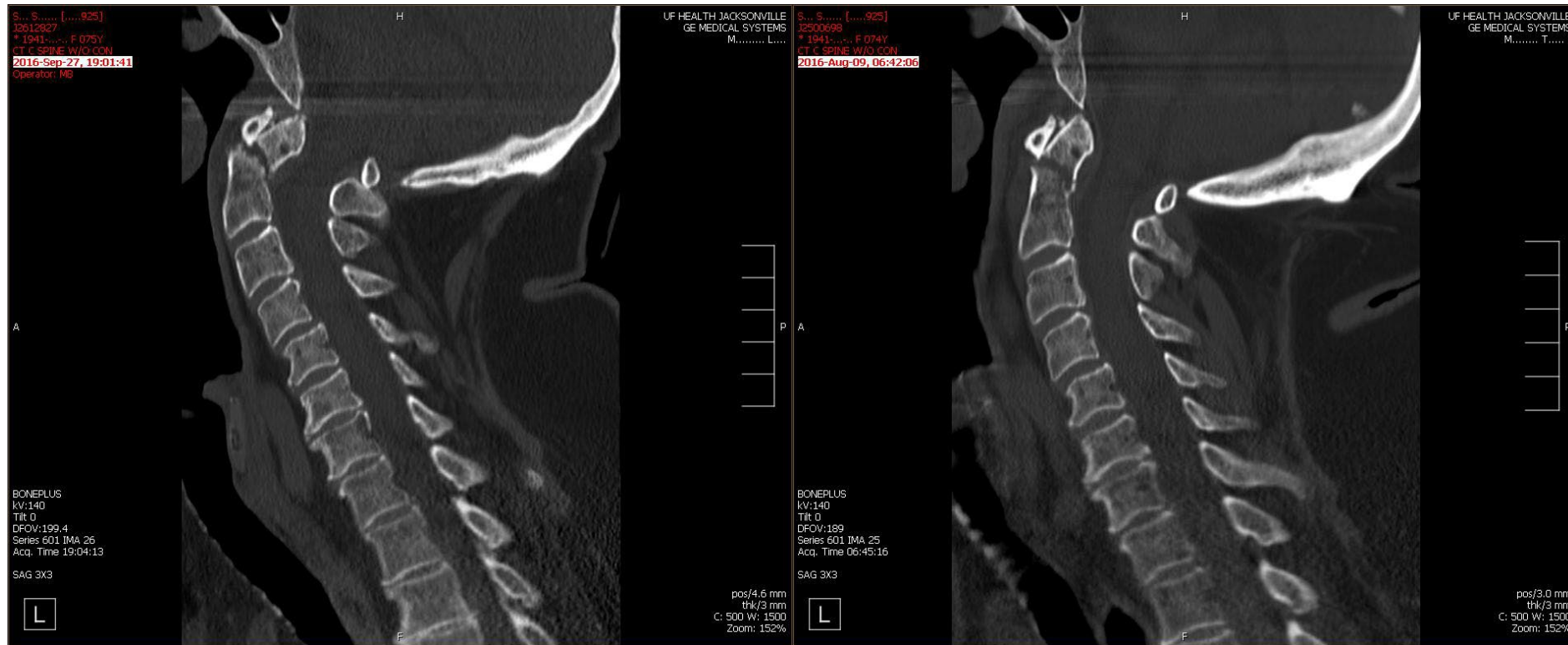
**Follow up on 9/21/16 - no healing and posterior displacement ;  
Operated 10/2016**

**worsening C1 arch / lateral mass junction fracture with subluxation and retroflexion at CV junction  
with gradual onset of symptoms**

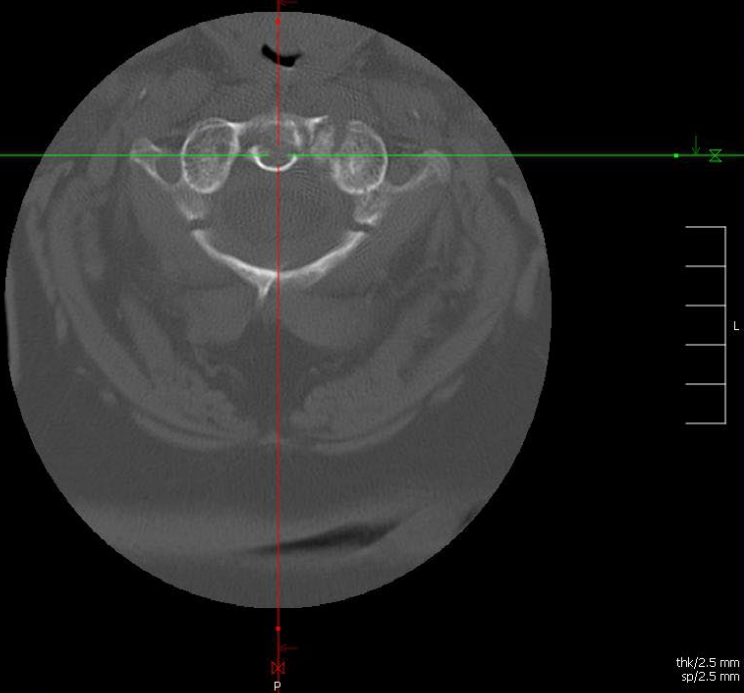
**PMH - Arthritis; Asthma; Cerebral artery occlusion with cerebral infarction; Diabetes mellitus;  
Hypertension; and Thyroid disease**

**Ambulating with a walker at 10months post op with chronic stable BL knee pain**

# CT C SPINE A) INITIAL B) 6 WEEKS LATER



**A**



BONEPLUS  
kv:140  
mA:498  
mAs:64  
Tilt:0  
DFOV:139  
Series:6  
Acq. Time 06:45:16  
C-SPINE

thk/2.5 mm  
sp/2.5 mm



BONEPLUS  
kv:140  
mA:498  
mAs:64  
Tilt:0  
DFOV:139  
Series:6  
Acq. Time 06:45:16  
C-SPINE

thk/2.5 mm  
sp/2.5 mm



BONEPLUS  
kv:140  
mA:498  
mAs:64  
Tilt:0  
DFOV:139  
Series:6 257/512  
Acq. Time 06:45:16  
C-SPINE

