



# C-Collar or De-Collar: Are Cervical Devices Harmful?

**David Persse MD, Peleg Ben-Galim MD,  
John Hipp PhD**

# Disclosure

- Baylor College of Medicine (BCM) has applied for a patent on a method to stabilize the cervical spine and has licensed this to Persys medical.
- If Persys develops, manufactures and commercializes a technology covered by this license and pays royalties to BCM than some of the authors may receive royalties in the future.



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**Spine  
Research  
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# Advanced Trauma Life Support (ATLS)

**A Airway Maintenance with Cervical Spine Protection**

**B Breathing and Ventilation**

**C Circulation with Hemorrhage Control**

**D Disability (Neurologic Evaluation)**

**E Exposure and Environment**

- Cervical spine protection is essential for saving life

# Cervical spine protection



The Journal of

**TRAUMA**<sup>®</sup>

Injury, Infection, and Critical Care

“Extrication Collars Can Result in Abnormal Separation Between Vertebrae in the Presence of Dissociative Injury”

Ben-Galim P, Dreiangel N, Mattox K,  
Reitman CA, Kalantar SB, Hipp JA

# Immobilization Concept Literature

## Spinal immobilisation for trauma patients (Review)

Kwan I, Bunn F, Roberts I, on behalf of the WHO Pre-Hospital Trauma Care Steering Committee



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COLLABORATION®

### Authors' conclusions

We did not find any evidence that spinal immobilisation reduces mortality, neurological injury, spinal stability and adverse effects in trauma patients. Spinal immobilisation is a major cause of preventable death in trauma patients, and spinal immobilisation, particularly of the cervical spine, can contribute to airway compromise, the possibility that immobilisation may increase mortality and morbidity cannot be excluded. Large prospective studies



# The Reality of it all

the so called  
“in line  
stabilization”





# Hypothesis: C-collars create distraction



# What is known about Collar stabilization.

- Collars will stabilize the head of young healthy INTACT volunteers.



# Question: What happens in the presence of a severe unstable cervical spine injury ?



# Clinical experience- Ben-Taub General Hospital



Harris County  
Hospital District

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# Case No. 1

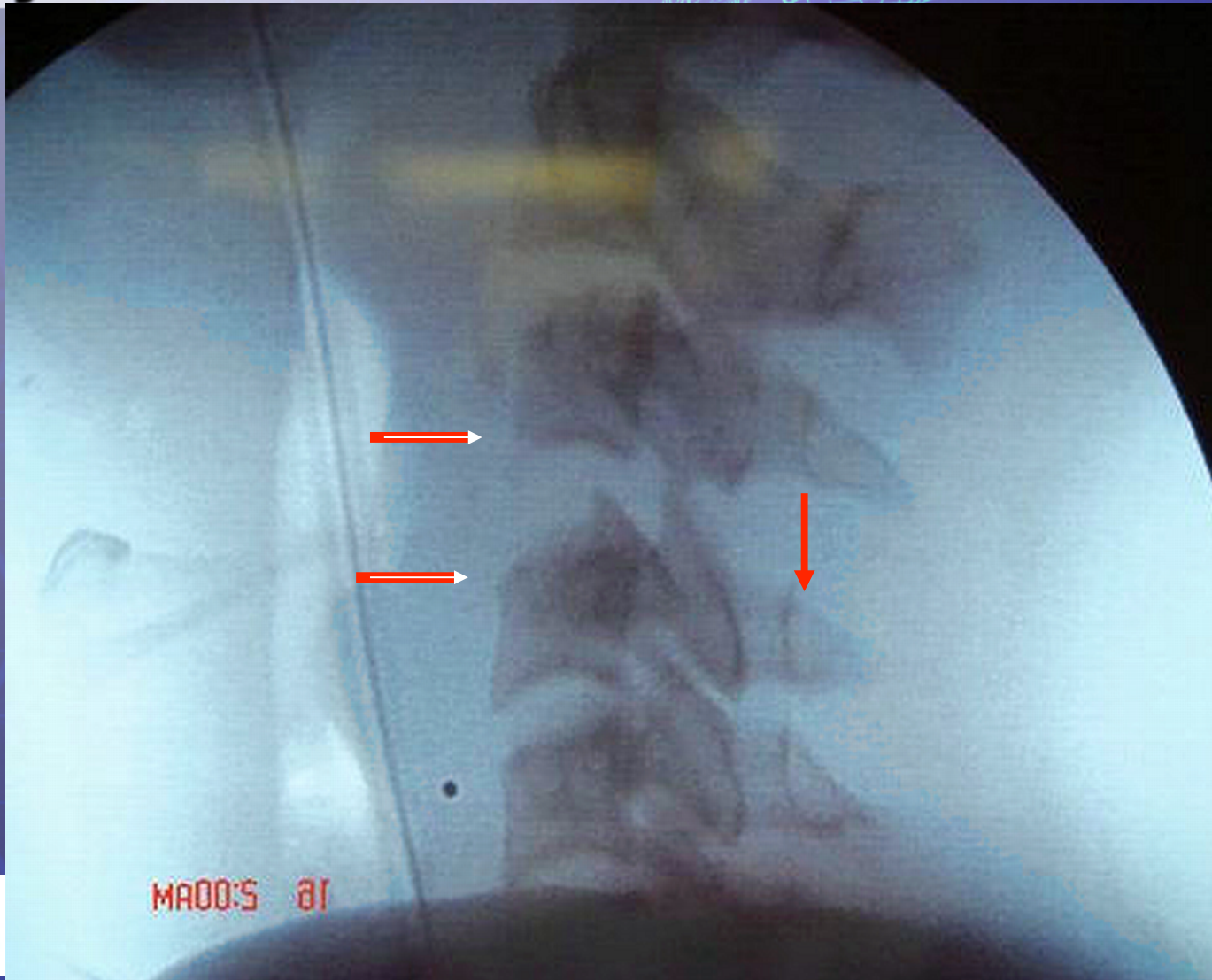
## High velocity MVA

- 25 Y/O male
- Mandible #
- No Collar



# Case No. 1

In line stabilization and collar application directly caused this C3-C4 distraction



