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Pain in the Neck: Red Flags On and Off the Field

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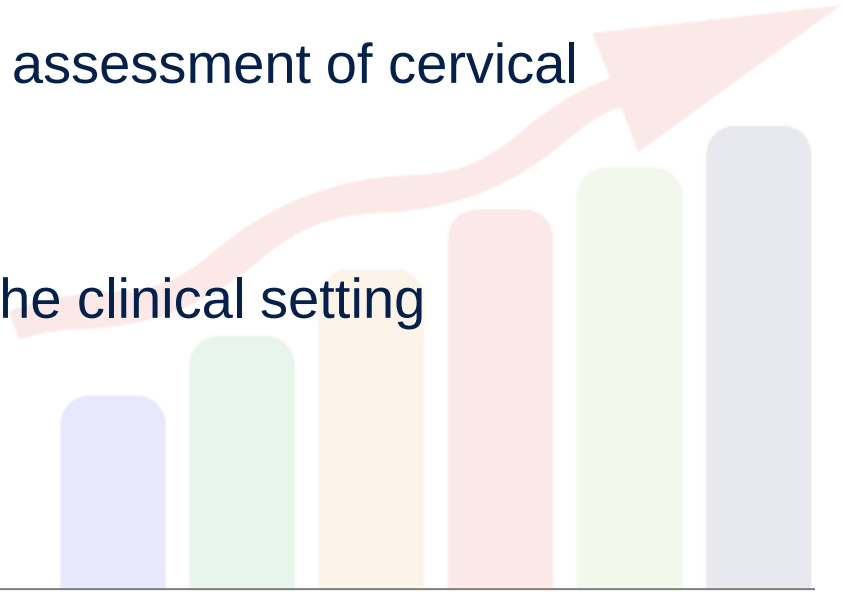
Disclosures

I have no relevant disclosures

Outline

- Understand the epidemiology of neck injuries
- Be familiar with different neck injuries
- Comfortable performing an on-field assessment of cervical spine injuries
- Know criteria for further imaging
- Recognize neck injury red flags in the clinical setting



Epidemiology

Incidence

- Cervical spine injuries are common
- **10,000 cases per year** of spinal cord injury
- 10% of these attributed to athletic events
- **“Unsupervised”** events
  - Diving, surfing and skiing
- Most seen in football, wrestling and ice hockey
- Sports-related cervical spine injury **most common in <30 years old**
  - **More than half occurring in those younger than 18**

Gregory et al. *J Craniofacial Surg* 2021
Oshlag et al. *Primary Care: Clinics in Office Practice* 2020

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High School Sports

- **3.04 per 100,000 athlete exposures**
- Rates greatest in:
  - **Football (10.10)**
  - Wrestling (7.42)
  - Girl's gymnastics (4.95)
- **Muscle Injury (63.1%)**, nerve injuries (20.5%)
- Football -> nerve injuries (20.5%); Boy's ice hockey -> fractures
- Mechanism: **player contact (70.7%)**, playing surface contact (16.1%)

Meron et al. *PMR* 2018

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Collegiate Sports

- 7.05 per 100,000 athlete exposures
- **Men:** 7.05 per 100,000 AE **Women:** 1.95 per 100,000 AE
- Men's football (29.09 per 100,000 AE)
- Women's field hockey (11.51 per 100,000 AE)
- **Competition** > practice; **In-season** > off-season
- 62.3% returned to play within 24 hours
- **<5% more than 3 weeks**

Deckey et al. *Spine* 2020

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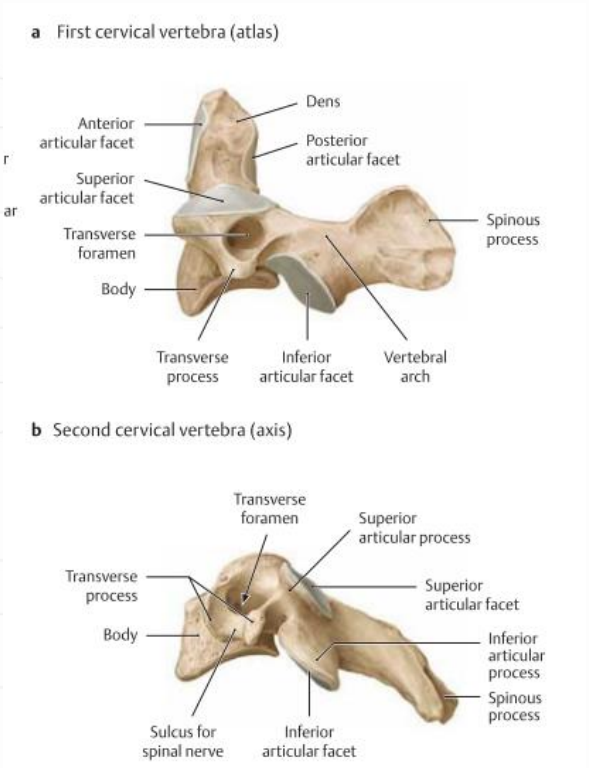
Anatomy

Cervical Spine: Basics

- 7 cervical vertebrae (C1-C7)
- 8 cervical nerves (C1-8)
  - Emerge above corresponding vertebra
  - Except C8 (below)
- Normal cervical lordosis
- Bifid spinous process
- Atlas and Axis



