Cervical Spine Injuries In The Athlete

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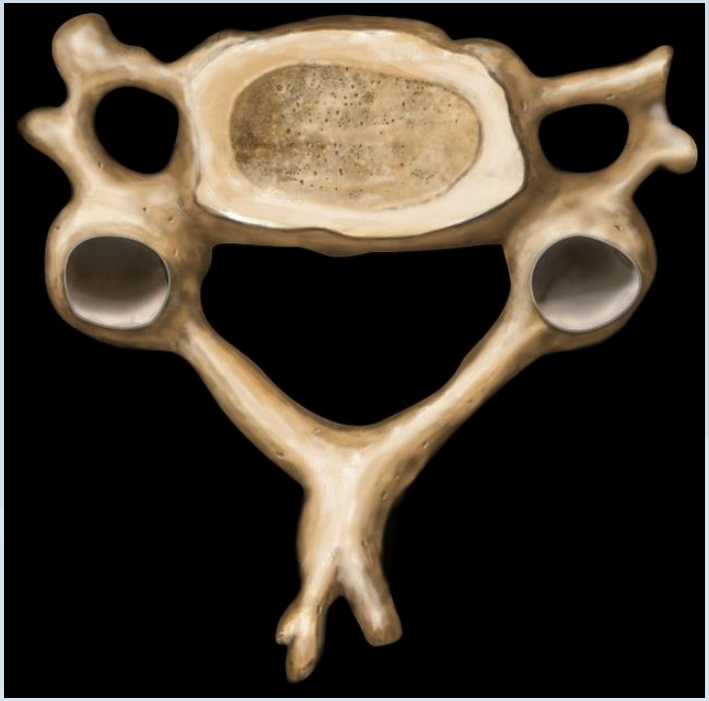
Objectives

- To identify most emergent, as well as most common, cervical spine injuries in athletics, and their appropriate sideline management.

Outline

- **Incidence of Cervical Spine Injury**
- **Risk Factors of Cervical Spine Injury**
- Cervical Spine Anatomy / Pathophysiology
- Cervical Spine Sideline Evaluation
- Cervical Spine Injuries
  - Transient Brachial Plexopathy (Burner/Stinger)
  - Cervical Cord Neurapraxia (Transient Quadriplegia)
  - Cervical Disc Herniation / Radiculopathy
  - Cervical Fracture
  - Cervical Strain / Sprain



Incidence of Cervical Spine Injury

- NFL
  - Spine Injuries (3)
    - 200 / season
    - 0.93 / 1000 athlete exposures (AEs)
  - Cervical Spine Injuries
    - ~ 91 / season (5)
    - 0.42 / 1000 AEs (3)
      - ~ 44.7 of all spine injuries (4)
- NCAA
  - Cervical Spine Injuries
    - ~ 1,250 / season (5)
    - 0.48 / 1000 AEs (3)
- High School
  - Cervical Spine Injuries (3)
    - 2-5x lower than NCAA
    - Football > wrestling > girls gymnastics

3. Fryhofer, GW; Smith, HE. Return to Play for Cervical and Lumbar Spine Conditions. *Clin Sports Med* 40 (2021). 555-569.
4. Rosenthal, B et al. Return to Play for Athletes. Nrsg Clin N Am. 2017. 163-71.
5. Sedgley, M et al. Cervical Spine Injuries. Curr Spts Med Rpts. Nov/Dec 2017. 16 (6); 379-80.
6. Swiatek, PR et al. Return to Play Guidelines After Cervical Spine Injuries in American Football Athletes. SPINE. Volume 46 (13), 886-892.

Risk Factors for Cervical Spine Injury

- Defensive football players 4x > offensive players (5)
  - Defensive backs > special teams > ball carriers > linebackers
- Tackling > being tackled > blocking (5)
  - Spear Tackling Ban (1970) → > 70% decrease in cervical spine injuries w/in 12 years (3,4)

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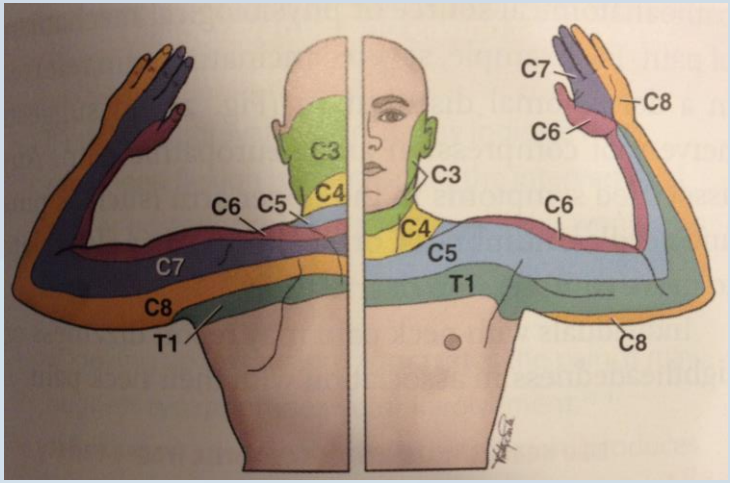
Cervical Spine Sideline Evaluation