# Case No. II

1<sup>st</sup> Ct scan



# Case no. II - Subtle findings

1<sup>st</sup> Ct scan



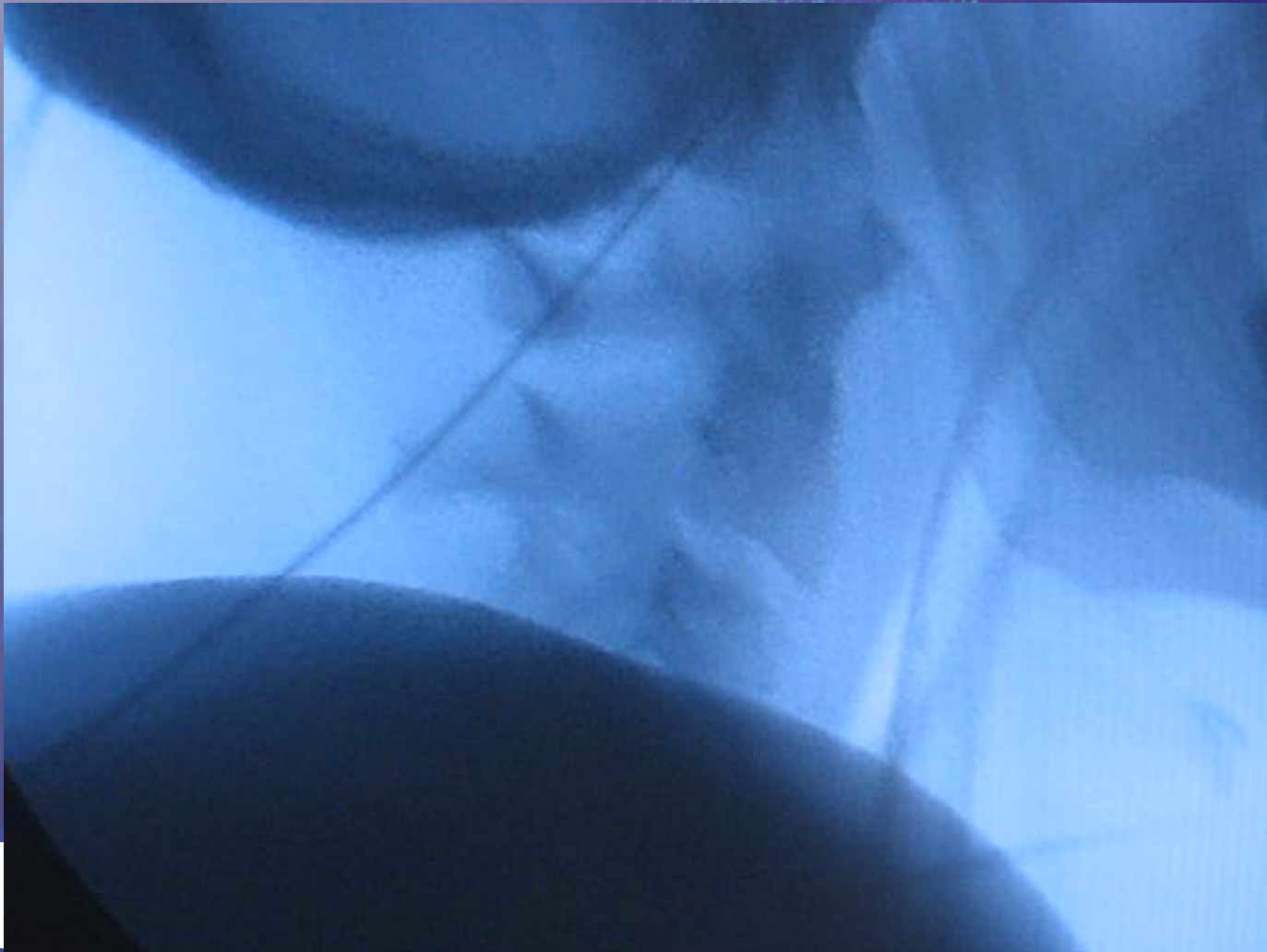


# Case No. II – Dissociative injuries are susceptible to distractive forces

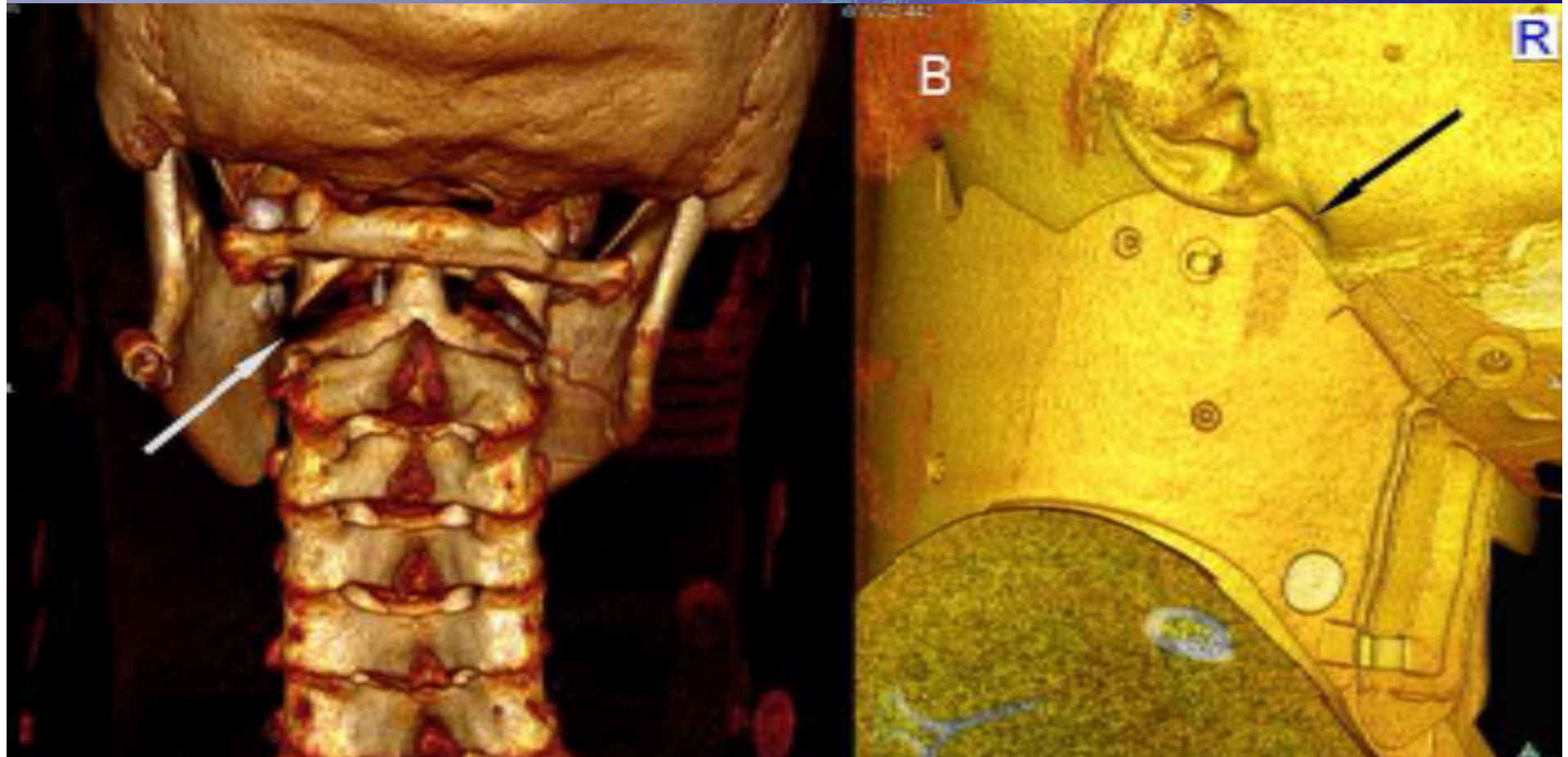
- In hospital flouroscopy

# Case No. III

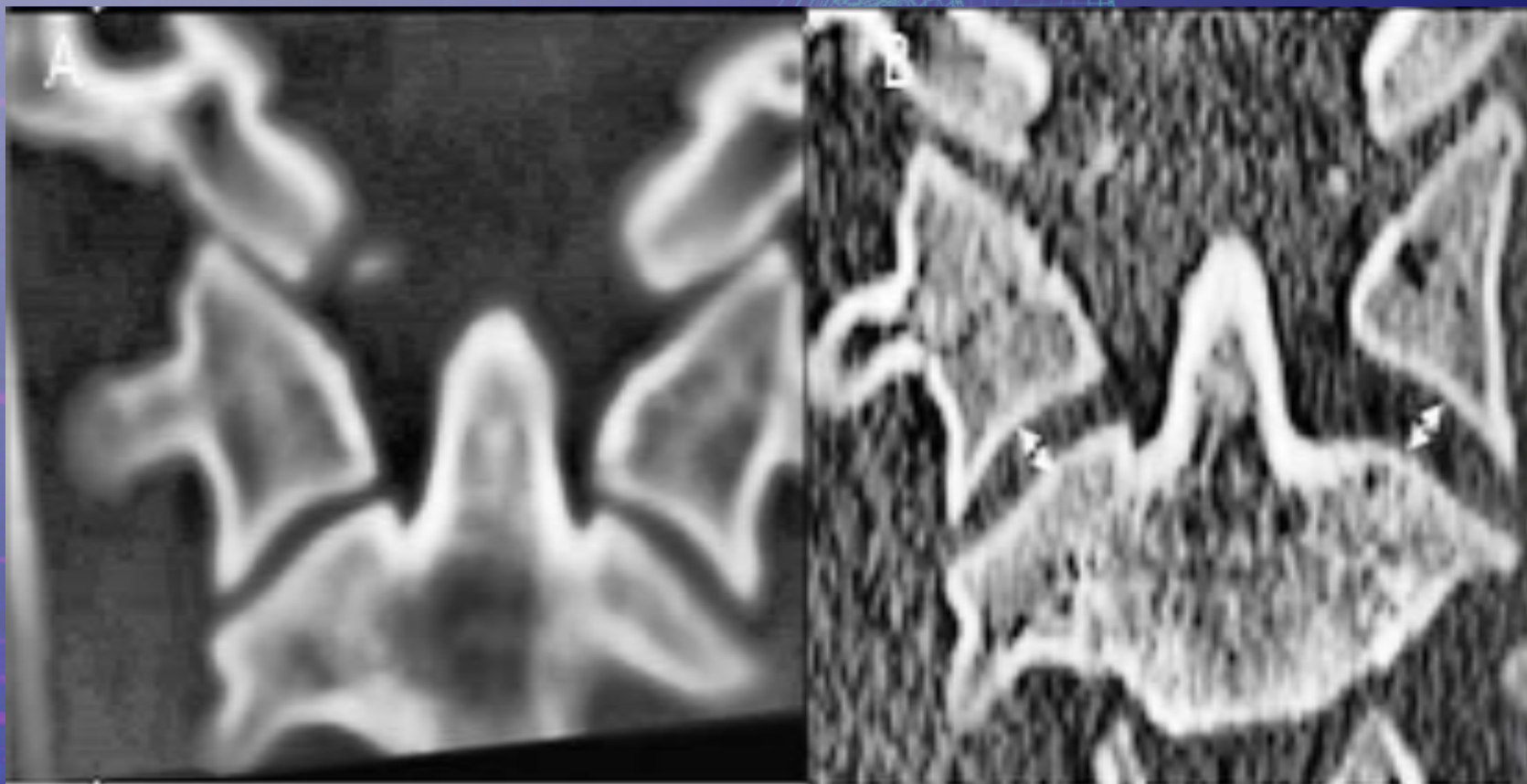
- In hospital flouroscopy



# Distraction 2<sup>nd</sup> collar application



# With and without C-Collar

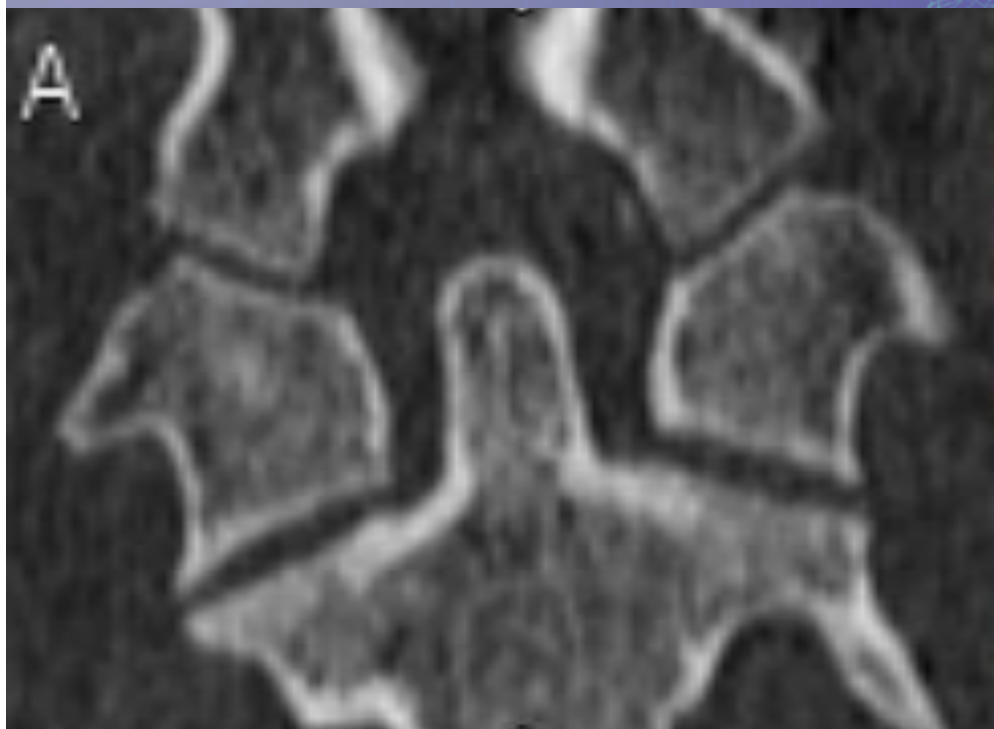


# Case No. VI

Collar application directly caused this C1-C2 distraction



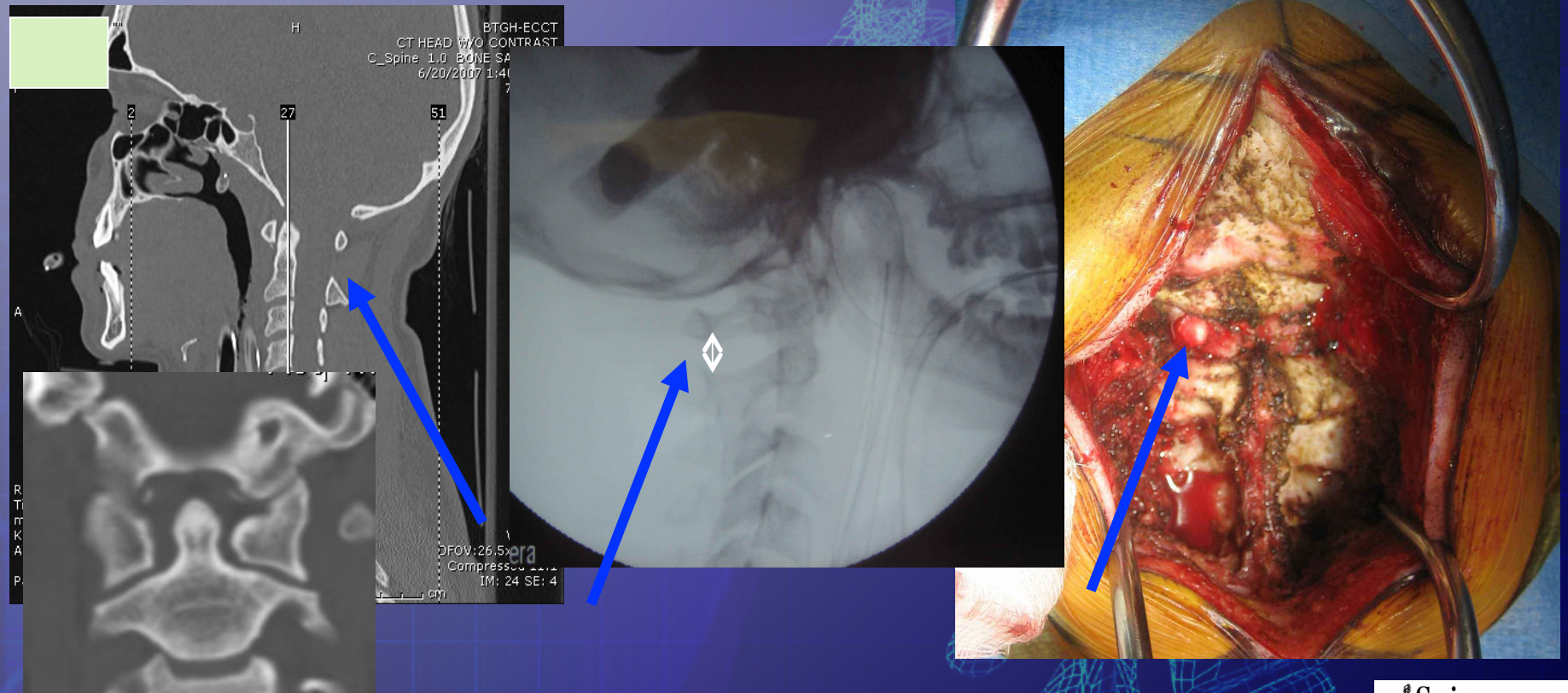
# With and without C-Collar



# Ben-Taub Clinical experience

## Case - VII

- 19 y/o female – auto-pedestrian accident



# Internal Decapitation

- **Complete, through and through dissociation from front to back**
- **Ligament Rupture**
- **Soft Tissue Rupture**

## Internal Decapitation

### Survival After Head to Neck Dissociation Injuries

Peleg J. Ben-Galim, MD,\* Tarek A. Sibai, MD,† John A. Hipp, PhD  
Michael H. Heggeness, MD, PhD,\* and Charles A. Reitman, MD\*

SPINE Volume 33, Number 16, pp 1744-1749  