Thieme Atlas of Human Anatomy

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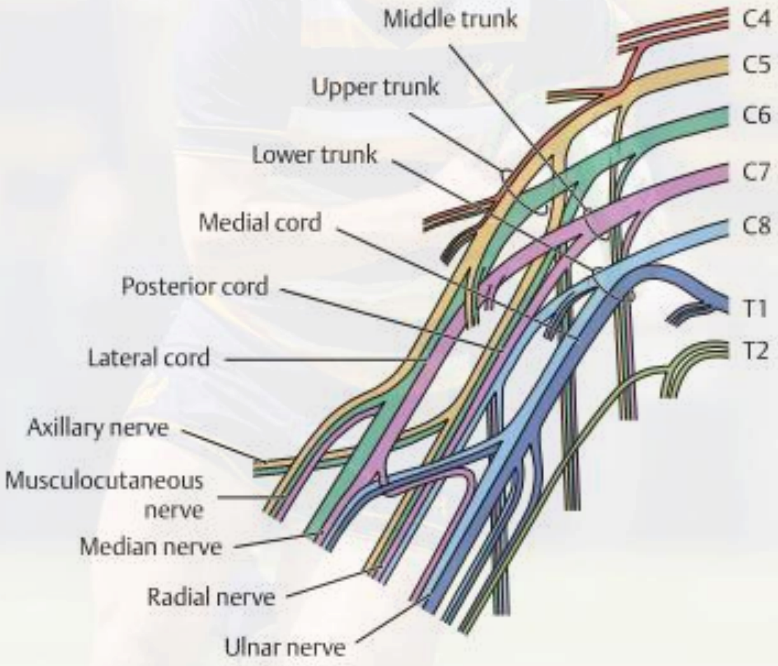
Cervical Spine: Brachial Plexus

Roots, **T**runks, **D**ivisions, **C**ords, **B**ranches



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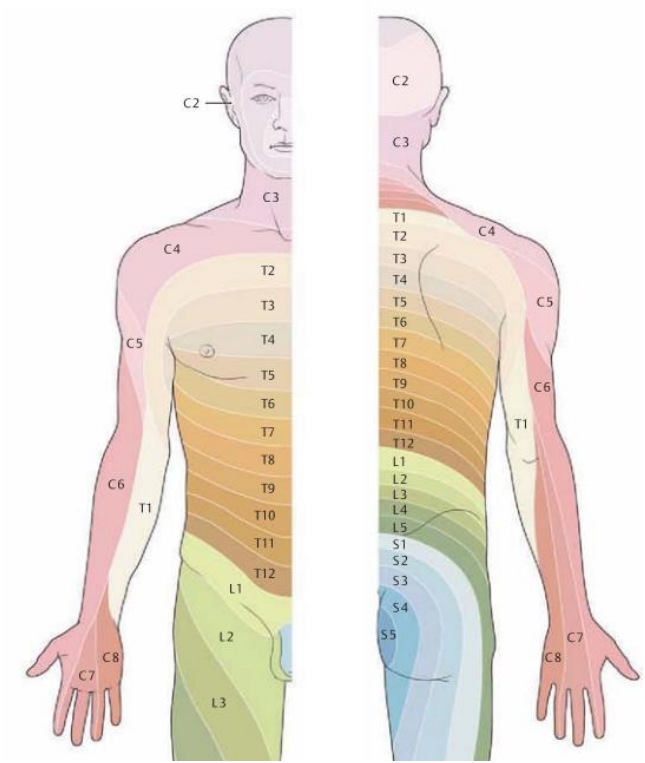
Cervical Spine: Dermatomes & Myotomes



Level	Action/Muscle
C1/2	Neck flex/ext
C3	Lateral neck flexion
C4	Shoulder elevation
C5	Biceps, deltoid (shoulder abduction)
C6	Wrist extensors
C7	Triceps
C8/T1	Interossi

Thieme Atlas of Human Anatomy

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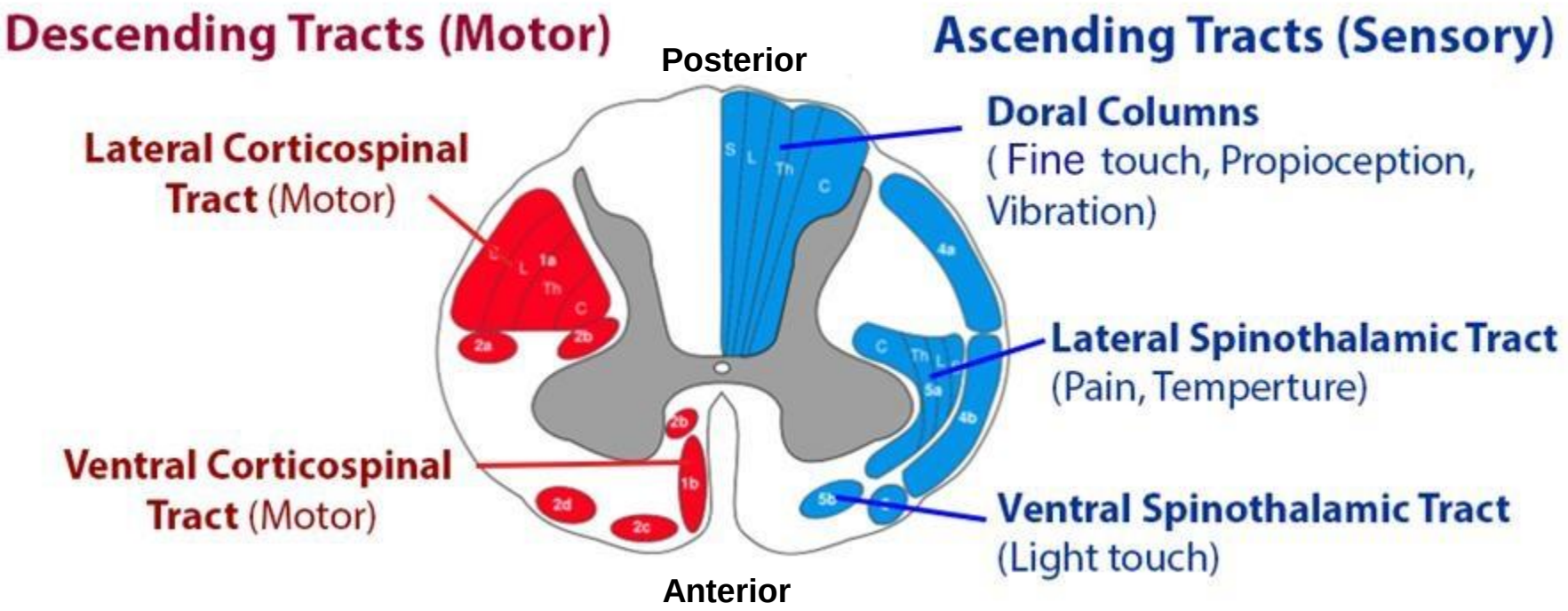
Cervical Spine: Spinal Tracts



