

Cervical Spine Trauma

Johns Hopkins Orthopaedic Surgery
Review Course

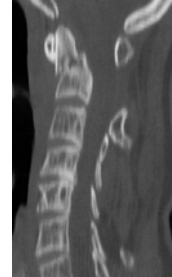
A. Jay Khanna, MD

The Johns Hopkins Medical Institutions
Department of Orthopaedic Surgery
Baltimore, Maryland



263. The risk factors for nonunion with nonsurgical treatment of the fracture shown in Figure 91 includes all of the following EXCEPT

- 1- displacement of more than 6 mm.
- 2- posterior displacement.
- 3- younger age.
- 4- a fracture gap of more than 2 mm.
- 5- treatment delay.



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Disclosures

Consultant/Teaching

Zimmer Spine
Kyphon, Inc./Medtronic
OrthoFix/Blackstone Medical

Speaker Bureau

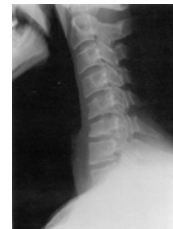
AO Spine North America

Equity

New Era Orthopaedics, LLC

169. A 37-year-old man has neck pain and stiffness following a motor vehicle accident 1 week ago. Examination reveals decreased active range of motion in all planes of the cervical spine, weakness of grip strength, and a bilateral Hoffmann's sign. A lateral radiograph is shown in Figure 58. Further evaluation should include

- 1- electromyography and nerve conduction velocity studies of the upper extremity.
- 2- MRI of the lumbar spine.
- 3- MRI of the cervical spine.
- 4- flexion-extension radiographs.
- 5- a bone scan.



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Key Points

1. Dermatome and Innervation Review
2. Importance of Transverse Ligament
3. Use of Power's Ratio in A-O Dislocation
4. Diagnosis and Tx of Jefferson Fracture
5. Type II Odontoid Fracture and When to Operate
6. Differentiate and Treat Type II and Type II A Hangman Fractures
7. Differentiate and Treat UFD and BFD

Injury to the C7 nerve root results in weakness primarily of the

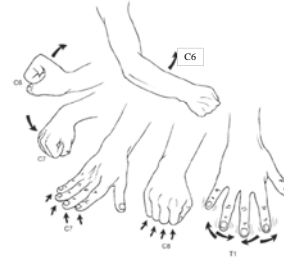
- 1- wrist flexors and finger flexors.
- 2- elbow flexors and wrist flexors.
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- 4- elbow extensors and wrist flexors.
- 5- elbow extensors and wrist extensors.

What is the most significant factor leading to nonunion when a halo vest is used to treat a type II fracture at the base of the odontoid?

- 1- Diabetes
- 2- Osteoporosis
- 3- Extension injury
- 4- Age older than 65 years
- 5- Displacement more than 5 mm

Physical Examination

CTQ



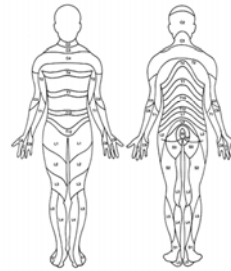
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- 1- A fracture pattern with a frontal oblique orientation
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Physical Examination

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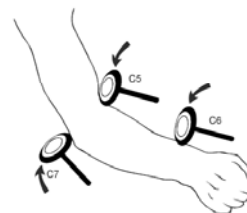
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Neural Anatomy

- 8 cervical roots
- Each cervical root exits the c-spine above the pedicle of the matching vertebrae
- The remainder of the spine roots all exit the canal under the corresponding pedicle

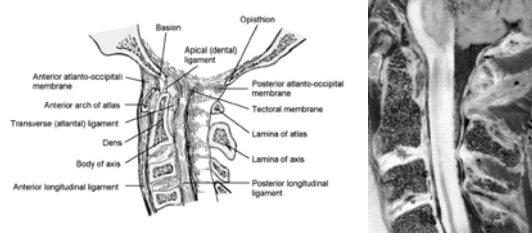
Physical Examination

CTQ



Browner, Jupiter. Skeletal Trauma, 2nd Edition, 1998.

Upper Cervical Spine Anatomy



Browner, Jupiter. Skeletal Trauma, 2nd Edition, 1998.