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- Dissociative injuries are susceptible to traction forces





# Why do these injuries happen ?

# Acceleration-deceleration Human Trials

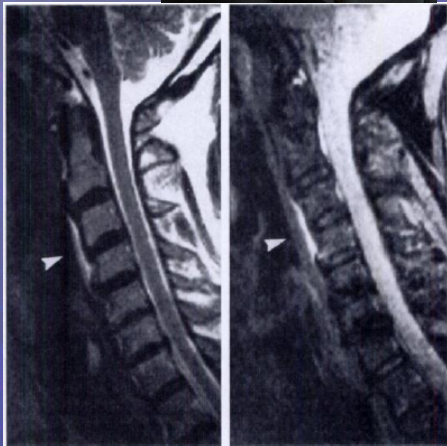


NBDL database

# Spectrum of dissociative Injury



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Frank separation

Death

Asymptomatic

Neck pain

Fractures and  
dislocations

Internal  
decapitation  
injury



# Hypothesis: collar creates distraction ?



# Can the Hypothesis be proven ?

- Whole Human Cadaver studies

- Whole human cadavers
- Intact head, torso, limbs
- Fresh / non-embalmed
- Post-rigor mortis



# Methods

## Cadavers

- **Whole human cadavers**
- **Intact head, torso, limbs**
- **Fresh / non-embalmed**
- **Post-rigor mortis**

# Cadaver studies

- Simulated OCI:



- C1-C2 flexion distraction injury was simulated
- Complete ligamentous disruption. (Muscle sparing)



# Cadaver studies

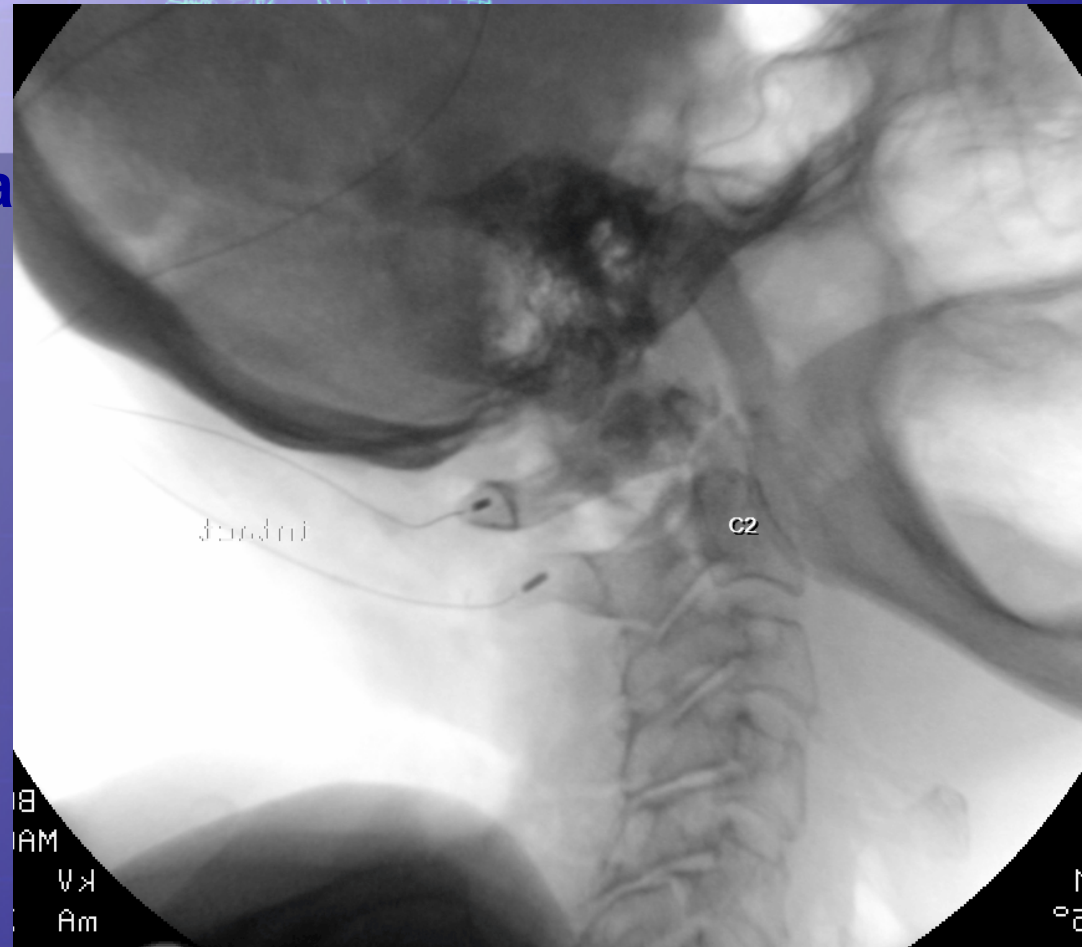
- **Standard patient maneuvers**
  - Rigid collar application process
  - Patient tilting
- **Fluoroscopic imaging**
  - Baseline
  - During maneuver