Injuries: Instability & Fractures

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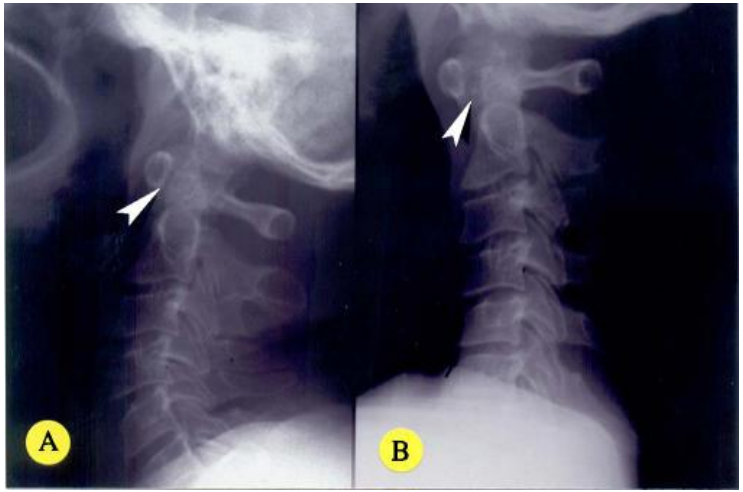
Instability: Atlantoaxial

Traumatic Instability:

- Poor prognosis, absolute contraindication to collision activities



The Anterior Atlanto-Odontoid Distance (AAOD) is 1 mm in neutral but 4 mm in flexion, indicating AAI

Down Syndrome:

- Affects 10-20%
- Most asymptomatic, diagnosed on radiography
- 1-2% manifest with spinal cord compression
- May limit sports participation
- Asymptomatic screening **not recommended** at this time

Tomlinson et al. *CJSM* 2020

Ali et al. *Int Orthop* 2006

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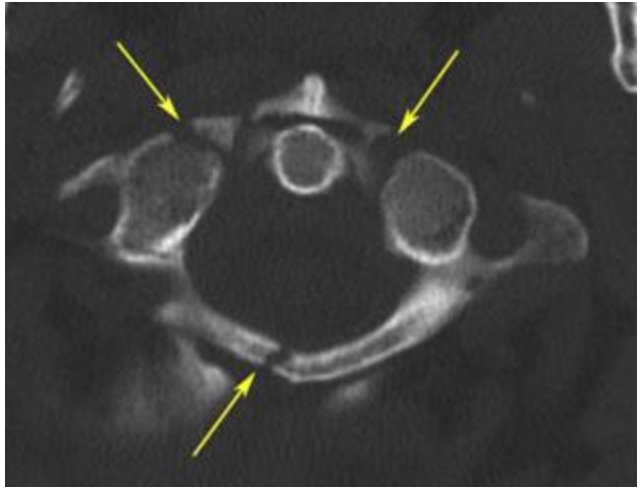
C1: Jefferson Fracture

- **Burst fracture at C1 (Atlas)**
- Axial compression forces atlas in to axis
- Fracture at weak points
- 2-4 part fracture, anterior and posterior arches
- Shallow water diving
- No neuro deficit (unless fragment retropulsed)
- **Unstable if >7mm displacement**



Marcon et al *Clinics* 2013

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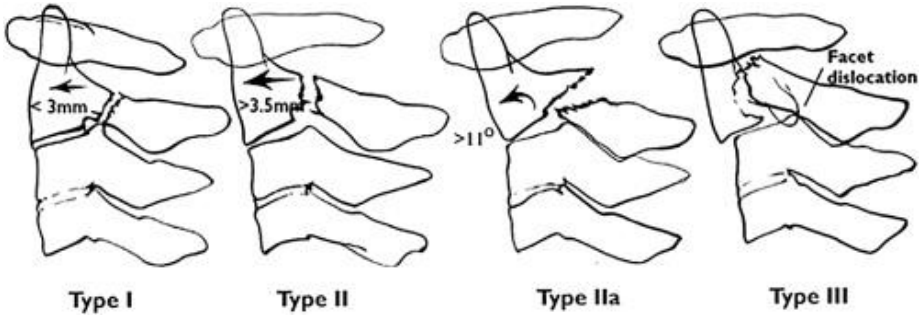
C2: Hangman's Fracture

- Traumatic spondylolisthesis of the axis
- Hyperextension distraction
- Fracture pedicle C2 with dislocation of the body on C3

Type	Management
1	Neck brace, halo
2	Halo vs surgery
3	Surgery



Marcon et al *Clinics* 2013

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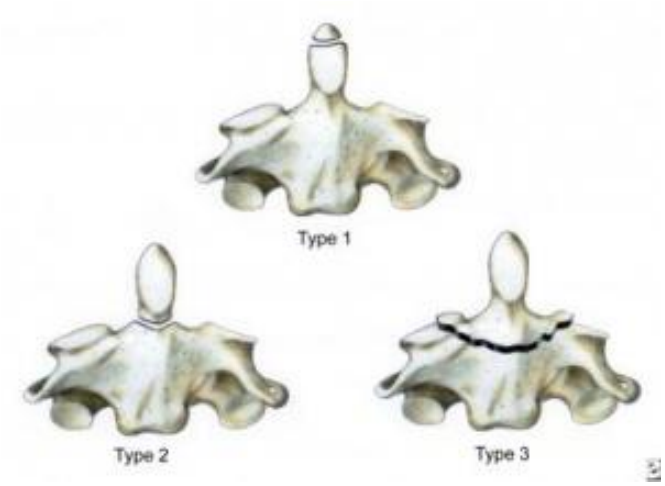
Odontoid Fractures

- Hyperextension injury, high-trauma (MVA)
- 20% of cervical spine fractures in adults

Types:

Type	Location	Management
1	Avulsion of tip (uncommon)	Collar
2	Fracture of base (most common)	Halo vest vs surgery
3	Fracture of body	Collar