<4-5mm



Ligaments

CTQ

- Primary Restraint: **Transverse (Atlantal) Ligament**
- 3-5mm ADI implies rupture of primary restraint
- Secondary Restraint: Alar & Apical Ligaments
- >5mm ADI implies rupture of primary and secondary restraints

Pseudo-Subluxation

• **C2 On C3** CTQ

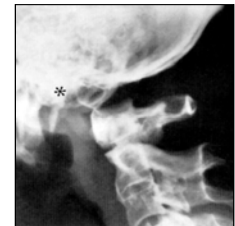
- Check Spinolaminar Line
- C2 WITHIN 2mm OF LINE



Upper Cervical Spine Fractures

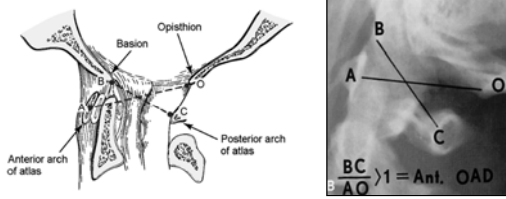
Atlanto-Occipital Dislocation

- Rare
- Usually Fatal
- Classification:
 - Anterior, Posterior or Longitudinal
 - Based on Lateral X-Ray
- Power's Ratio
- Tx: Early Occipital-Cervical Fusion, Fixation & Post-Op Halo Stabilization



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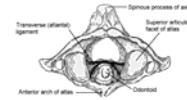
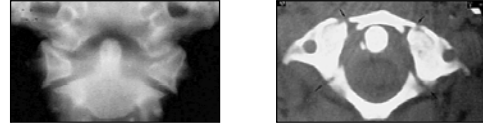
Atlanto-Occipital Dislocation



CTQ

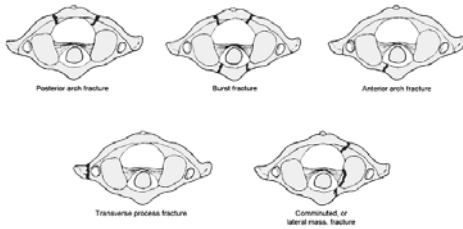
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C1 (Atlas) Fracture



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C1 (Atlas) Fracture



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C1-2 Subluxation (Atlantoaxial Instability)

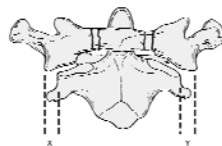
- occurs d/t transverse ligament rupture
- increased atlantodens interval > 5 mm
- >treated w/ C1-2 fusion
- ligament injury w/o fx rare



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C1 (Atlas) Fracture

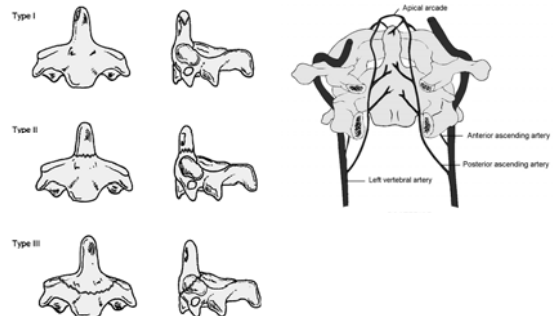
- < 6.9 mm
→ Halo Vest x 3 Months
- > 6.9 mm
– Treatment Controversial
 1. Traction x 6-8 weeks f/b 6 weeks Halo
 2. Halo Vest Only
- Flex-Ex after Halo Removed
–Tx C1-C2 Instability (> 5 mm) with Fusion



CTQ

Tay, Eismond. OKU: Spine 2, 2002
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Odontoid Fracture



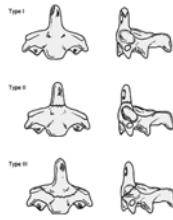
Browner, Jupiter. Skeletal Trauma, 2nd Edition, 1998.

Odontoid Fracture

-Most Common Mechanism: Flexion (80%)

-Type I (2-3%)

- usually @ upper tip
- usually stable if displacement < 2 mm
- Tx w/ rigid orthosis x 6-8 weeks



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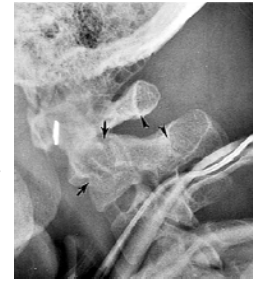
Odontoid Fracture

Type III

-high healing rate d/t greater cancellous bony overlap and rarity of fracture distraction

-treated w/ closed reduction & halo x 8-12 weeks

-13% Nonunion Rate
-15% Malunion Rate



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Odontoid Fracture

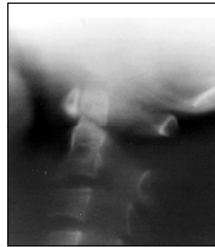
Type II (60%)

- @ junction of odontoid & C2 body
- nonunion rate is higher-- related to:
 - angulation > 10 degrees
 - displacement > 5 mm
 - age > 60-65 years (OKU: 40 years)
 - smoking

-nonunion rate reported as high as 88% (average 33%)

-associated w/ C1 Fx in 16%

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C2 Isthmus (Hangman's) Fracture

-Mechanism:

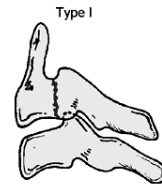
Hyperextension + axial load + rebound flexion

-Neuro injury uncommon

-Often associated w/ other C-Spine injuries

Type I

-vertical fracture w/ no angulation
-Tx: Rigid orthosis x 8-12 weeks



Miller, MD. Review of Orthopaedics, 3rd Edition, 2000.
Browner, Jupiter. Skeletal Trauma, 2nd Edition, 1998.