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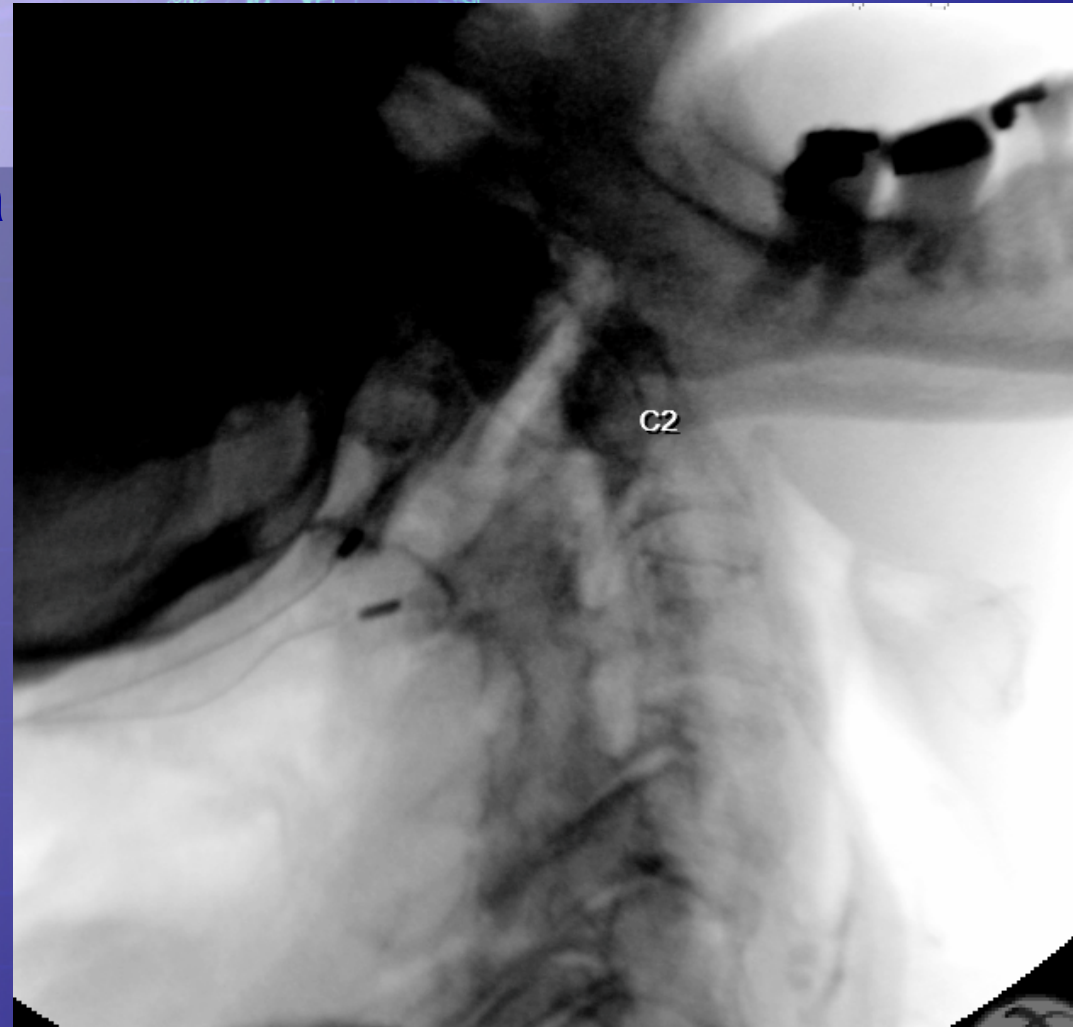
# Intervertebral Motion in the Unstable Cervical Spine

Caused by Application of a  
Conventional Collar  
Laboratory Test 3



# Intervertebral Motion in the Unstable Cervical Spine

Caused by Application of a  
Conventional Collar  
Laboratory Test 4



Lying Supine injured -> Collar on -> Intubate

## Vertical atlantoaxial distraction injuries: radiological criteria and clinical implications

L. FERNANDO GONZALEZ, M.D., DAVID FIORELLA, M.D., PH.D., NEIL R. CRAWFORD, PH.D.,  
ROBERT C. WALLACE, M.D., IMAN FEIZ-ERFAN, M.D., DENISE DRUMM, PH.D.,  
STEPHEN M. PAPADOPOULOS, M.D., AND VOLKER K. H. SONNTAG, M.D.

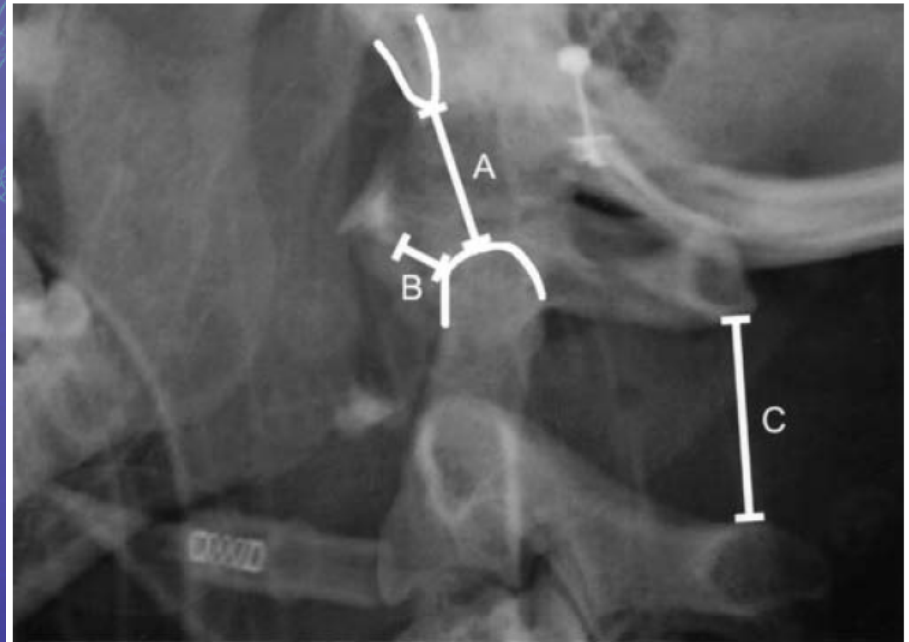


FIG. 2. Cross-table lateral cervical radiograph revealing a vertical distraction injury in a patient who died soon after the radiographs were obtained. The C-1 ring and skull base are markedly displaced cephalad with respect to C-2. The BDI is widened (Line A), and the atlantodens distance is increased (Line B). The distance between the posterior elements of C-1 and C-2 is grossly increased (Line C).