Tenny et al *StatPearls: Odontoid Fractures* 2023

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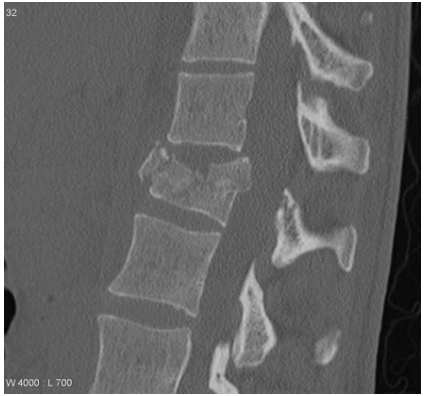
Subaxial Fractures

Clay shoveler's (usually C7)

- Direct trauma (weight lifter)
- Sudden muscular contraction
- Avulsion of spinous process
- Conservative



Burst of vertebral body

- Comminuted vertebral body
- Stable: immobilization
- Unstable: surgical

Marcon et al *Clinics* 2013

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Injuries: Neurologic

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Spear Tackler's Spine

Four characteristics:

- Developmental narrowing of the cervical canal
- Loss of normal cervical lordosis
  - Axial load imparted on vertebral bodies more
- Pre-existing traumatic abnormalities
- Employed "spear-tackling"

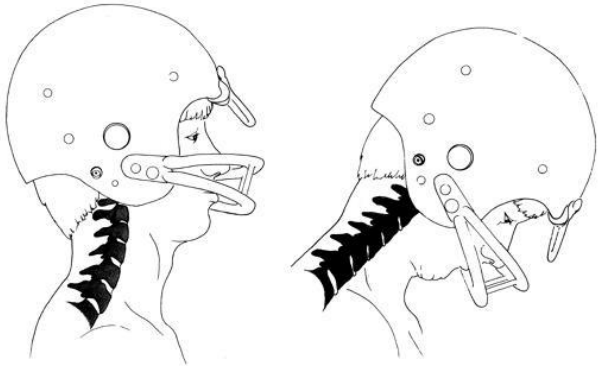

Figure 1

Contraindication to participation

Torg et al. *AJSM* 1993

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Spear Tackler's Spine

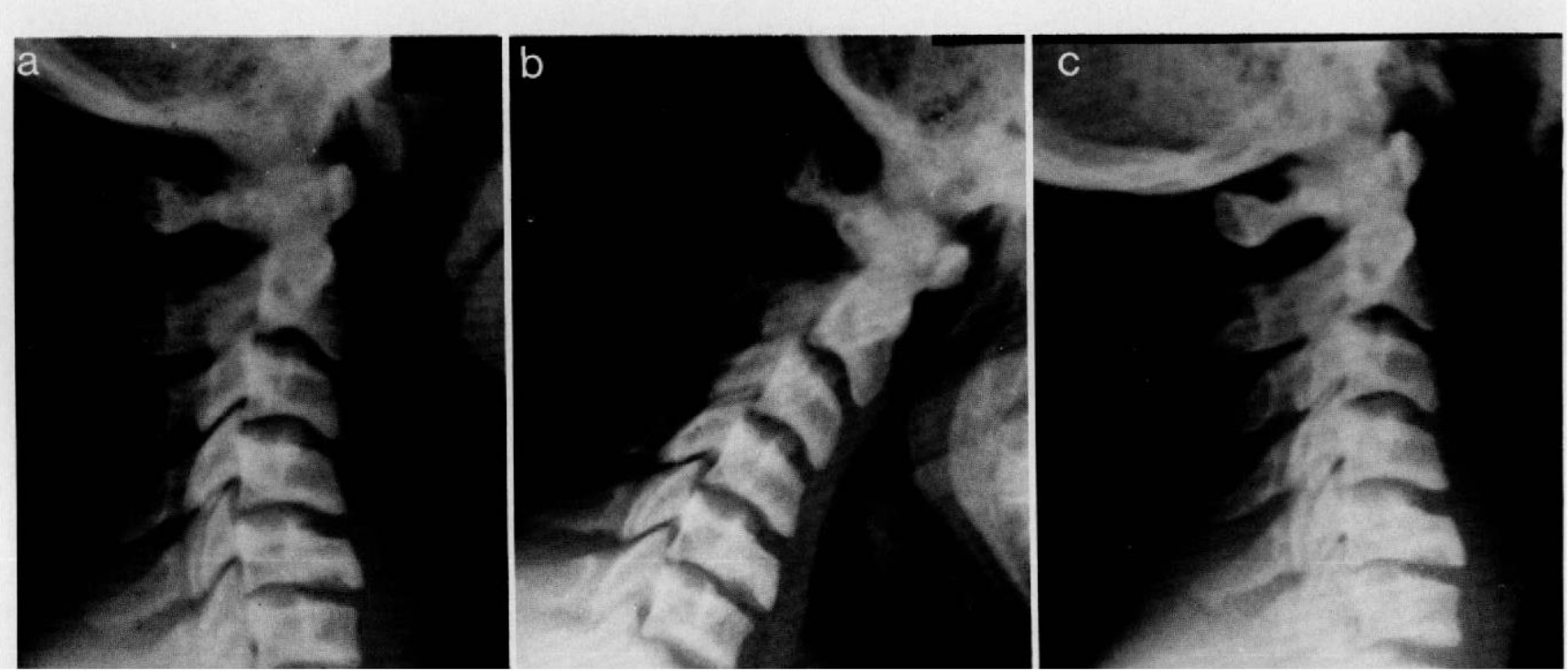

Figure 2. Lateral roentgenograms of the cervical spine obtained in neutral (A), flexion (B), and extension (C) demonstrate reversal