Odontoid Fracture

Type II (60%)

-Treatment

-Nondisplaced (< 5 mm)

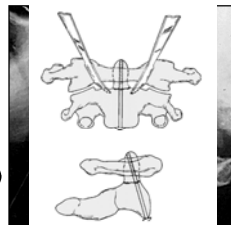
--> Halo x 8-12 weeks

-Two or more risk factors:

-->PSF of C1-2

-->Odontoid screw

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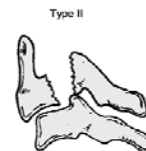
C2 Isthmus (Hangman's) Fracture

-Type II

> 3mm translation

> 11° angulation

-associated with wedge compression of anterior-inferior C2 VB



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C2 Isthmus (Hangman's) Fracture

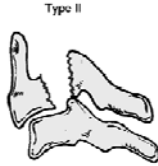
-Type II

-Tx: Closed extension traction if > 6 mm translation & halo immobilization x 12 weeks

-Nonunions treated w/ anterior C2-3 fusion or posterior C1-3 fusion

-Acceptable reduction
= < 4 mm translation &
< 10° angulation

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Miller, MD. Review of Orthopaedics, 3rd Edition, 2000.
Browner, Jupiter. Skeletal Trauma, 2nd Edition, 1998.

Lower Cervical Spine Fractures

C2 Isthmus (Hangman's) Fracture

-Type IIA

-severe angulation with minimal translation

-Tx: extension and compression halo treatment for 6 weeks and fusion as necessary.

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Classification of Cervical Spine Injuries

- **Hyperflexion Injuries**
 - Posterior Ligamentous Injuries
 - Unilateral Facet Dislocation
 - Bilateral Facet Dislocation
- **Axial Loading**
 - Compression Fracture
 - Burst Fracture
- **Axial Load with Flexion**
 - Tear Drop Fracture
- **Extension Injuries**
 - Isolated "Fractures" of Posterior Ligaments
 - Anterior Longitudinal Ligament Rupture
 - Central Cord Syndrome
 - Traumatic Retrolisthesis



An H. Principles & Techniques of Spine Surgery, 1998.

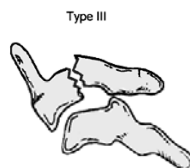
C2 Isthmus (Hangman's) Fracture

-Type III

-vertical fracture w/ bilateral or unilateral facet dislocation

-highest association with neurologic deficits

-Tx: open reduction, PSF & halo



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Browner, Jupiter. Skeletal Trauma, 2nd Edition, 1998.

C3-C7 Facet Joint Injuries

-**Unilateral facet dislocations**
-- less than 50% translation

-**Bilateral facet dislocations**
-- greater than 50% translation
--BFDs-- Often assoc. w/ nerve root or spinal cord injuries (75%)

-Most common level for dislocations-- C5-6 and C6-7

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C3-C7 Facet Joint Injuries

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UFD



BFD

Browner, Jupiter. Skeletal Trauma, 2nd Edition, 1998.

C3-C7 Compression Fracture

- Anterior Wedge Fracture-- d/t flexion forces
- Injuries most often at C4-5 and C5-6 levels
- Spinal canal compromise is rare
- Treated w/ rigid orthosis x 8-12 weeks
- C-Spine instability results if posterior ligaments involved
- Rule out translation or angular displacement w/ flexion/extension radiographs

Tay, Eismont. OKU: Spine 2, 2002
Miller, MD. Review of Orthopaedics, 3rd Edition, 2000.

C3-C7 Facet Joint Injuries

-Use of MRI **controversial** for closed or operative/open reductions.

-Most authors:

-MRI before reduction to R/O HNP (7%)

CTQ

-If HNP present--> anterior open decompression & fusion

-If HNP absent--> closed reduction (in alert, cooperative patients).