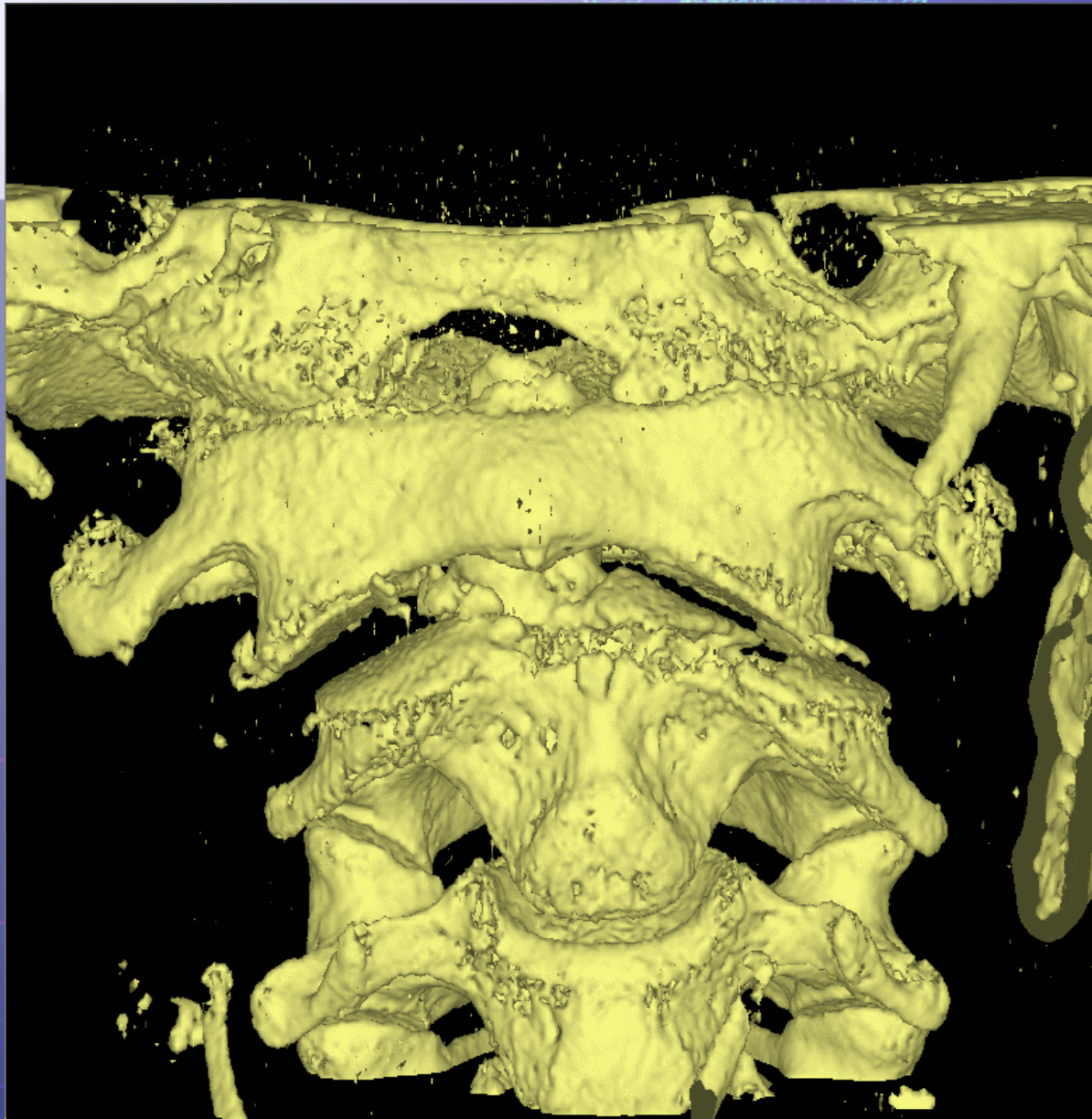
# Cadaver studies

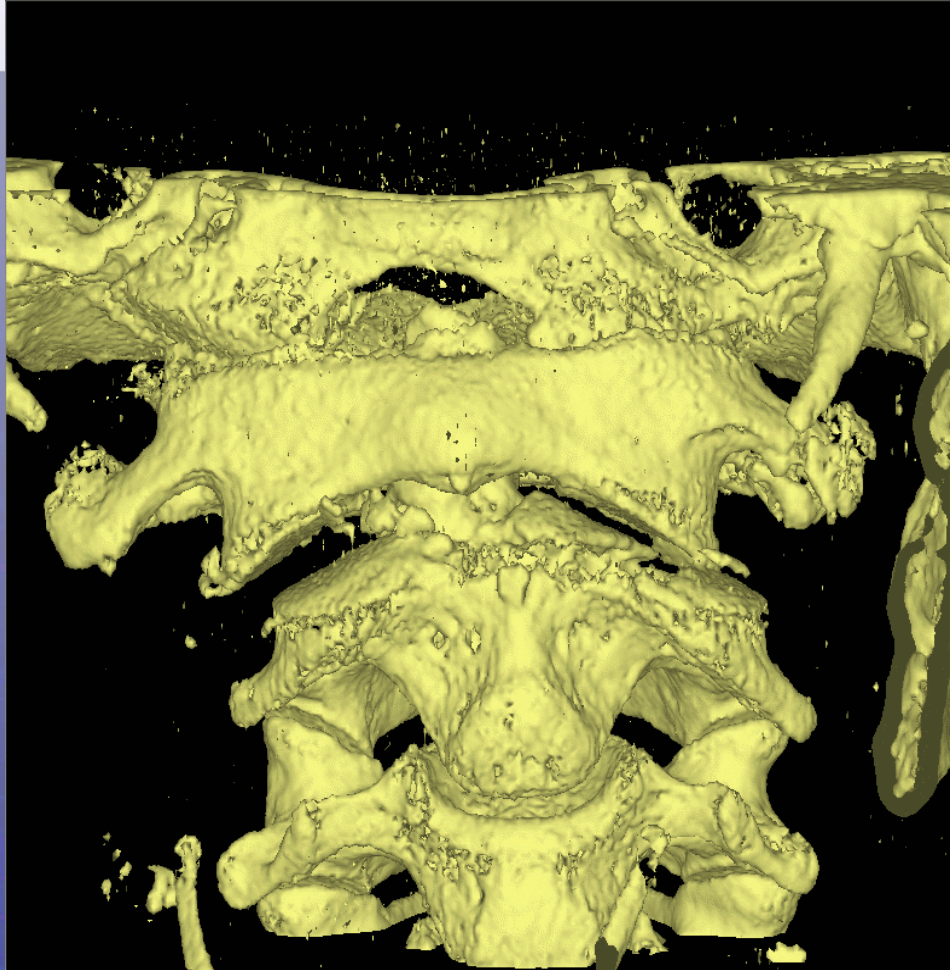
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  - During maneuver