Torg et al. *AJSM* 1993

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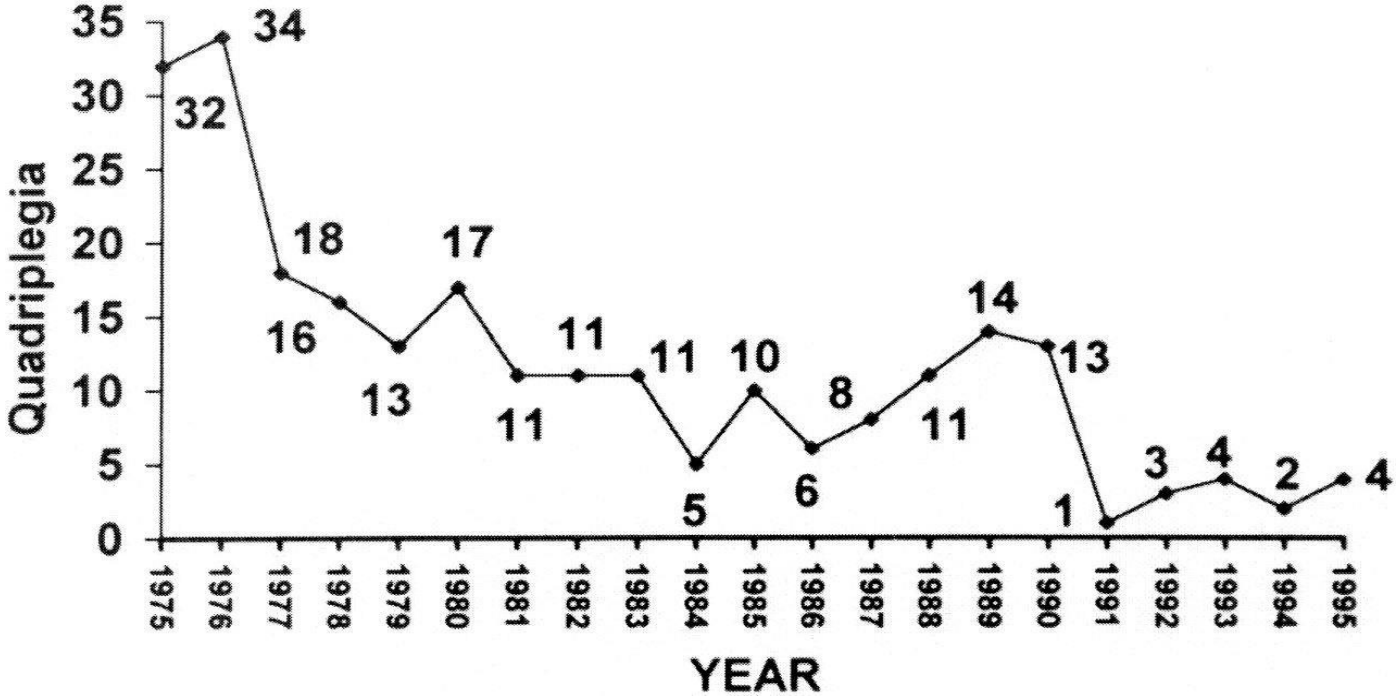
Spear Tackling: NCAA banned 1976



Torg et al. *JBJS* 2002

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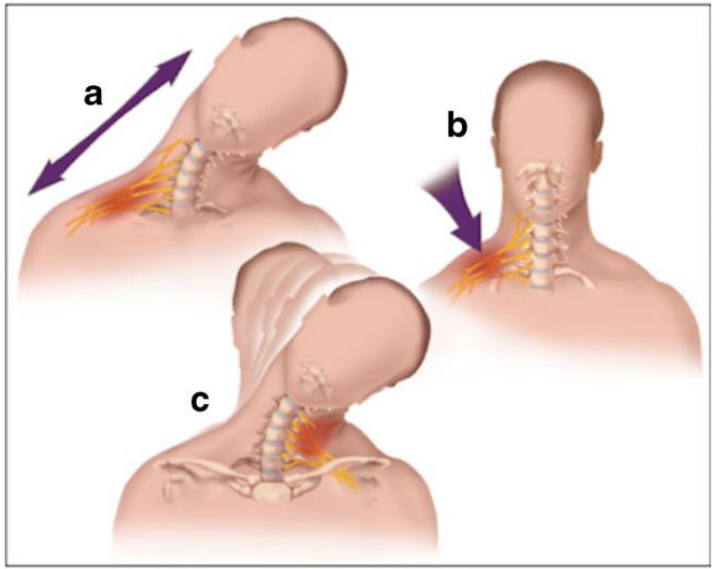
Cervical Neuropraxia:

“Burner or Stinger”

- **Traction injury** to the brachial plexus
- **Unilateral:** Motor + sensory
- Usually **no focal tenderness**
- Rule out other causes
- 85% do not miss next game/practice
- Recurrent:
  - 2 in same game
  - 3 in same season



Bowles et al. *Curr Rev Musculoskelet Med* 2020

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Central Cord Neuropraxia

- **Transient** quadriplegia
- Hyperextension, hyperflexion, or axial load
- 1.3-6/10,000 athletes, most in football
- **Spectrum of symptoms**
  - Paresthesias, motor weakness
- **Usually < 15 minutes but can be up to 48 hours**
- Spinal precautions
- Imaging ± EMG
- **Return to baseline neurological functional status without deficit**

Clark et al. *Journal of Neurosurg* 2011

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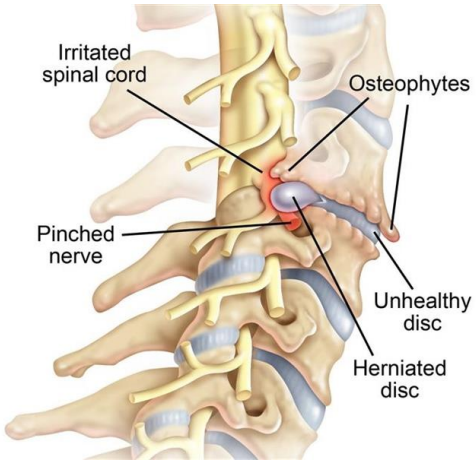
Cervical Radiculopathy

- Condition that causes compression or irritation of a spinal nerve root
- **Radiating** from neck to arm, neck chest, upper back or shoulders
- C7 most common level
- **85% resolve within 8-12 weeks**
- Conservative management
- Refractory: surgical