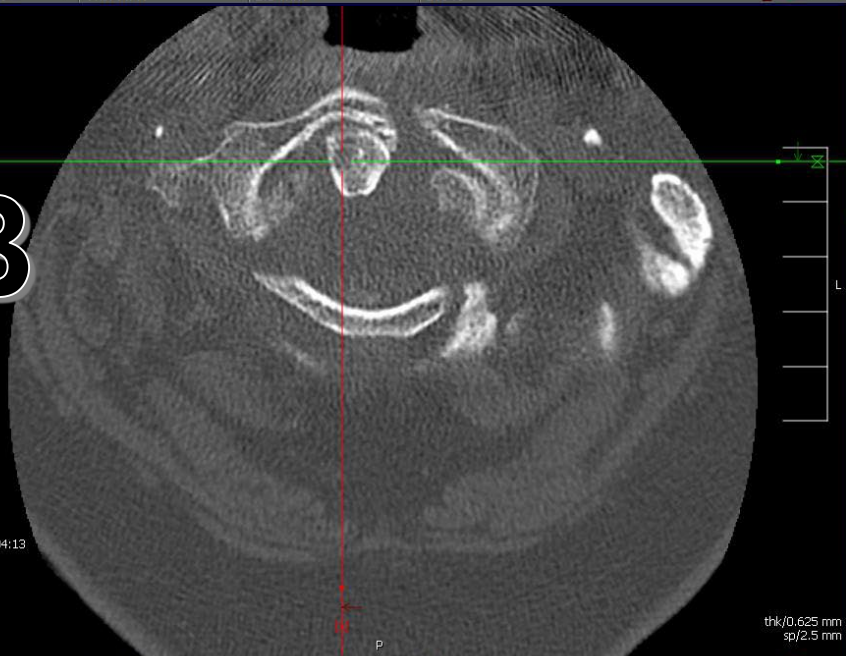
thk/2.5 mm  
sp/2.5 mm

C:350 W:2000 Thin MPR 2.5 mm 109%

:350 W:2000 Thin MPR 2.5 mm 119%

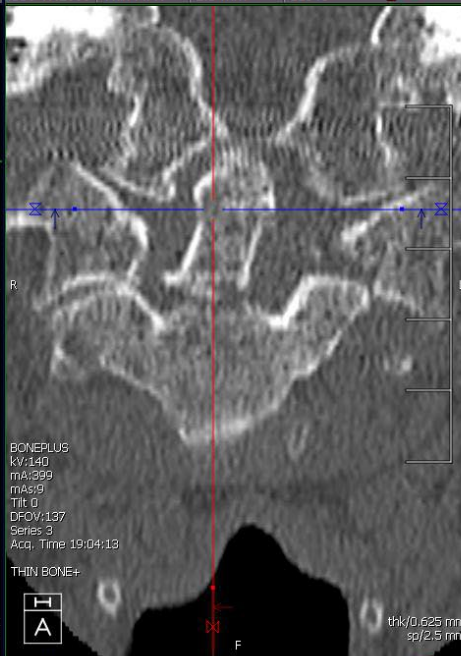
:350 W:2000 Thin MPR 2.5 mm 119%

**B**



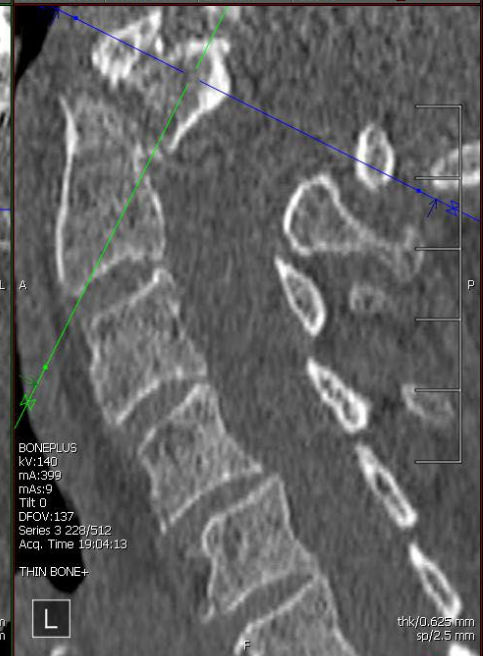
BONEPLUS  
kv:140  
mA:399  
mAs:9  
Tilt:0  
DFOV:137  
Series:3  
Acq. Time 19:04:13  
THIN BONE+

thk/0.625 mm  
sp/2.5 mm



BONEPLUS  
kv:140  
mA:399  
mAs:9  
Tilt:0  
DFOV:137  
Series:3  
Acq. Time 19:04:13  
THIN BONE+

thk/0.625 mm  
sp/2.5 mm



BONEPLUS  
kv:140  
mA:399  
mAs:9  
Tilt:0  
DFOV:137  
Series:3 223/512  
Acq. Time 19:04:13  
THIN BONE+