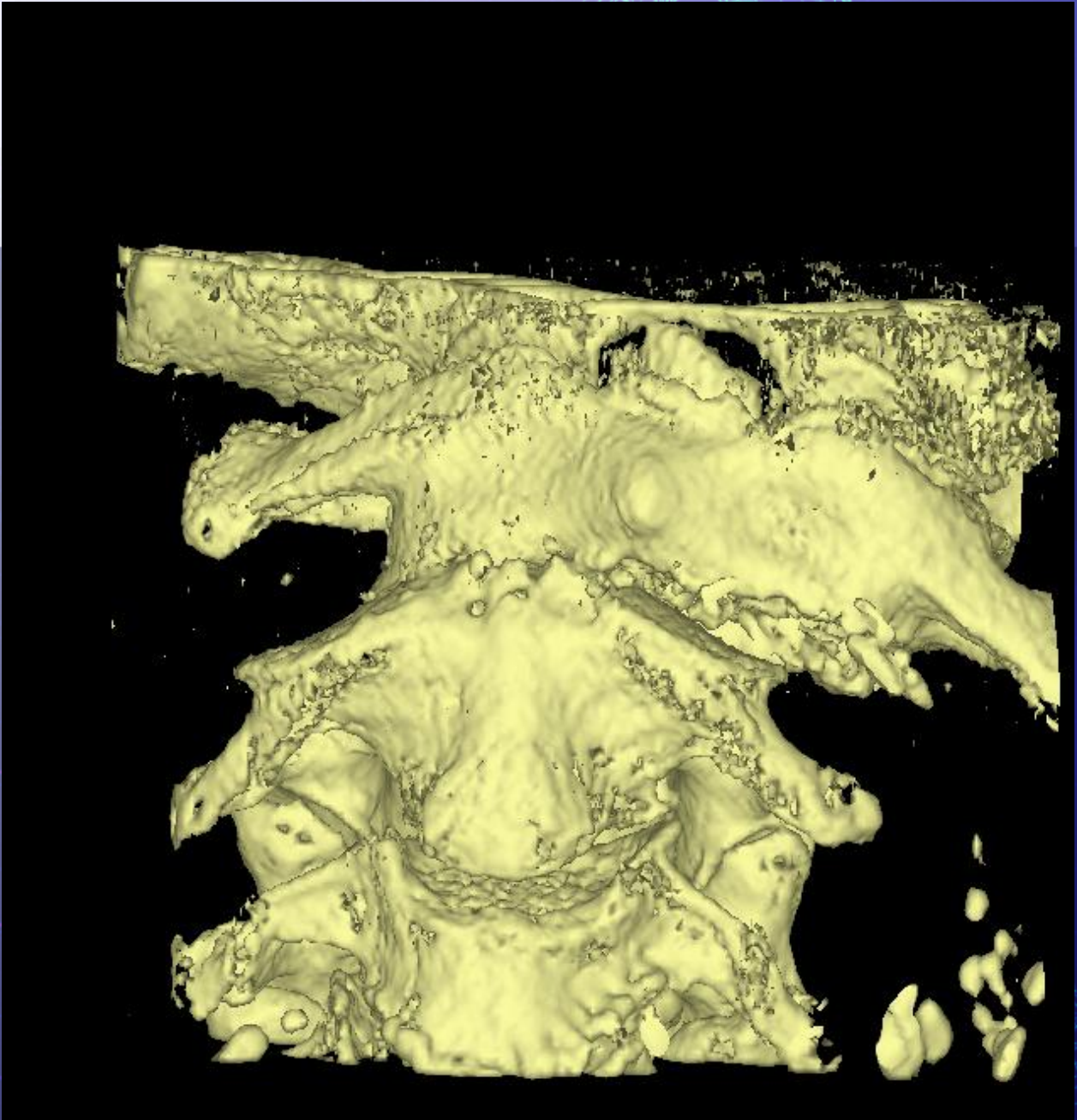
nu317009 www.fotosearch.com

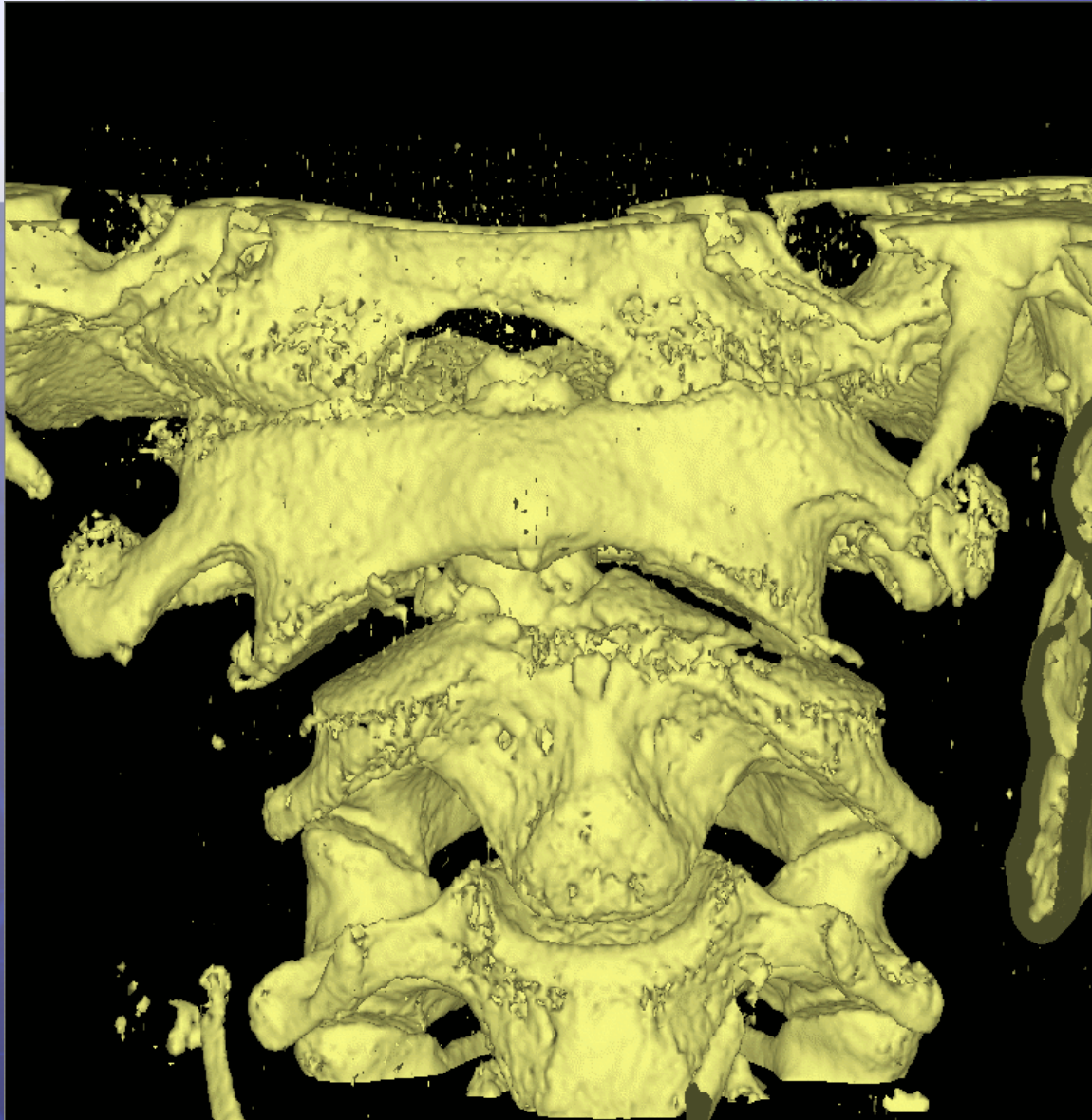


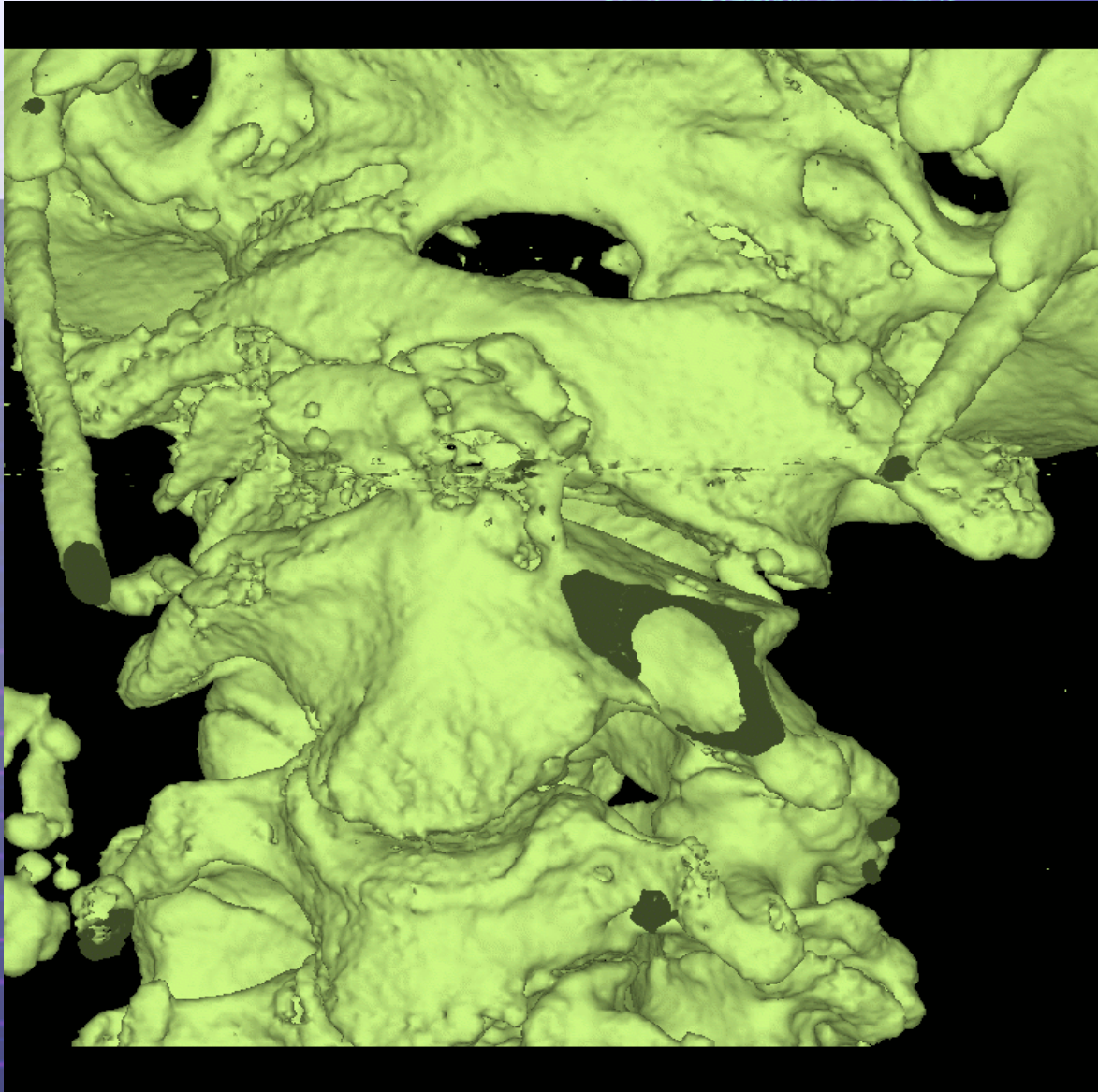




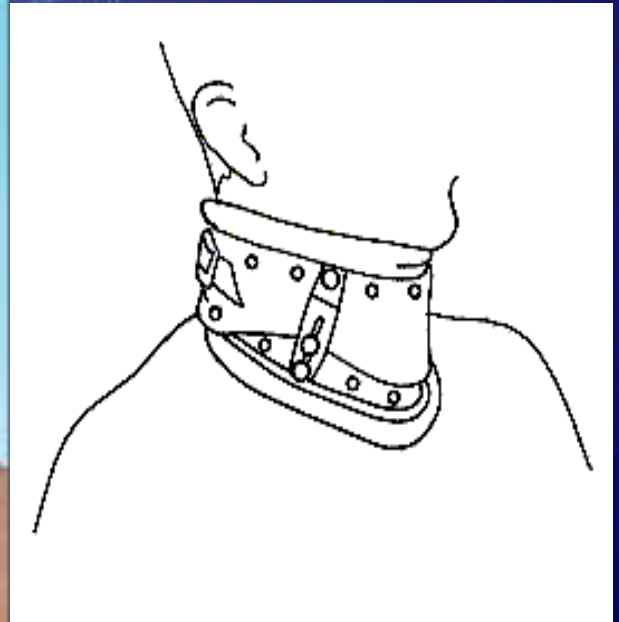




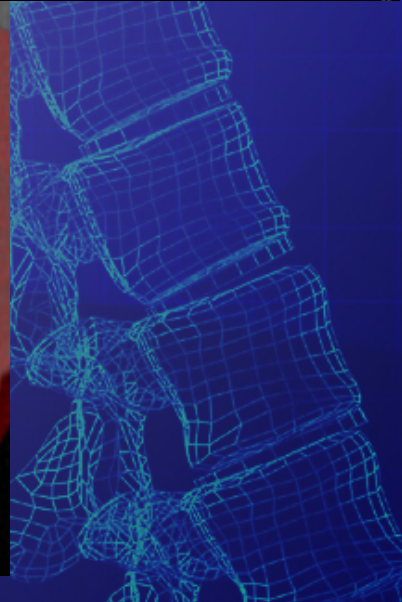
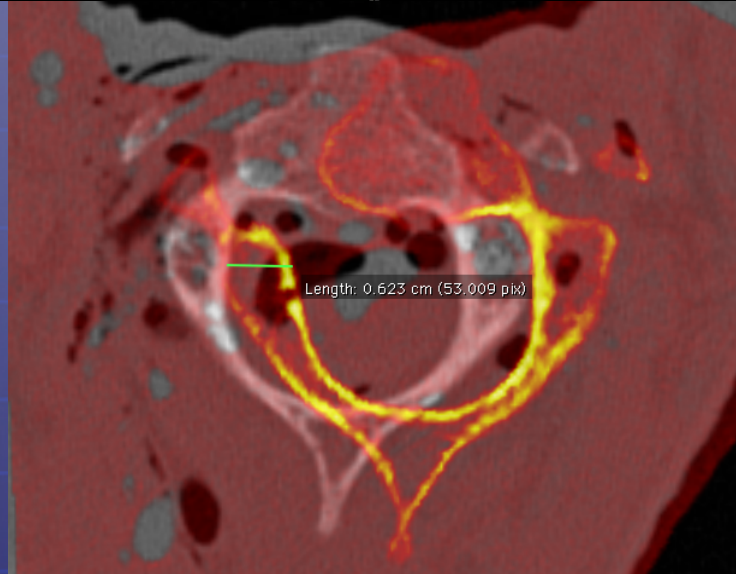
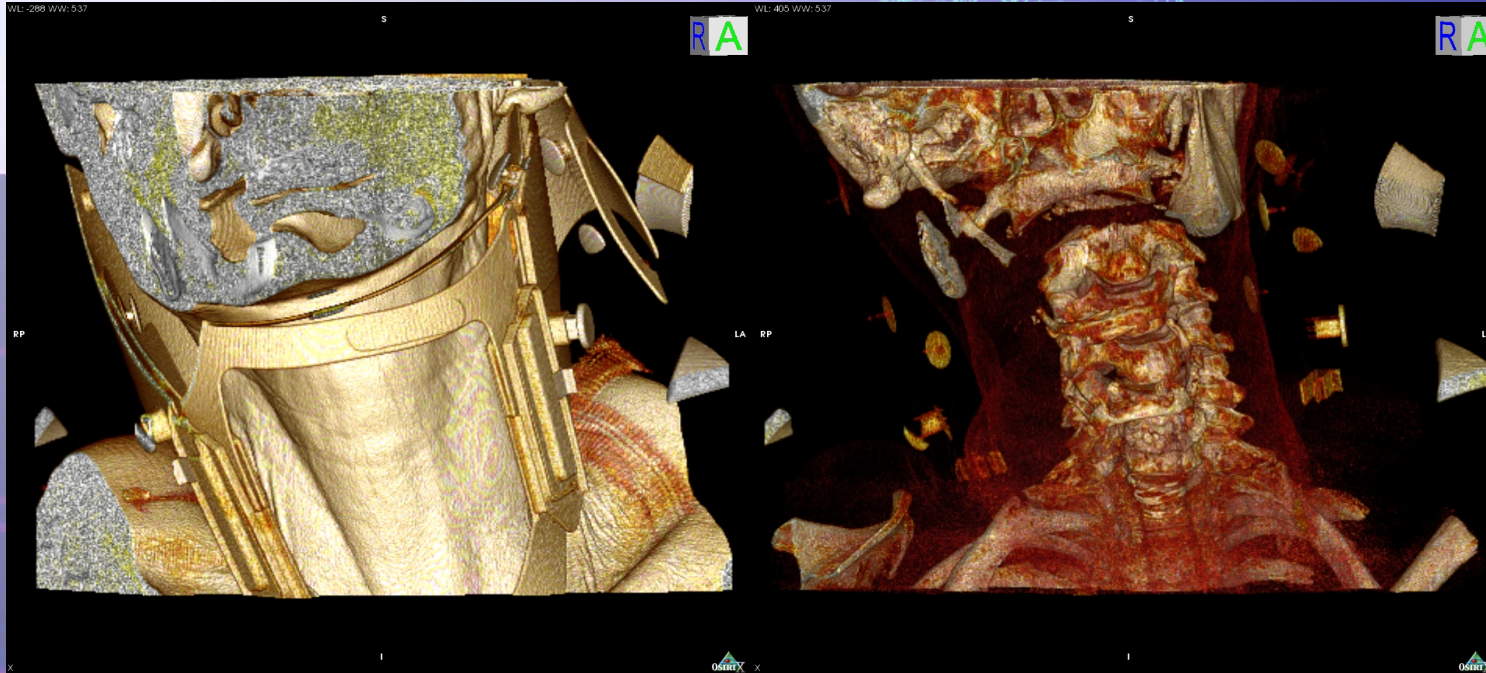