Magnus et al. *StatPearls Cervical Radiculopathy* 2022

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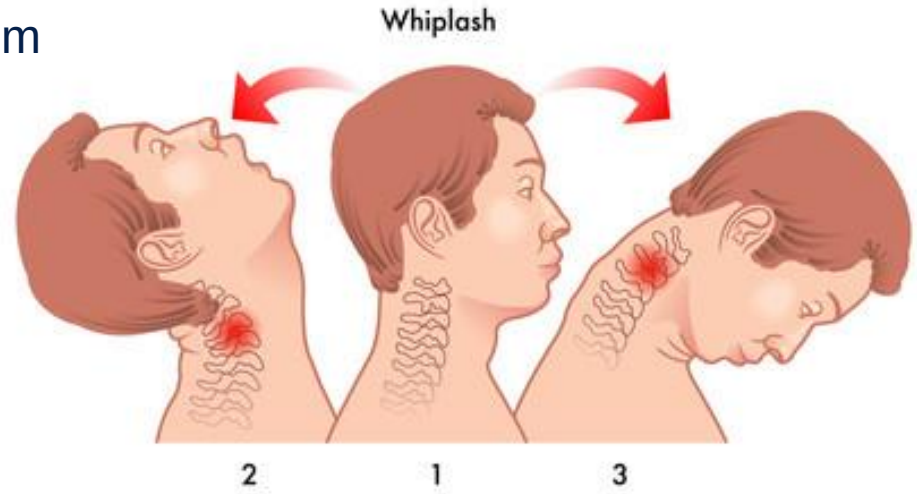
Cervical Sprain

“Whiplash” Injury

- Acceleration-deceleration mechanism
- Diagnosis of exclusion



Treatment:

- Pain control
- Soft cervical collar
- Resume normal activity
- Mobilization exercises

Bragg et al. *StatPearls Cervical Sprain* 2022

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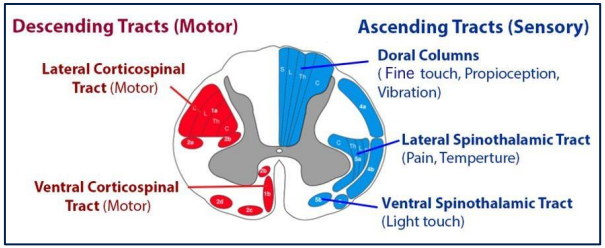
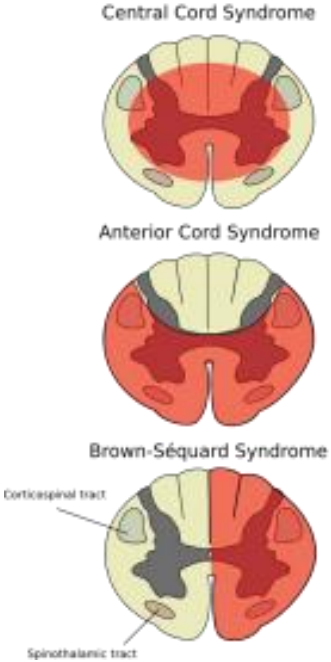
Spinal Cord: Partial Injuries



Incomplete lesions of the spinal cord



Central Cord

- Incomplete quadriparesis (UE>LE)
- Sensory deficits variable

Anterior Cord

- Loss of pain and strength below
- Touch proprioception intact

Posterior Cord

- Loss of sensation
- Strength preserved

Brown-Sequard

- Ipsilateral paralysis and sensory below
- Contralateral loss of pain & temperature

Bennett et al *StatPearls Spinal Cord Injuries* 2022

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On-Field Assessment

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On-Field Assessment

Assume a spinal cord injury until proven otherwise

- Recognize catastrophic injury
- **C**irculation, **A**irway, **B**reathing
- Establishing and controlling the scene safely
- Initiate direct care of the injured athlete
- Activating the EMS system/Emergency Action Plan if necessary
- Stabilize, move head and trunk as a unit

Preparation and practice are key!

Blatz et al. *Sports Neurology* 2018

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Indications for spine stabilization

Altered level of consciousness

Cervical spine tenderness

Obvious cervical spine deformity

Extremity motor and/or sensory deficits (bilateral)

Glasgow Coma Score

Eye Opening	
Spontaneous	4
Open to verbal command	3
Open to pain	2
No eye opening	1
Verbal Response	
Oriented	5
Confused	4
Inappropriate words	3
Incomprehensible sounds	2
No verbal response	1
Motor Response	
Follows commands	6
Localizes to pain	5
Withdrawals from pain	4
Flexes to pain	3
Extends to pain	2
No Movement	1
Total score	3-15

Blatz et al. *Sports Neurology* 2018

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Best techniques for stabilization/transferring?

"Athletic trainers are recognized as the medical professional with the most training experience in athletic equipment removal"

"The decision to remove equipment before transport should be based on a variety of factors, such as the medical status of the injured athlete, type of equipment worn, number of onsite rescuers and training and experience of on-the-field and emergency room rescuers in equipment removal."

Courson et al. *Journ Ath Train* 2020

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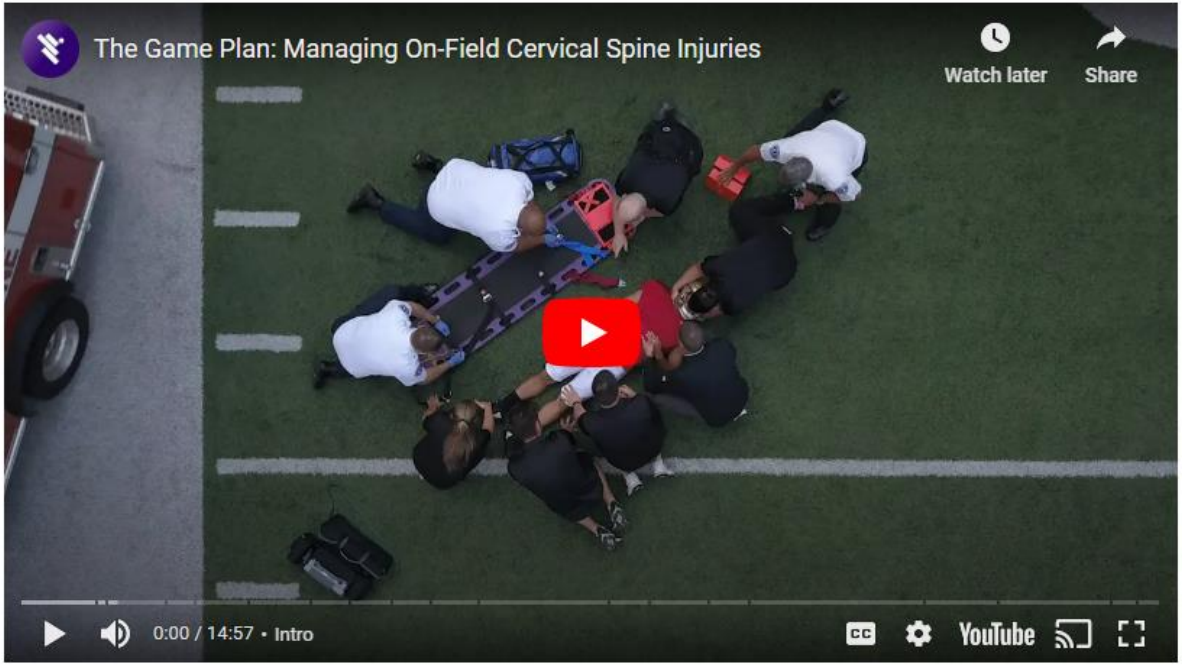
The Sports Institute at UW Medicine unveils new film as part of its work to expand participation and safety in sports