thk/0.625 mm  
sp/2.5 mm

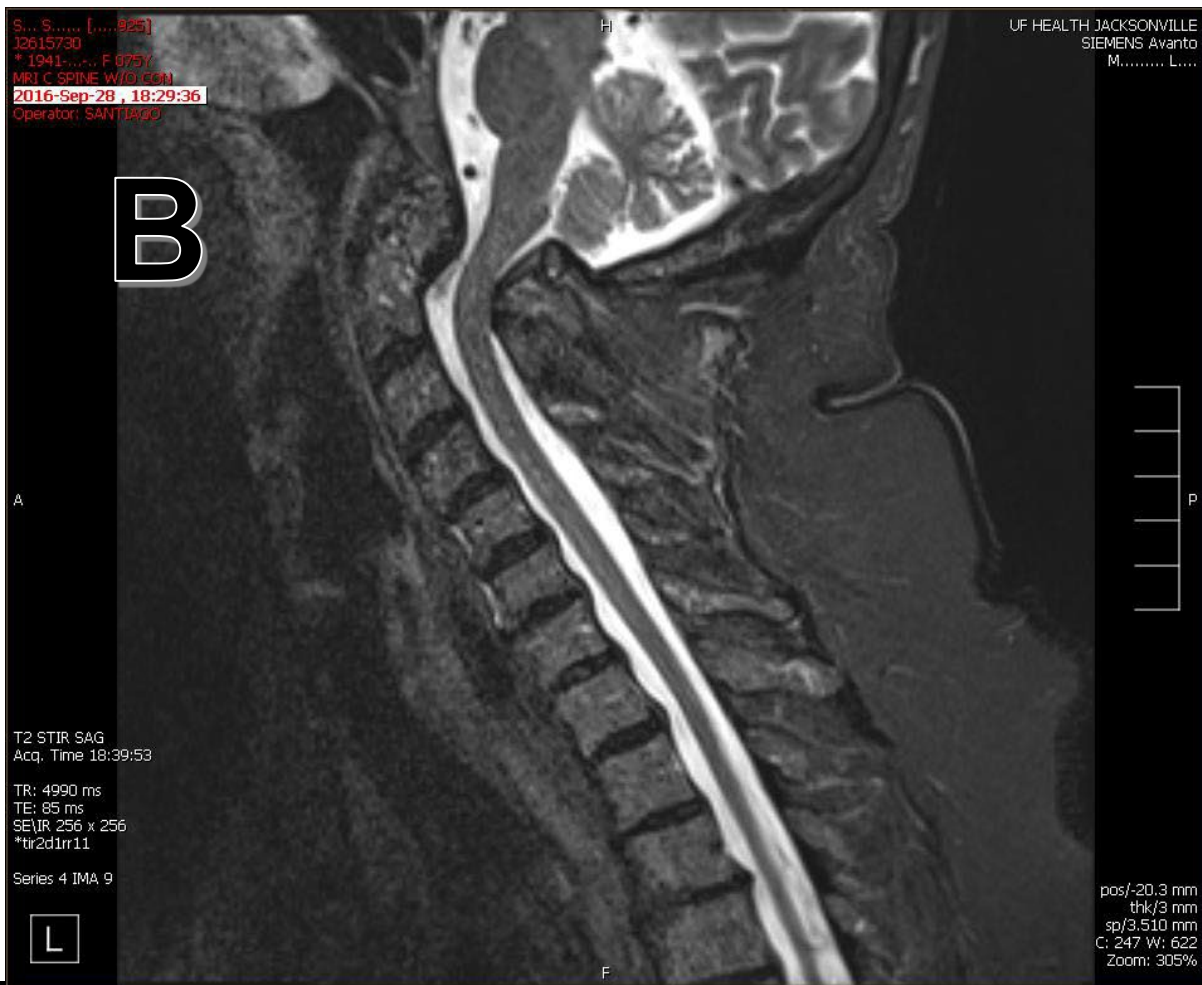
C:350 W:2000 Thin MPR 0.62 mm 149%

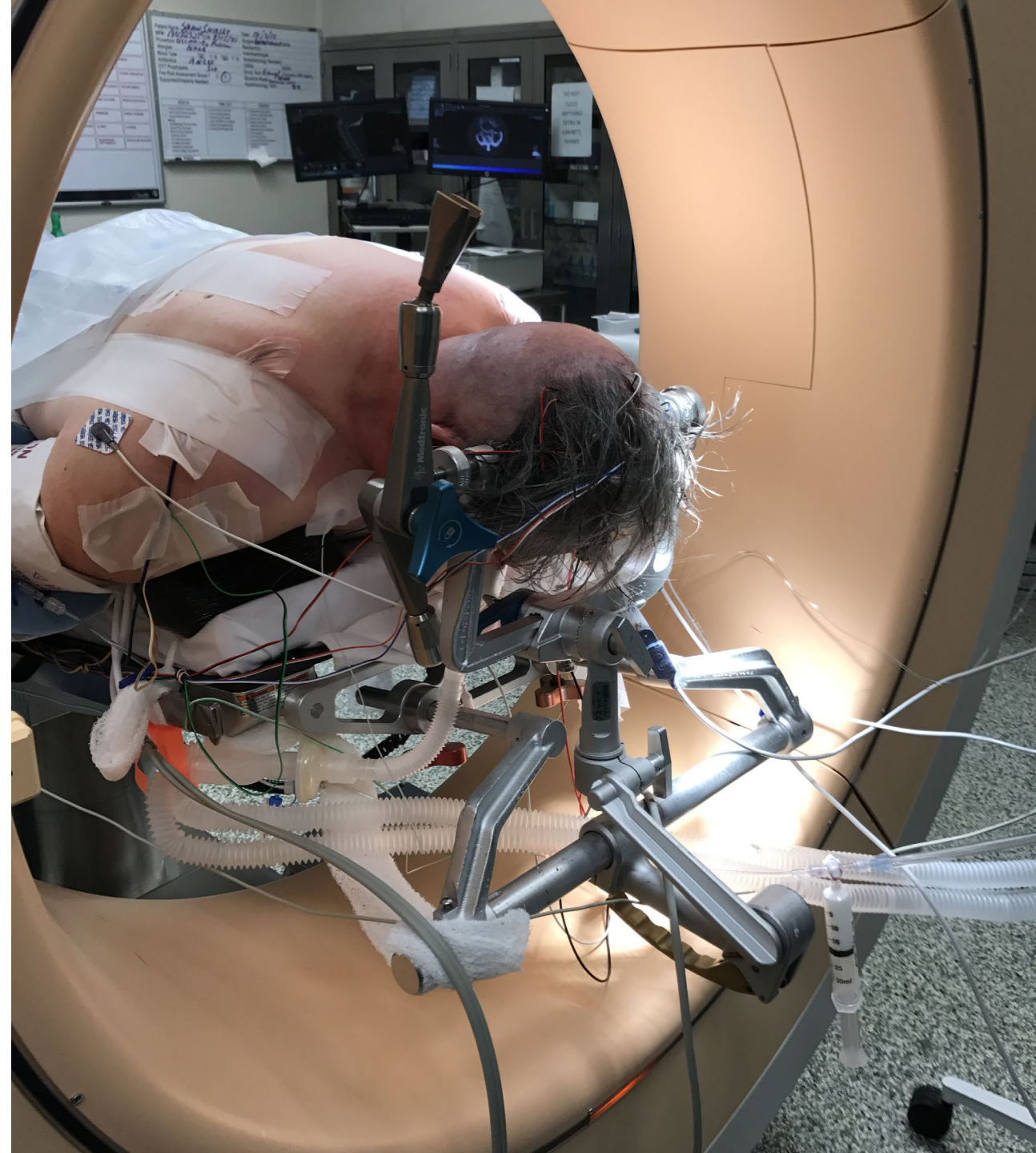
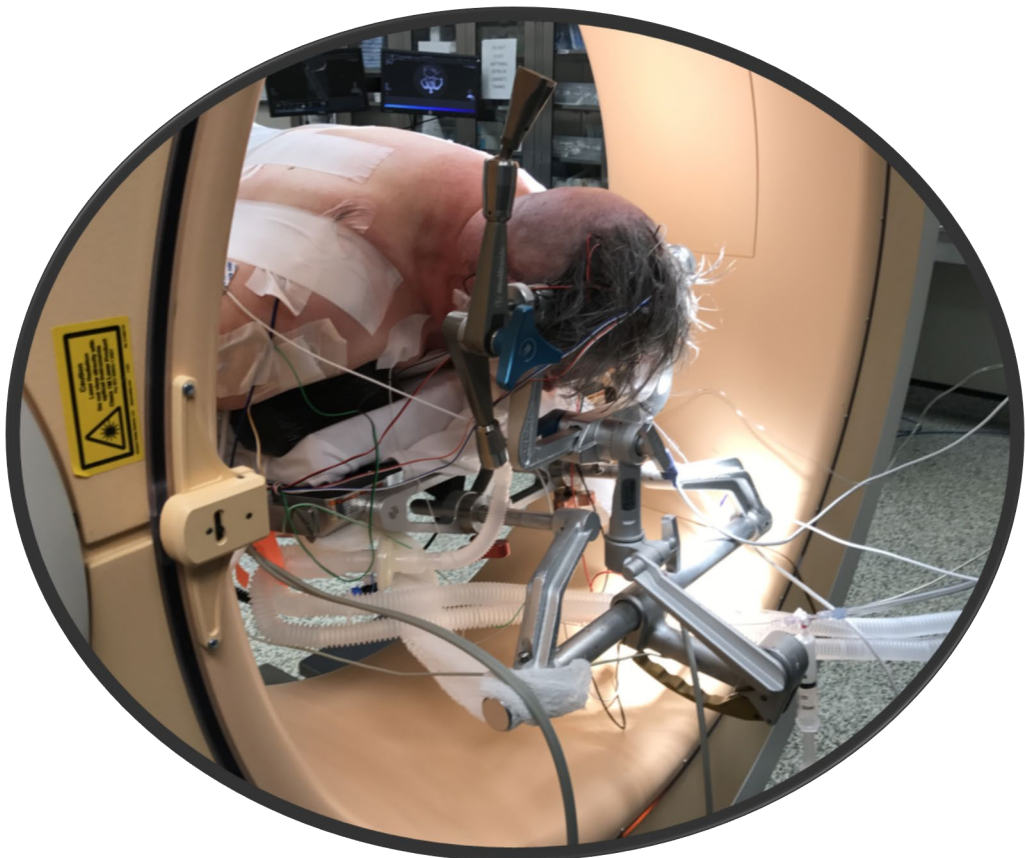
:350 W:2000 Thin MPR 0.62 mm 193%