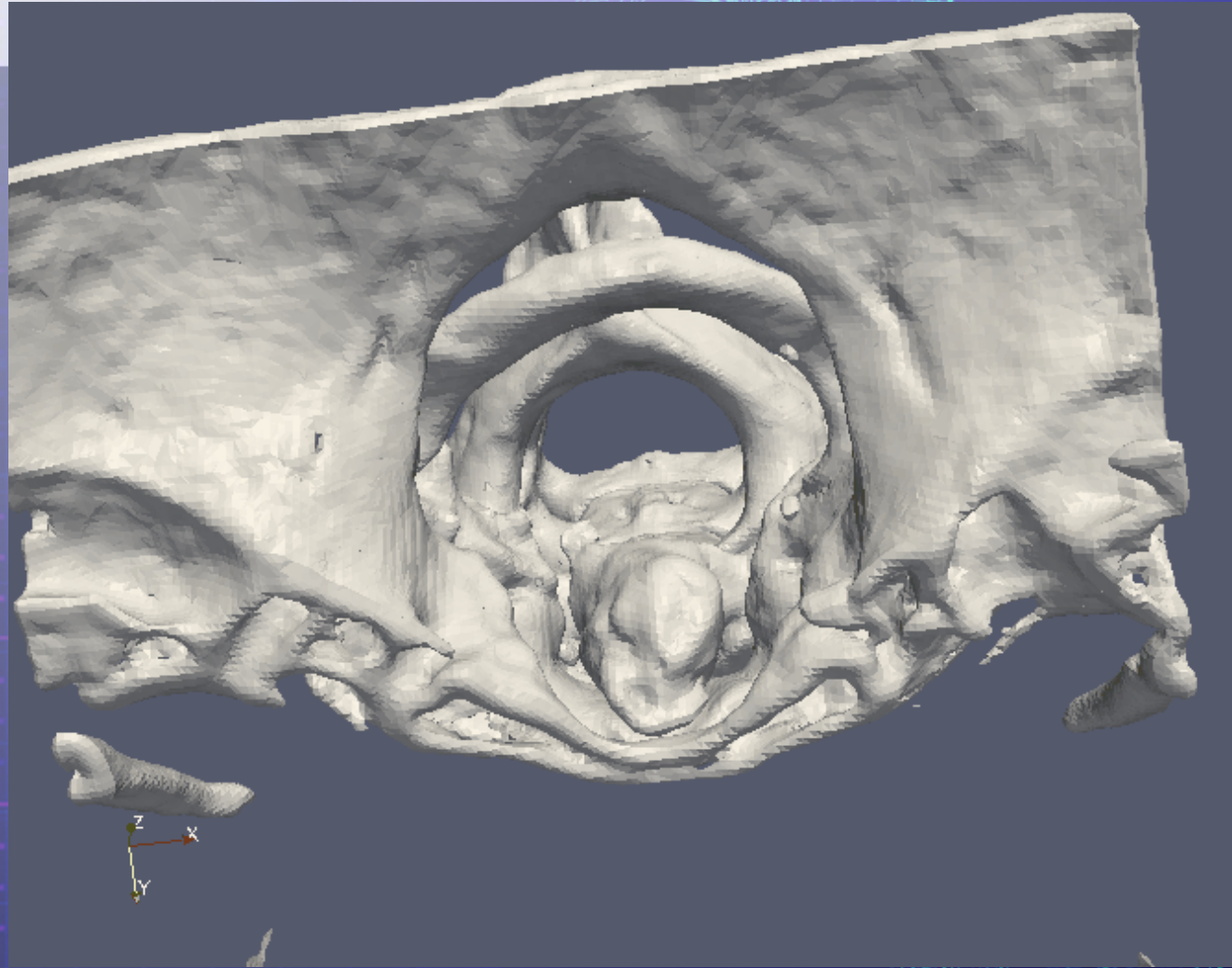
# Collar size does not change C-collars insufficient neck stabilization



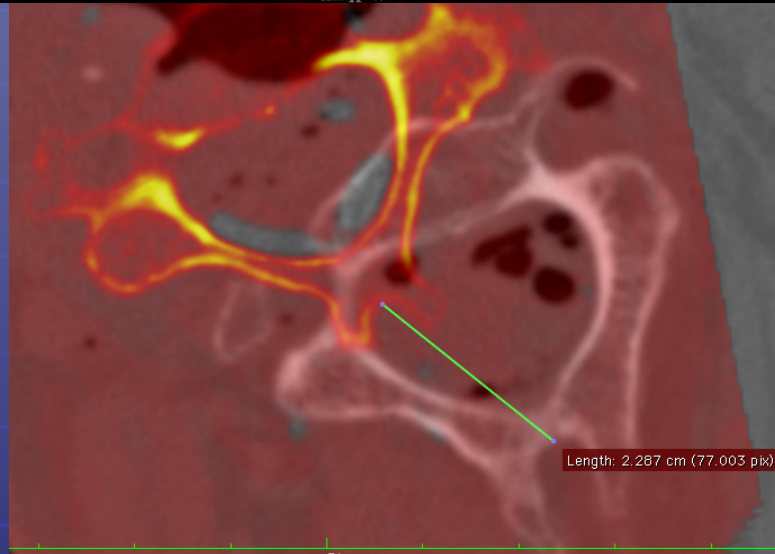
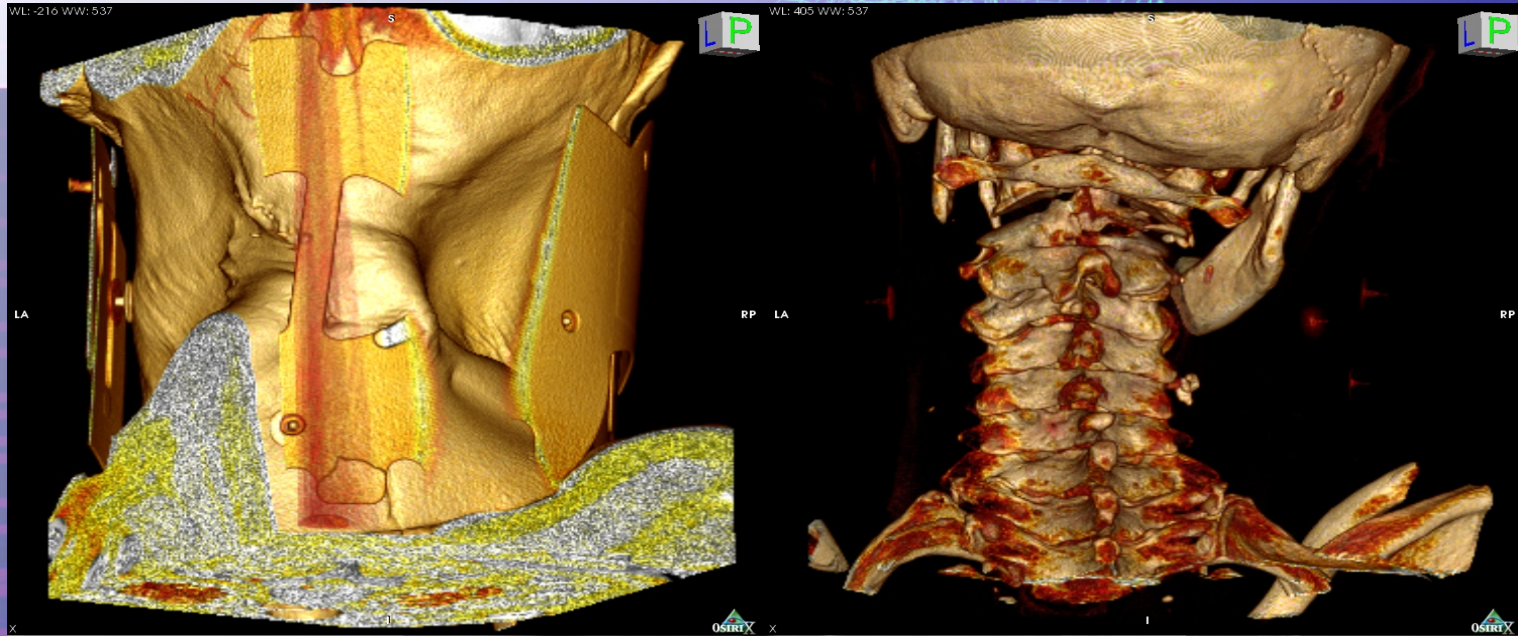
51760