When to get imaging?

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Imaging criteria: NEXUS

National Emergency X-Radiography Utilization Study (NEXUS)

Yes/No to the following questions:

- Focal neurologic deficit present?
- Midline spinal tenderness present?
- Altered level of consciousness present?
- Intoxication present?
- Distracting injury present?
    - Long bone fracture, visceral injury, large laceration, crush injury, large burns

Imaging

Sensitivity: 99%
Specificity: 12.9%
NPV: 99.8%

Hoffman et al. *Ann Emerg Med* 1998

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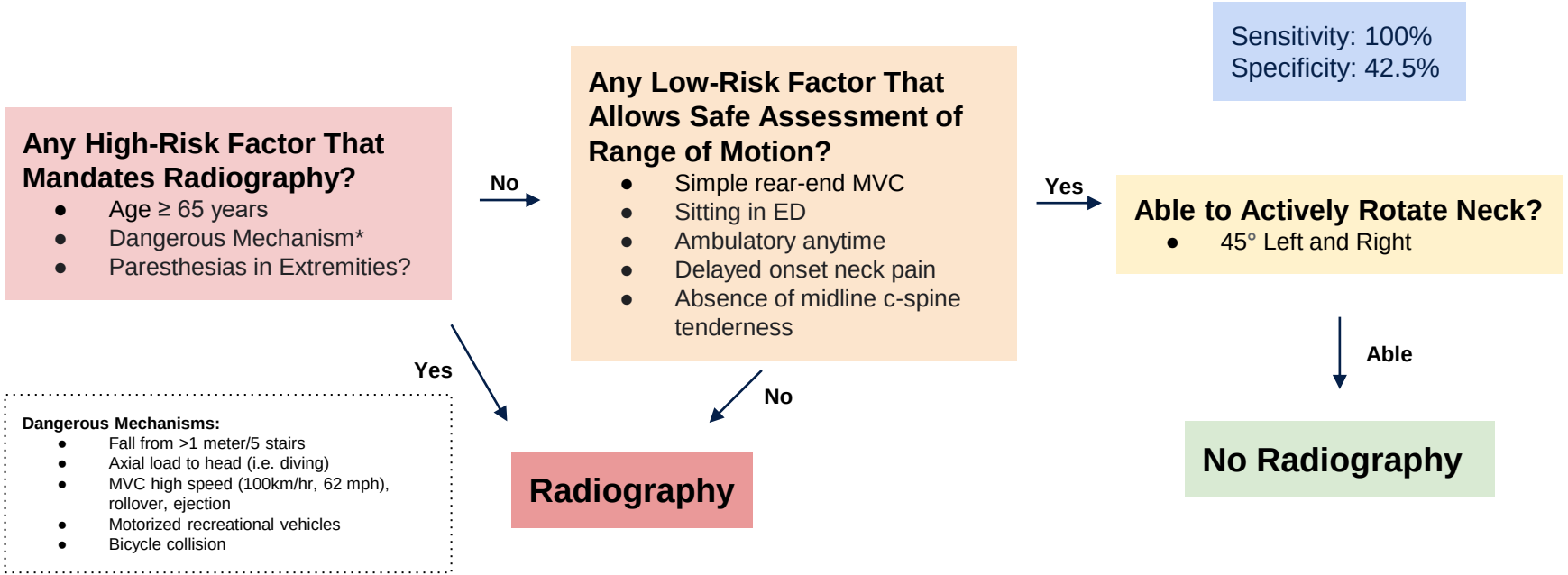
Imaging criteria: Canadian C-Spine Rule

For alert, GCS = 15, stable trauma patient where cervical spine injury is of concern



Stiell et al. *JAMA* 2001

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NEXUS vs Canadian C-Spine?

Accuracy of the Canadian C-spine rule and NEXUS to screen for clinically important cervical spine injury in patients following blunt trauma: a systematic review

Zoe A. Michaleff, BAppSc, Chris G. Maher, PhD, Arianne P. Verhagen, PhD, Trudy Rebbeck, PhD, and Chung-Wei Christine Lin, PhD

	NEXUS	Canadian C-Spine Rules
Sensitivity	0.83-1.00	0.90-1.00
Specificity	0.02-0.46	0.01 to 0.77

Canadian C-spine rule appears to have better diagnostic accuracy than NEXUS

One study compared both: Canadian c-spine better accuracy

Michaeleff et al. *CMAJ* 2012

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NEXUS vs Canadian C-Spine?

Canadian C-spine Rule versus NEXUS in Screening of Clinically Important Traumatic Cervical Spine Injuries; a systematic review and meta-analysis

Mohammadhossein Vazirizadeh-mahabadi[1] and Mobina Yarahmadi[2,*]

	NEXUS	Canadian C-Spine Rules
Sensitivity	0.899	0.987
Specificity	0.167	0.254

Both CCR and NEXUS are sensitive rules but have low specificity. CCR appears to have better screening accuracy

Low specificity and false positive results of both mean individuals will undergo unnecessary imaging

Varzirizadeh-mahabadi et al. *Arch Acad Emerg Med* 2023

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What about pediatrics?