:350 W:2000 Thin MPR 0.62 mm 193%



# MRI C SPINE – A) AT PRESENTATION B) 6 WEEKS LATER WITH WORSENING





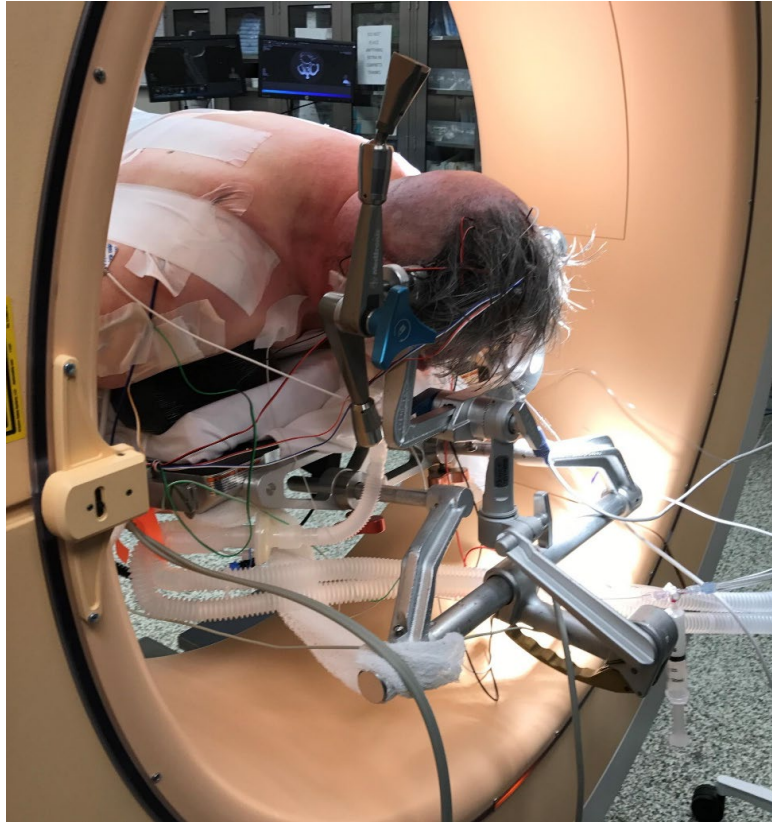




**SURGERY 10/13/2016 - S/P POSTERIOR SPINAL FUSION OCCIPUT TO C4**  
**A) EARLY 2 WEEK**  
**B) 6WEEK CERVICAL SPINE POST OP X-RAYS**

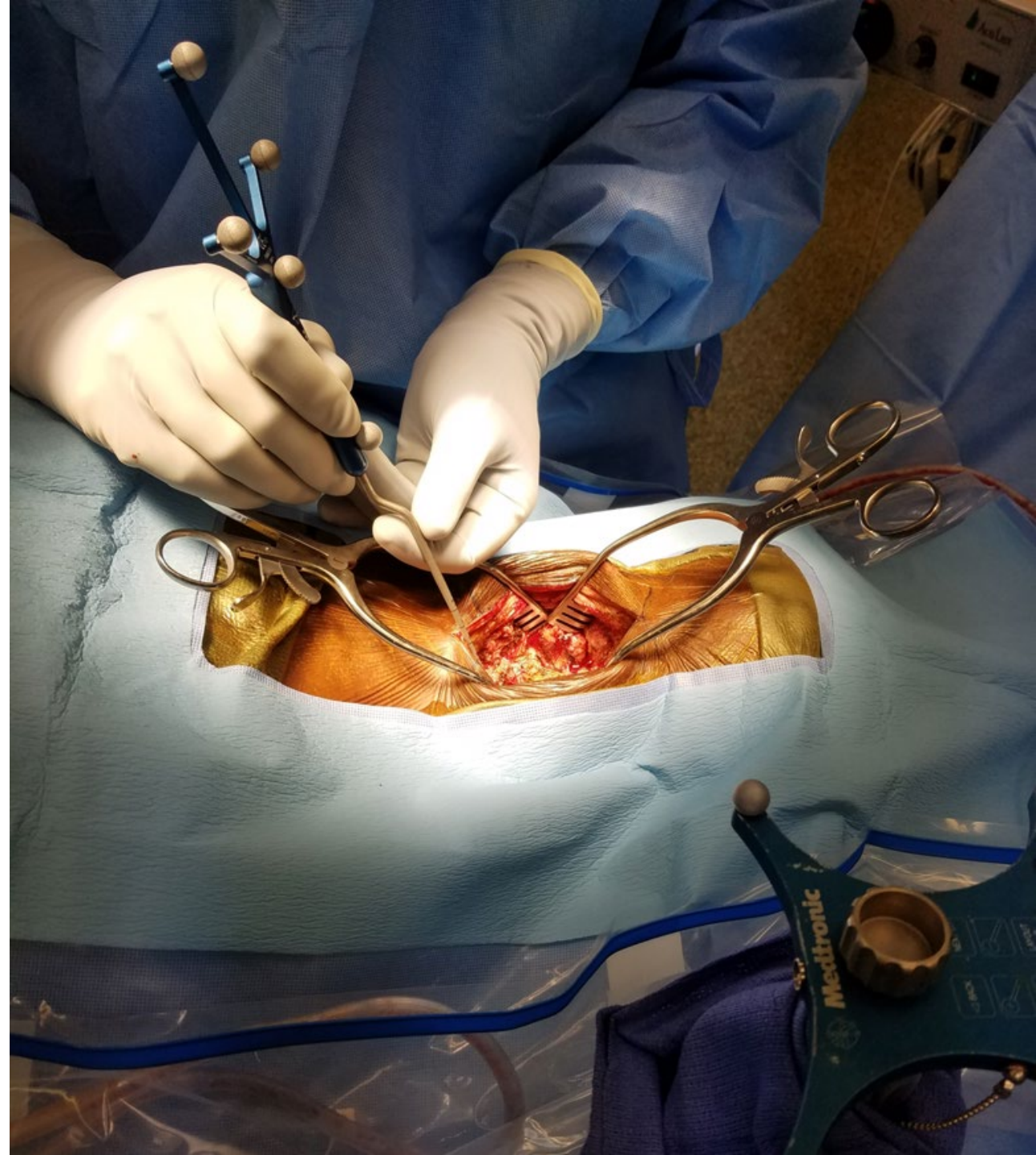
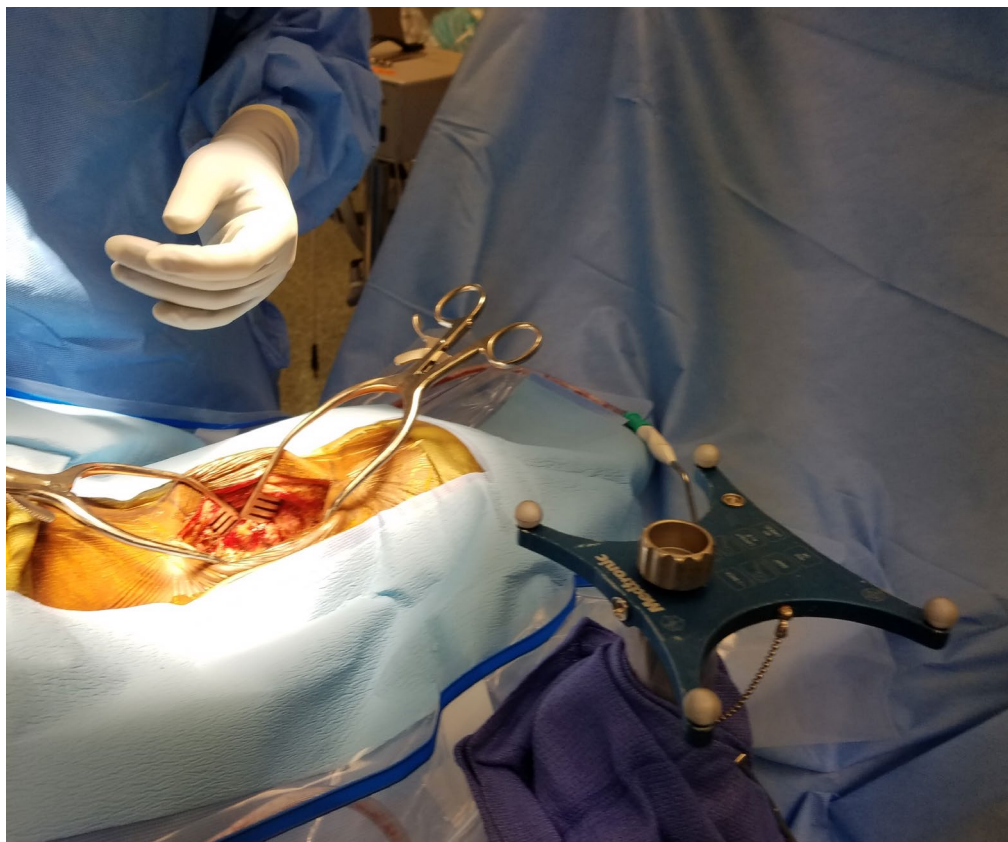