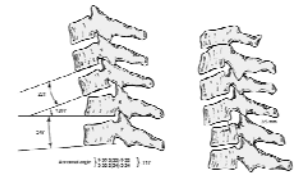
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C3-C7 Compression Fracture

-considered unstable & Tx w/ PSF

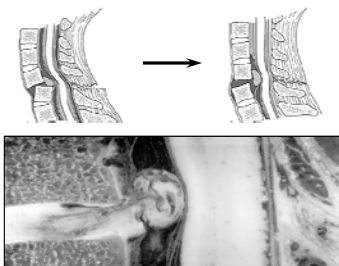
- translation > 3.5 mm
- angulation > 11 mm
- loss of height > 25%

-If incomplete neurologic injury, then anterior column decompression and fusion.



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C3-C7 Facet Joint Injuries



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C3-C7 Burst Fracture

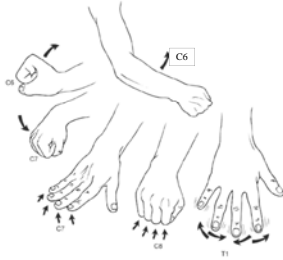
-Mechanism-- compression-flexion or vertical axial load on C5 or C6

-Results in canal compromise from posterior wall involvement w/ resultant neurologic compromise



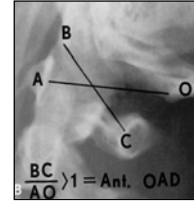
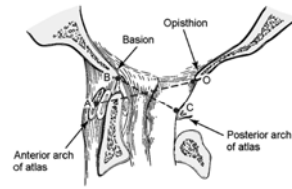
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Physical Examination



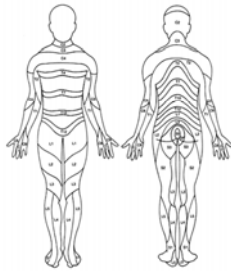
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Atlanto-Occipital Dislocation



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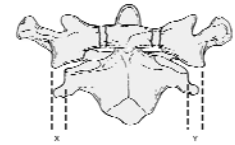
Physical Examination



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C1 (Atlas) Fracture

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→ Halo Vest x 3 Months
- > 6.9 mm
– Treatment Controversial
 1. Traction x 6-8 weeks f/b 6 weeks Halo
 2. Halo Vest Only
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Ligaments

- Primary Restraint: Transverse (Atlantal) Ligament
- 3-5mm ADI implies rupture of primary restraint
- Secondary Restraint: Alar & Apical Ligaments
- >5mm ADI implies rupture of primary and secondary restraints

Type II Odontoid Fracture

Type II (60%)

Higher Non-Union Rate Related to:

1. angulation > 10 degrees
2. displacement > 5 mm
3. age > 60-65 years (OKU: 40 years)
4. smoking

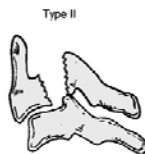


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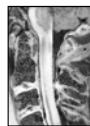
C2 Isthmus (Hangman's) Fracture

-Type II

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Thank You



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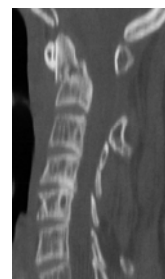
-Tx: extension and **compression** halo treatment for 6 weeks and fusion as necessary.



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263. The risk factors for nonunion with nonsurgical treatment of the fracture shown in Figure 91 includes all of the following EXCEPT

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C3-C7 Facet Joint Injuries



UFD

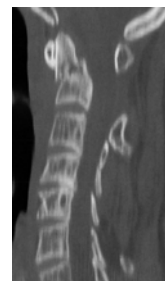


BFD

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Preferred Response: 3

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169. A 37-year-old man has neck pain and stiffness following a motor vehicle accident 1 week ago. Examination reveals decreased active range of motion in all planes of the cervical spine, weakness of grip strength, and a bilateral Hoffmann's sign. A lateral radiograph is shown in Figure 58. Further evaluation should include

- 1- electromyography and nerve conduction velocity studies of the upper extremity.
- 2- MRI of the lumbar spine.
- 3- MRI of the cervical spine.
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Injury to the C7 nerve root results in weakness primarily of the

- 1- wrist flexors and finger flexors.
- 2- elbow flexors and wrist flexors.
- 3- elbow flexors and finger flexors.
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Preferred Response: 4

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OITE, 2003

What is the most significant factor leading to nonunion when a halo vest is used to treat a type II fracture at the base of the odontoid?

- 1- Diabetes
- 2- Osteoporosis
- 3- Extension injury
- 4- Age older than 65 years
- 5- Displacement more than 5 mm

Preferred Response: 3

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Preferred Response: 5

Which of the following is considered an appropriate surgical indication for management of acute type II odontoid fractures?

- 1- A fracture pattern with a frontal oblique orientation
- 2- A sagittal oblique fracture that may extend into the body of dens
- 3- A patient with osteoporosis
- 4- Displacement of 2 mm and any posterior angulation
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Thank You