- Prior history (congenital / acquired)
  - No Contraindication
    - Spina bifida occulta
    - Single level Klippel Feil anomaly not involving C0/C1 articulation
  - Absolute Contraindication
    - Distraction/extension injury
    - Multi-level Klippel Feil anomaly
    - Ankylosing Spondylitis
    - Rheumatoid Arthritis
    - Arnold chiari malformation, basilar invagination
    - Occipital-C1 assimilation

Cervical Spine Sideline Evaluation

- Detailed history
  - Mechanism of Injury
  - Symptoms
- Neurologic examination
  - Myotomes / Dermatomes
    - Special Tests including l'hermitte's test
  - ROM



Distribution (Figure 4–155)

Root	Muscle Weakness	Reflex Abnormalities	Sensory Deficits
C5	Biceps brachii	Biceps brachii	Lateral arm
C6	Extensor carpi radialis	Brachioradialis	Lateral forearm
C7	Triceps brachii	Triceps brachii	Middle finger
C8	Flexor digitorum profundus	None	Medial forearm
T1	Interossei	None	Medial arm

Cervical Spine Sideline Evaluation

- If
  - Cervical point tenderness, neck stiffness, bony deformity, fear of moving his/her head and/or c/o a heavy head → spine board immobilization
- Else
  - Remove from competition and perform physical examination

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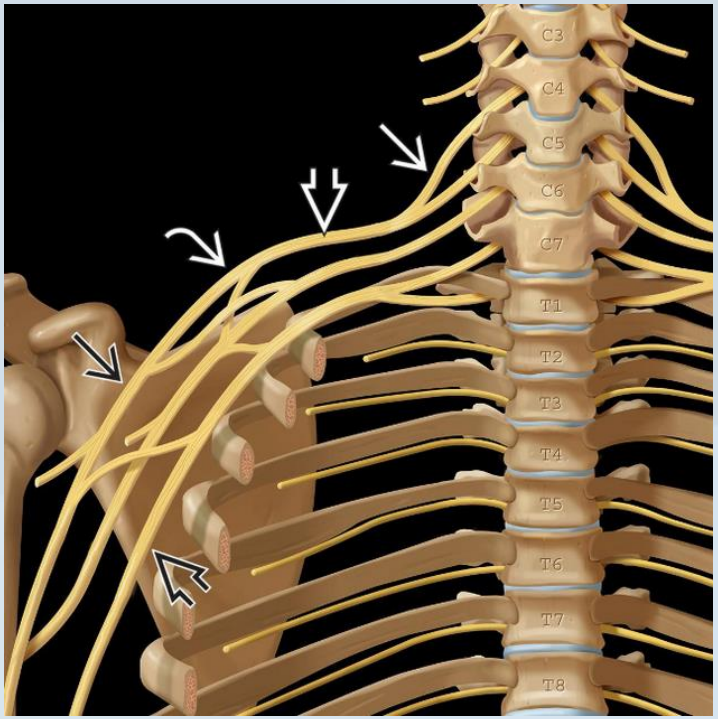

Transient Brachial Plexopathy (Burner / Stinger)

- Incidence
  - Most common cause of cervical spine injury in NFL @ 45.9% (4) and NCAA @ 65% (5)
  - Up to 52% of college football players in single season, 70% in career (5)
- Risk Factors
  - Foraminal stenosis (5,6)

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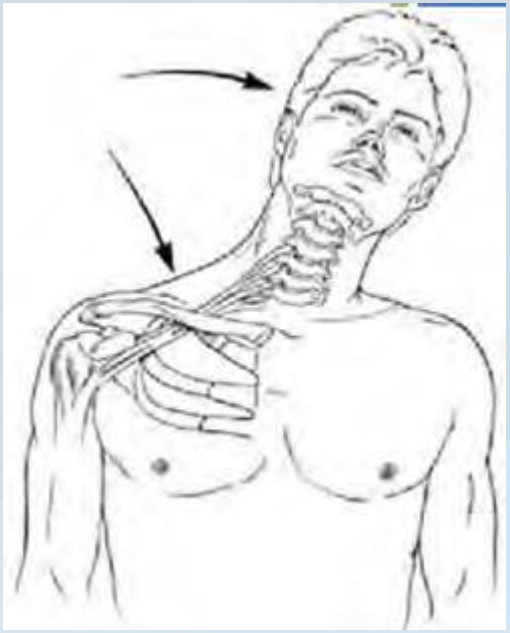
Transient Brachial Plexopathy (Burner / Stinger)

- Mechanism (3,4)
  - Direct compression @ Erb's point (direct blow to shoulder pads)
  - Traction (stretch) ipsilateral side (picture)
  - Hyperextension @ neuroforamen