**OCCIPITAL PLATE WITH ALLOGRAFT  
RIB HELD IN PLACE WITH SONNTAG  
CABLE**





# USING NAVIGATION FOR LANDMARKS





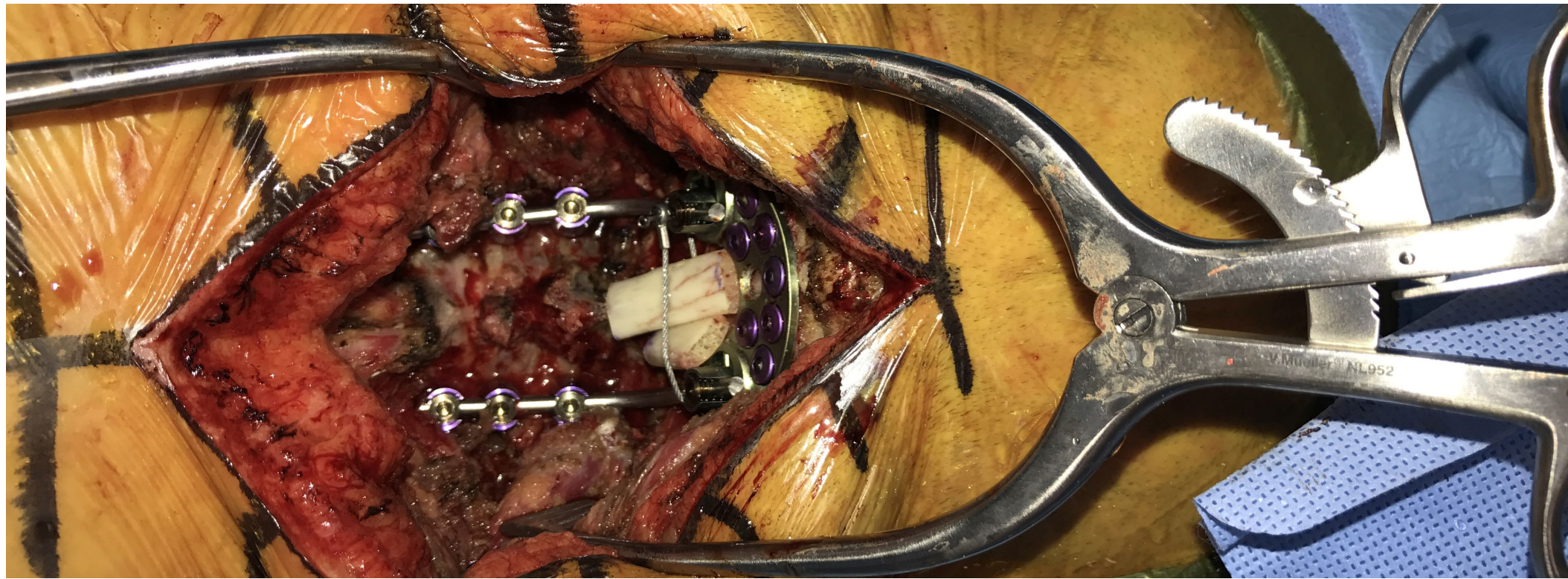


A) Initial ct  
B) At 6weeks



C) 4MO P.OP  
D) 11MO P.OP





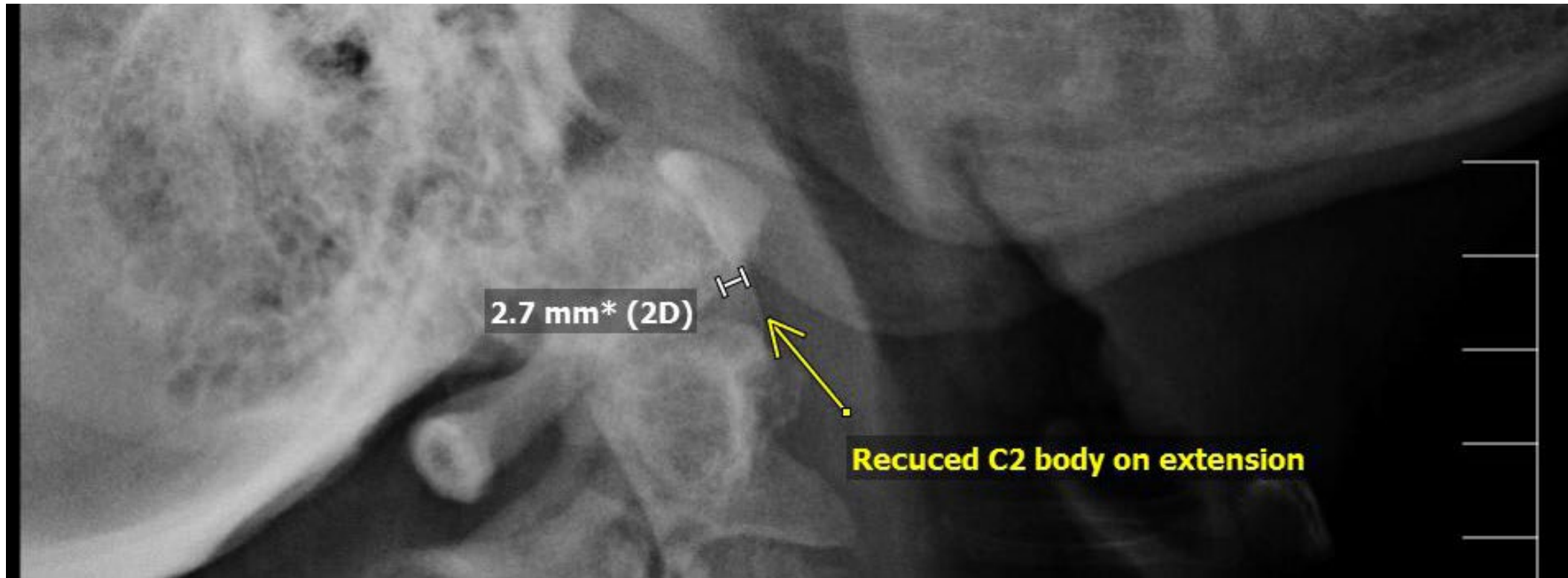


# CHRONIC TYPE 2 ODONTOID FRACTURE

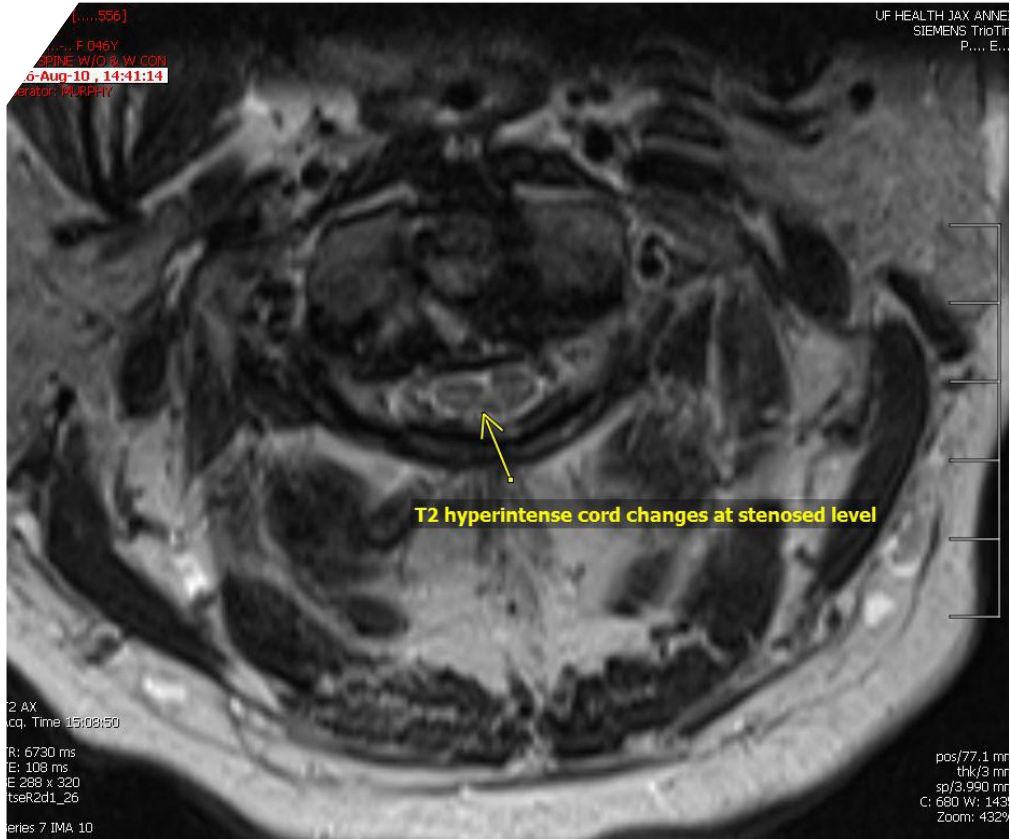


- ▶ 47 yo female patient