Pediatric Emergency Care Applied Research Network (PECARN)

Yes/No to the following questions:

- Neck pain
- Decreased neck ROM
- Torticollis
- AMS (intoxication or trauma)
- Focal neurologic deficit
- Conditions predisposing to cervical injury?
  - Down Syndrome, Ehlers-Danlos
- High risk mechanism?
  - Diving, MVC, clotheslining injury

Imaging

Sensitivity: 98%
Specificity: 26%

***Not yet fully validated**

Leonard et al. *Ann Emerg Med* 2011

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Off-Field Evaluation

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Case Scenario: “Feels like I have mittens on”

58 year old male basketball player

- Mild neck pain, acute on chronic
- History of cervical facet arthropathy in 2018
    - C5-6 and C6-7 transforaminal epidural steroid injection with relief
- **“Feels like I have mittens on”**
- More clumsy with his hands

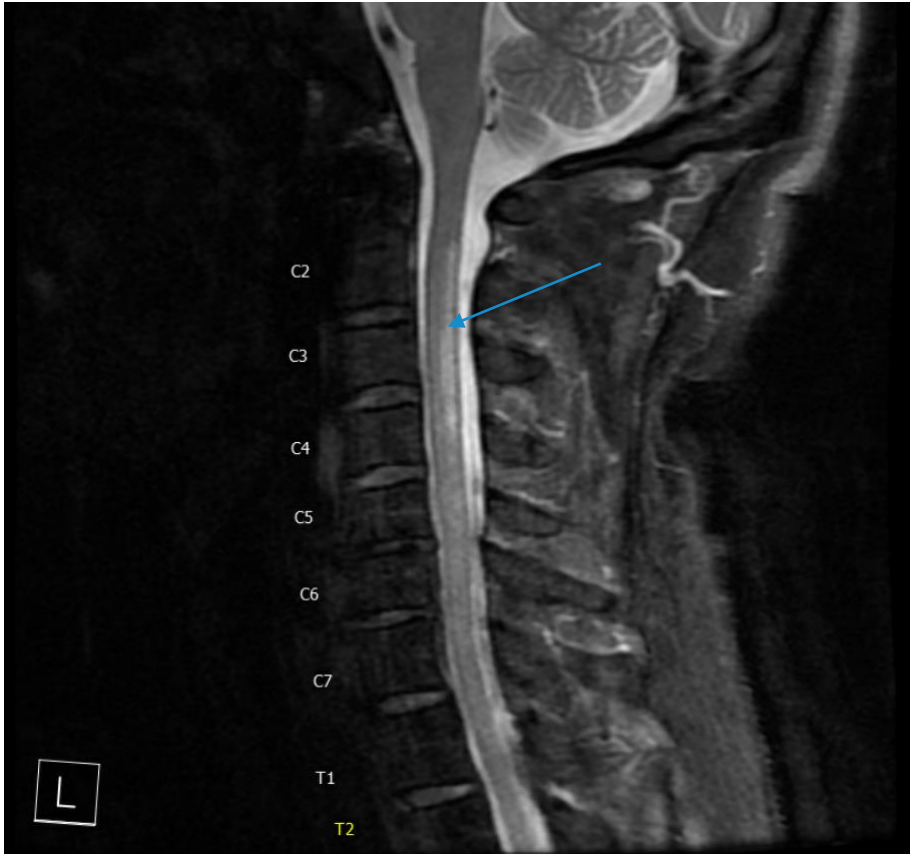
Case Scenario Cont…

Exam:

- Mild limitation in extension and sidebending left, no bony tenderness, negative spurling's
- Diminished sensation over thumb, index, middle, ring and pinky fingers
- Mild weakness in elbow flexion/extension, shoulder abduction and wrist flexion extension

1. **Multilevel degenerative changes** of the cervical spine, most pronounced at C5-6 where there is **mild canal stenosis** and **severe bilateral neural foraminal narrowing.**

2. **T2 signal hyperintensity within the bilateral dorsal columns of the spinal cord extending from C2-3 to C4-5**. The differential includes subacute combined degeneration, demyelinating disorders, or other infectious/inflammatory etiologies.



Case Scenario: “Feels like I have mittens on”

- Discussed with non-operative spine
- Urgent referral to Neurology
- Labs + imaging
- **B12 levels <146** (normal 301-816 ng/L)
  - Elevated Methylmalonic acid and homocysteine
  - + anti-parietal cell antibodies and anti-intrinsic factor antibodies

Diagnosed with pernicious anemia causing subacute combined degeneration and demyelination

- Can lead to spasticity and paraplegia
- Immediate B12 replacement

Red Flags:

In the setting of recent trauma:

- Bilateral symptoms
- Decreased consciousness or unconscious athlete
- Focal tenderness to palpation over the cervical spine
- Paralysis
- Restricted or apprehensive cervical range of motion
- Severe neck pain

Usman *Am Fam Physician* 2022

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In-Office: Broaden Differential

Symptom or finding	Clinical significance
Recent major neck trauma	Raises concern for cervical spine fracture
Neurologic symptoms or signs that suggest spinal cord issue (eg, weakness, gait difficulty, bowel or bladder dysfunction)	Raises concern for cervical cord compression
Shock-like paresthesia (Lhermitte's phenomenon) with neck flexion	Suggestive of cervical cord compression or multiple sclerosis
Fever or chills	Suggestive of infection
History of injection drug use	Raises concern for cervical spine or disc infection
Immunosuppression	Raises concern for infection
Chronic glucocorticoid use	Raises concern for infection or cervical spine compression fracture
Unexplained weight loss	Suggestive of malignancy
History of cancer	Raises concern for metastatic disease to cervical spine
Headache, shoulder or hip girdle pain, or visual symptoms in older patient	Suggestive of rheumatic disease (eg, polymyalgia rheumatica, giant cell arteritis)
Anterior neck pain	Suggestive of a non-spinal cause (eg, angina pectoris)

Isaac et al *UpToDate* 2021

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Summary:

- Epidemiology of neck injuries
- Discussed different neck injuries
- Reviewed on-field assessment of cervical spine injuries
- Know the criteria for further cervical spine imaging
- Recognize neck injury red flags in the clinical setting

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Questions?

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