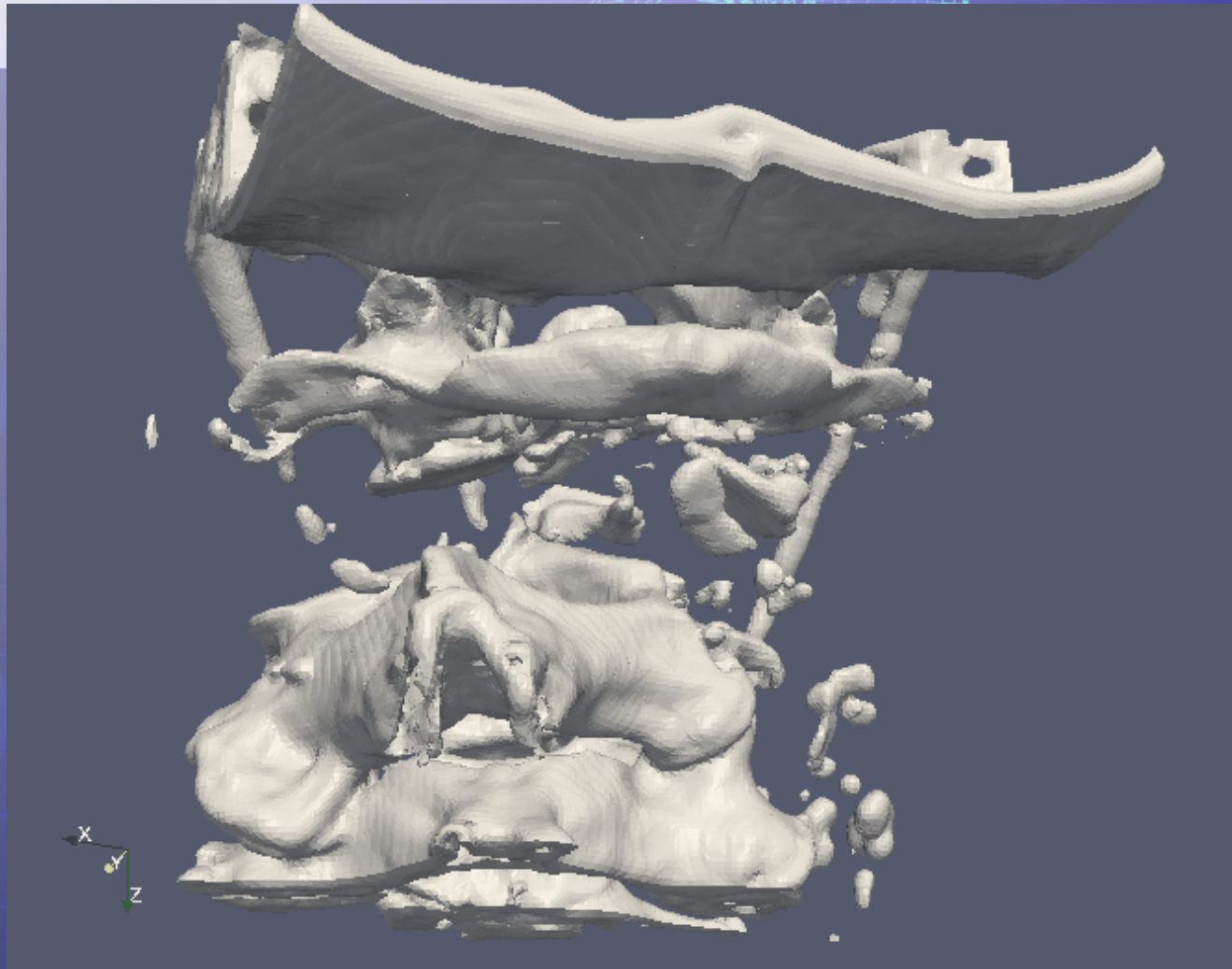
# 51760 Board Tilt with Collar On



# Head Hinges upon Collar edge



# 51766 Board Tilt with Collar On





# Survivors

**McMonagle,**  
NEJM 354;4 January 26, 2006

THE NEW ENGLAND JOURNAL OF MEDICINE

IMAGES IN CLINICAL MEDICINE

## The Importance of Early Cervical-Spine Radiography



- Blunt trauma
- Emergency laparotomy
- Stabilization in the ICU
- CT in ICU

A 19-YEAR-OLD MAN WAS BROUGHT TO THE EMERGENCY DEPARTMENT AFTER a high-speed motorbike collision. The patient had a score of 3 on the Glasgow Coma Scale (possible scores range from 3 to 15, with higher scores indicating better function), and his blood pressure was 70/35 mm Hg. He did not respond adequately to advanced resuscitation; results of a subsequent emergency laparotomy were normal. After the patient's condition was further stabilized in the intensive care unit, computed tomography of the cervical spine showed major atlanto-occipital dislocation in the lateral view (Panel A) and anteroposterior view (Panel B, arrows), which proved to be fatal.

Early radiography of the cervical spine may help guide resuscitation efforts. Some trauma surgeons favor performing such radiography as part of the secondary evaluation, rather than as part of the primary evaluation. However, in cases such as this one, early radiography can reveal such serious injury that further resuscitative efforts are futile.

## Spine Immobilization in Penetrating Trauma: More Harm Than Good?

Haut, Elliott R. MD; Kalish, Brian T. BA, EMT-B; Efron, David T. MD; Haider, Adil H. MD, MPH; Stevens, Kent A. MD, MPH; Kieninger, Alicia N. MD; Cornwell, Edward E. III MD; Chang, David C. MBA, MPH, PhD

**Methods:** We performed a retrospective analysis of penetrating trauma patients in the National Trauma Data Bank (version 6.2). Multiple logistic regression was used with mortality as the primary outcome measure. We compared patients with versus without prehospital spine immobilization, using patient demographics, mechanism (stab vs. gunshot), physiologic and anatomic injury severity, and other prehospital procedures as covariates. Subset analysis was performed based on Injury Severity Score category, mechanism, and blood pressure. We calculated a number needed to treat and number needed to harm for spine immobilization.

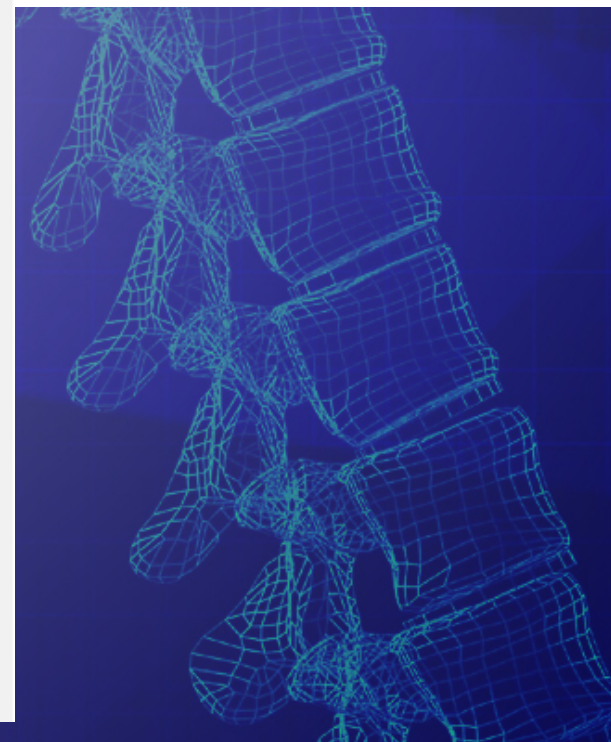
**Results:** In total, 45,284 penetrating trauma patients were studied; 4.3% of whom underwent spine immobilization. Overall mortality was 8.1%. Unadjusted mortality was twice as high in spine-immobilized patients (14.7% vs. 7.2%,  $p < 0.001$ ). The odds ratio of death for spine-immobilized patients was 2.06 (95% CI: 1.35-3.13) compared with nonimmobilized patients. Subset analysis showed consistent trends in all populations. Only 30 (0.01%) patients had incomplete spinal cord injury and underwent operative spine fixation. The number needed to treat with spine immobilization to potentially benefit one patient was 1,032. The number needed to harm with spine immobilization to potentially contribute to one death was 66.

**Conclusions:** Prehospital spine immobilization is associated with higher mortality in penetrating trauma and should not be routinely used in every patient with penetrating trauma.

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# Conclusions

- Dissociative injuries to the spine (OCI) do occur in our blunt trauma population
- Many of these suspected OCI's are not diagnosed
- OCI's seem to be associated with severe clinical outcomes.

# Conclusions

- Injuries to the spine occur in the penetrating neck trauma population as well.

# Take Home Message:

- Cervical collars are applied to millions of trauma patients with a good intent to protect against further injury in the rare event of an unstable cervical injury
- Ironically, it is in these patients that this good intent may be harmful.

# Take Home Message:

- Increased Vigilance for the potential that severe blunt trauma patients may have dissociative cervical spine injuries
- Current stabilization paradigms do not address this issue.



# Take Home Message:

- IT IS NOT YET TIME TO CHANGE THE STANDARD OF CARE,
- IT IS TIME TO BE CAREFUL WITH WHAT YOU DO!