- ▶ Type 2 dens fracture in 1992 treated with HALO for 9 months
- ▶ 4 months of worsening balance issues and then myelopathy in LUE and dysesthesias
- ▶ Worsening with movement of her neck along with possible Lhermitte
- ▶ No deficits on exam
- ▶ Presented 08/2016
- ▶ Operated 11/2016
- ▶ h/o of steroid use in past

# REDUCES WITH EXTENSION

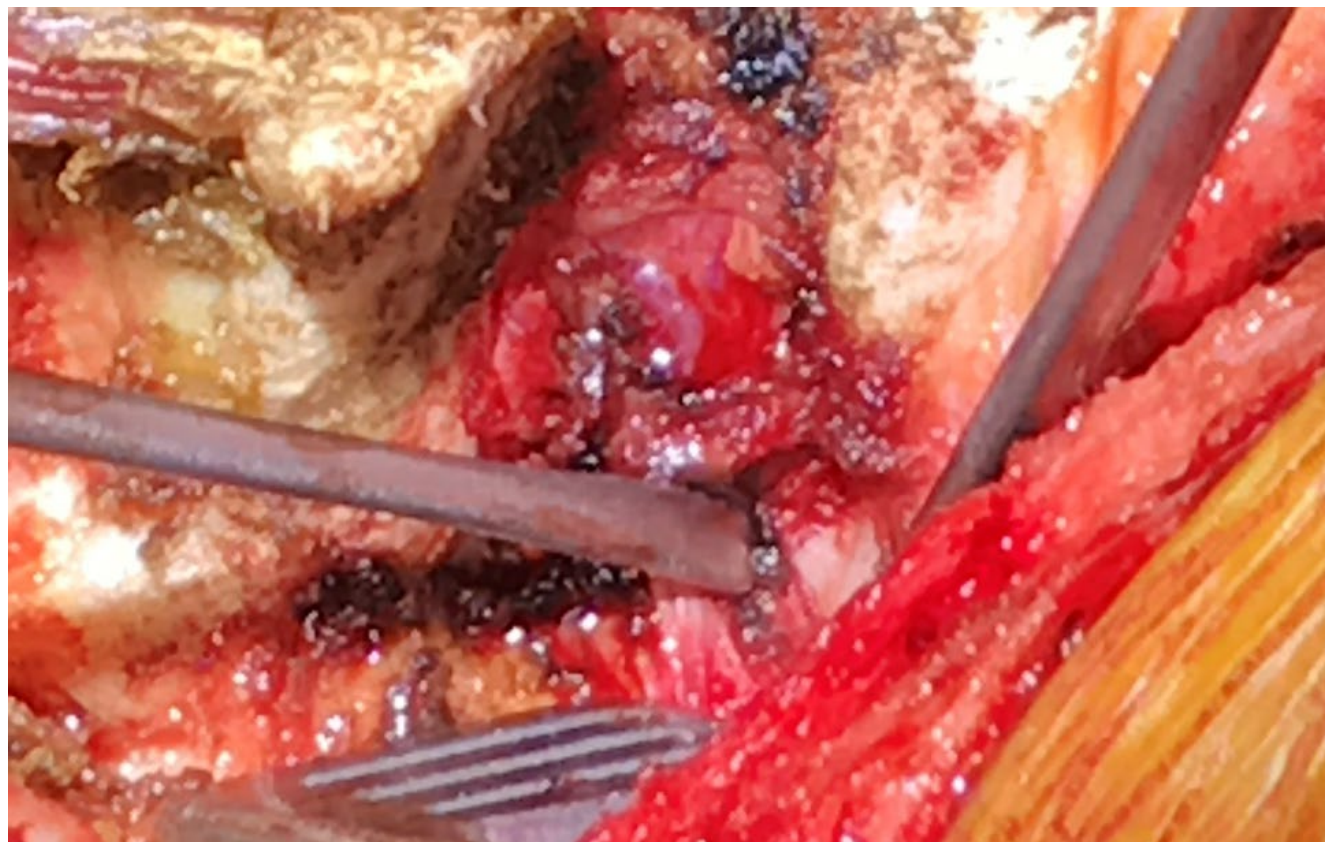
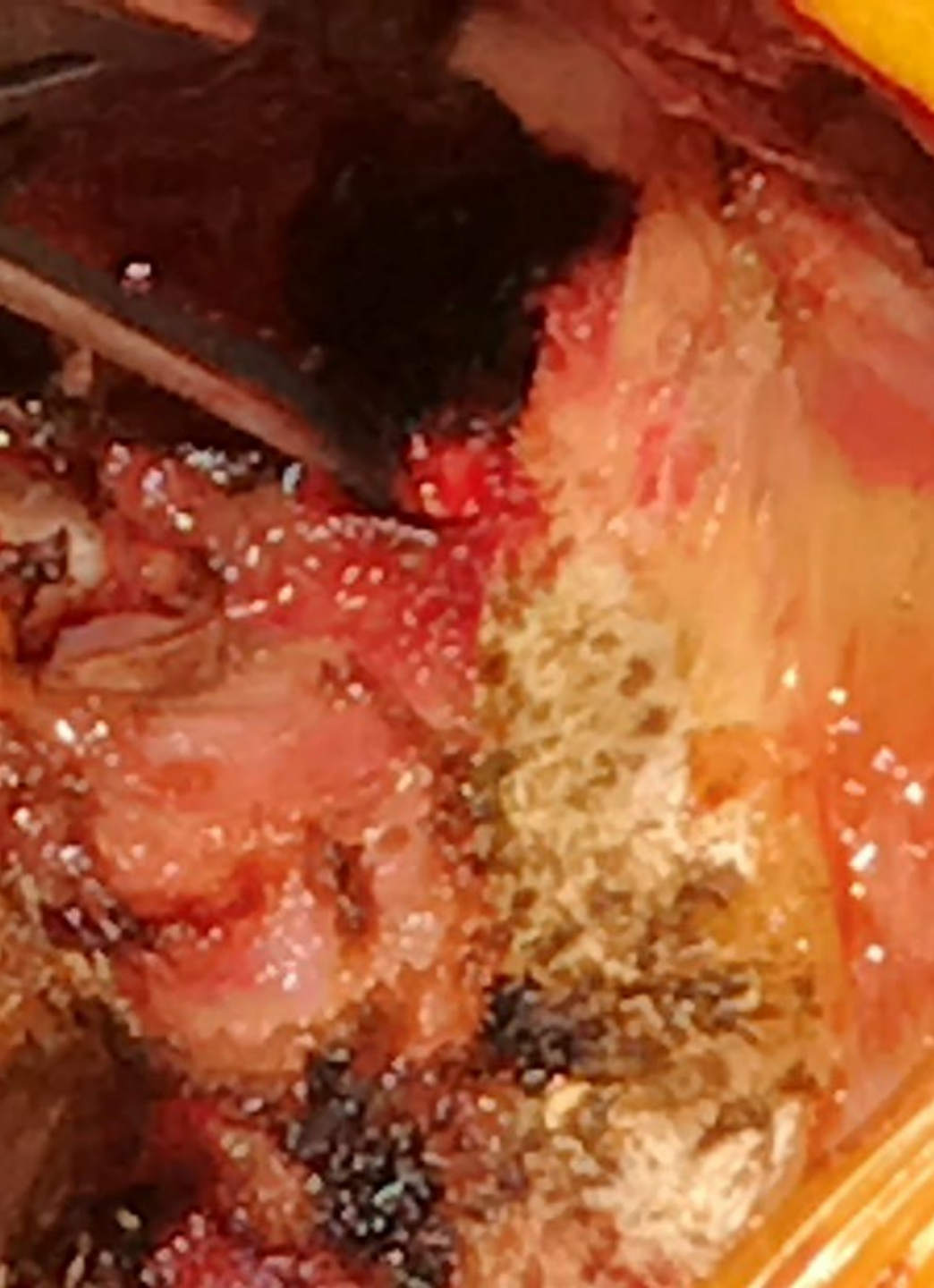


# CHRONIC COMPRESSION CAUSING MYELOPATHY



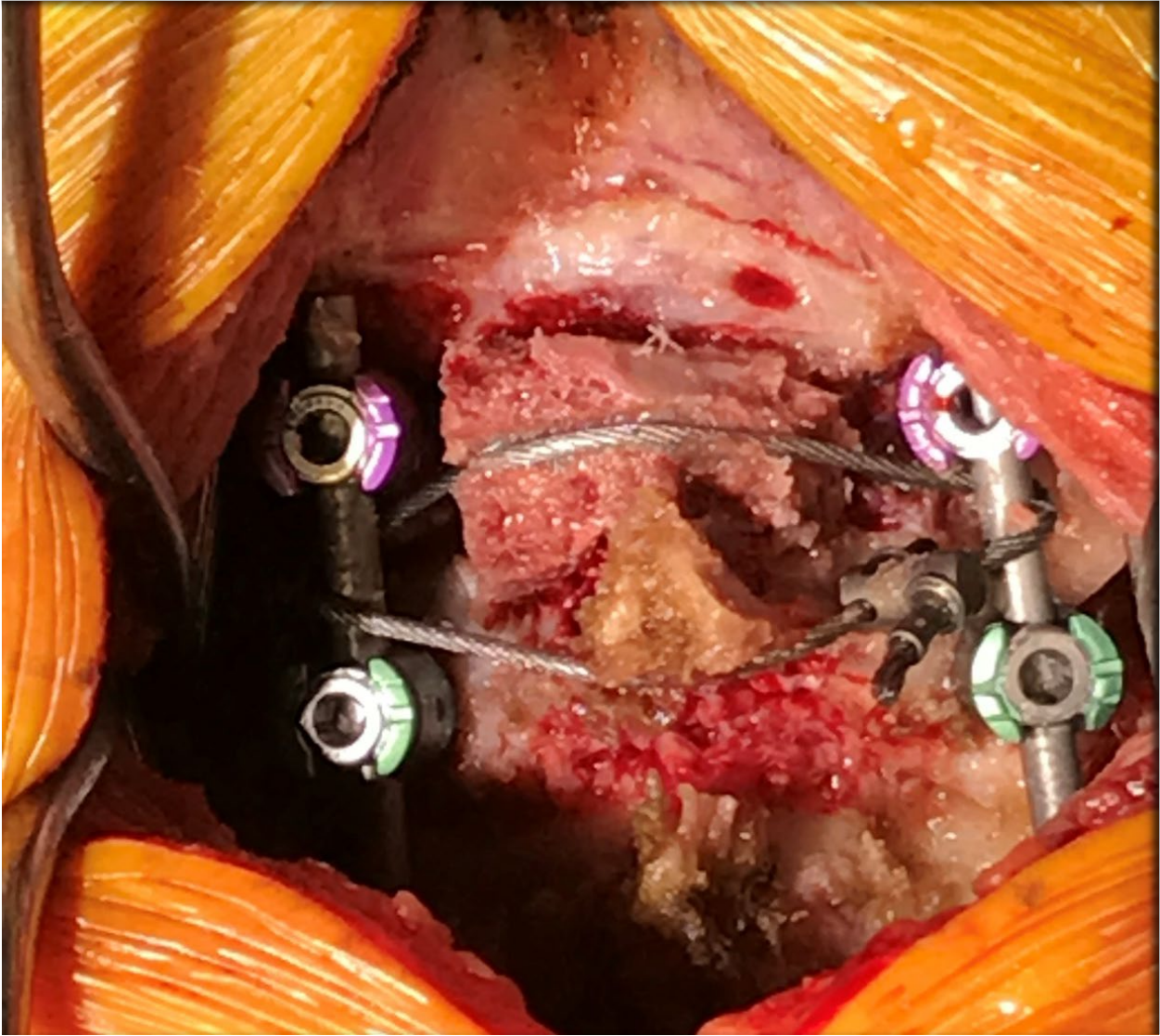


**C1 LATERAL MASSES DISSECTED OUT PRESERVING THE C2 NERVE ROOTS (IMAGES NOT FROM PRIOR CASE)**

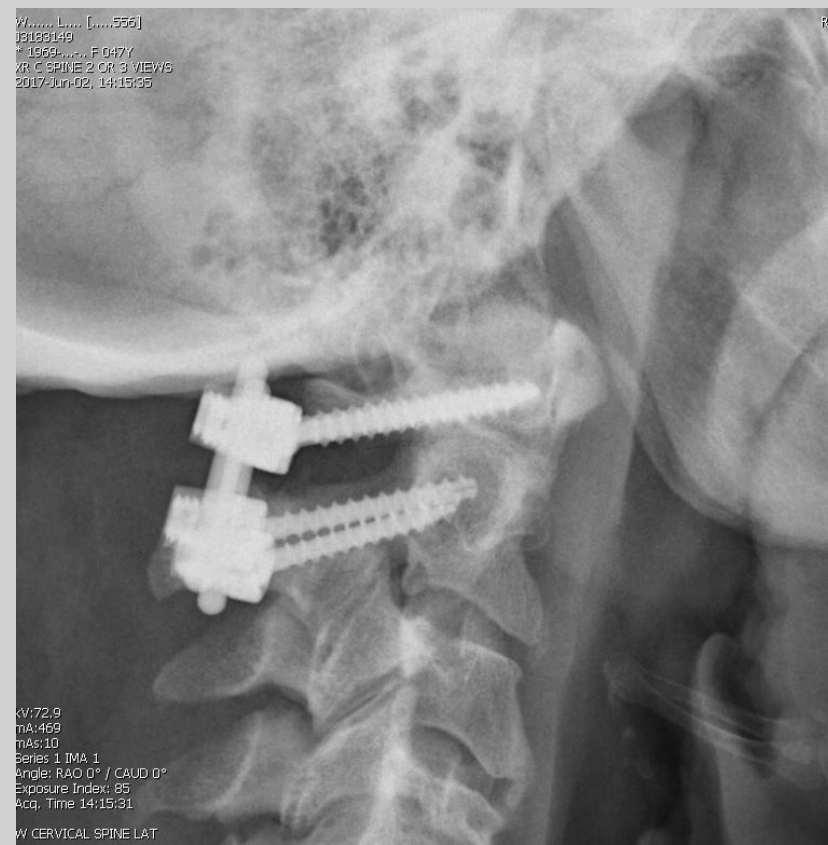
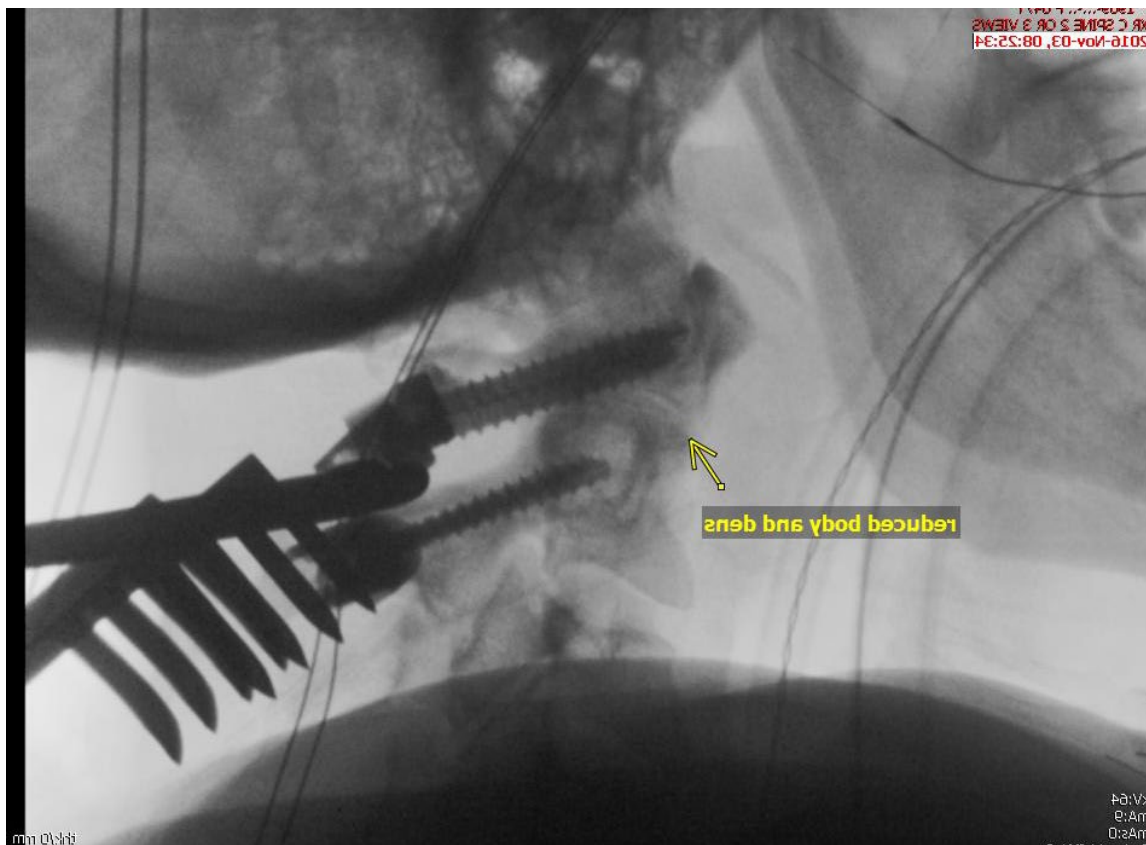




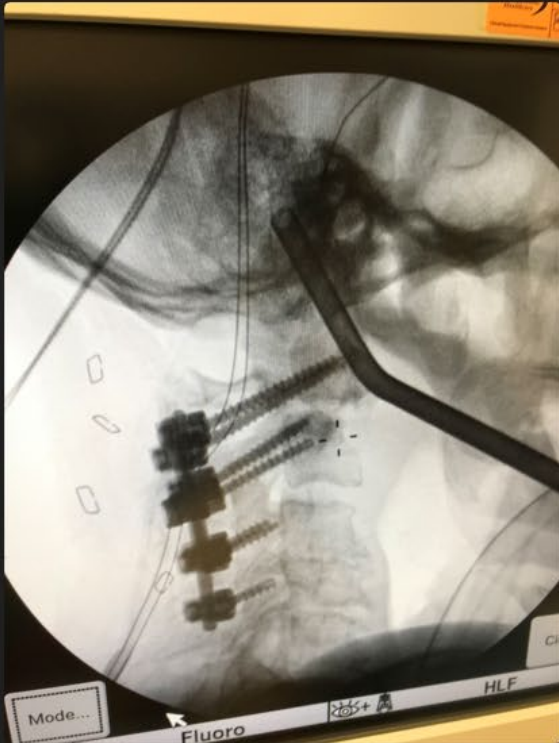
AUTOGRAFT ILIAC  
CREST WIRED INTO  
PLACE WITH SONNTAG  
CABLE



# S/P C1-C2 FIXATION AND C1 ARCH DECOMPRESSION INTRA-OP, 3 MONTHS AND 9MONTH X-RAYS







# 40 PATIENT OVER 6 YEARS AT UF JACKSONVILLE

Characteristics	All patients, n (%) N=40	<65 years, n (%) N=22	>65 years, n (%) N=18
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Fusion outcomes			
Fused	28 (70%)	16 (72.7%)	12 (66.6%)
Non fused	11 (27.5%)	6 (27.2%)	5 (27.7%)
Information not available	1 (2.5%)	0	1 (5.5%)

# QUESTIONS & ANSWERS