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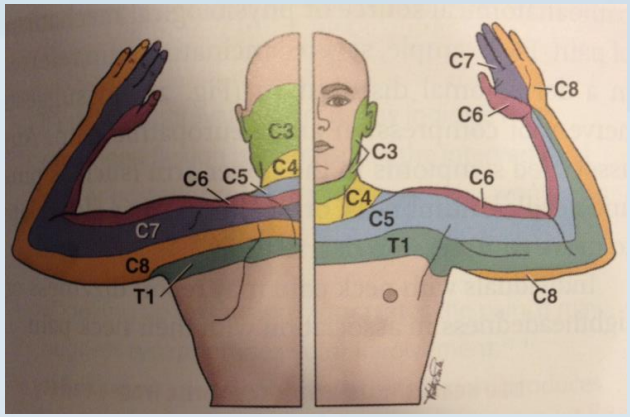
Transient Brachial Plexopathy (Burner / Stinger)

- Symptoms
  - Unilateral UE Pain / numbness (paresthesias)
    - Most commonly involving C5/6 dermatomes (upper trunk) (3,4)
    - Unilateral UE Weakness



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Transient Brachial Plexopathy (Burner / Stinger)

Return To Play IF …

- Sx resolution < 5 minutes
  - 85% of spine surgeons (6)
- Normal Neck / Neuro Exam
  - Complete ROM / strength
  - No evidence of instability (subluxation, abnormal curvature)
- Re-examine after competition/few successive days to detect any recurrence

Further Evaluation IF …

- Sx persist for > 5 minutes OR 3+ episodes (4,6)
  - C-spine XR/MRI
  - +/- CT / EMG (chronic sx)

2. France, JC et al. Return to Play After Cervical Spine Injuries: A Consensus of Opinion. Global Spine J. 2016;6:792-797.
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Transient Brachial Plexopathy (Burner / Stinger)

- Treatment (4)
  - Therapy
    - PT w/ neck / trunk strengthening exercises
  - Equipment Modification
    - Fit of shoulder pads checked, use of “high shoulder pads”
    - Consider soft neck roll / collar (limit flexion / extension)
  - Tackling
    - Review blocking / tackling technique (Rosenthal)

4. Rosenthal, B et al. Return to Play for Athletes. Nrsg Clin N Am. 2017. 163-71.

RECURRENT Transient Brachial Plexopathy (Burner / Stinger)

- Return To Play
  - No clear guidelines concerning return to play
    - 3+ episodes = relative contraindication
    - At-risk athletes
      - Foraminal stenosis (5,6)
      - Poor neck / shoulder muscular stabilization
    - Minimal risk of permanent nerve injury exists
    - Ensure consistent reporting to medical personnel

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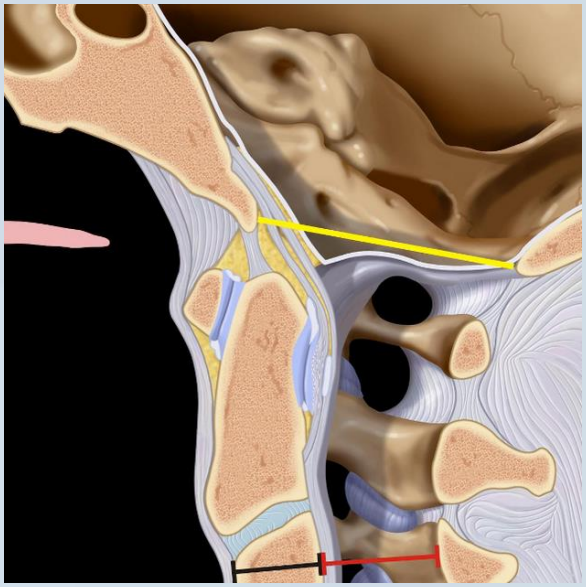
Cervical Cord Neurapraxia (Transient Quadriplegia)

- Incidence
  - Up to 7.3 / 10,000 of college football players
  - 0.13 / 1,000 AEs (college athletes) (3)
  - 56% recurrence rate after RTP
    - Associated w/ radiographic evidence of cervical canal stenosis
- Risk Factors
  - High-velocity, high-impact sports (fb, rugby, hockey) – collision vs contact
  - Cervical canal stenosis (Pavlov-Torg ratio < 0.8) – 93% sensitivity / 0.2% specificity (7)



Cervical Canal Stenosis

Canal width < 13mm (lateral XR) or T2 MRI (Sw)

Pavlov / Torg ratio < 0.8 (7)

(diameter of cervical canal / width of vertebral body, lateral XR, nl = 1) … High sensitivity, low specificity / PPV

3. Fryhofer, GW; Smith, HE. Return to Play for Cervical and Lumbar Spine Conditions. Clin Sports Med 40 (2021). 555-569.
7. Torg, JS et al. Cervical Spine and Brachial Plexus Injuries: Return-To-Play Recommendations. Phys Sportsmed. 1997;25;61-88.

Cervical Cord Neurapraxia (Transient Quadriplegia)

- Mechanism
  - Axial loading (head-down contact aka “spear tackling”) (F+R)
    - Normal lordotic curve lost when neck is slightly flexed (thus cannot absorb shock as well) (4)
    - Fracture / dislocation can occur < 150 ft-lb of kinetic energy (running football player can possess 10x this energy) (4)

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Cervical Cord Neurapraxia (Transient Quadriplegia)

- Symptoms
  - Bilateral Weakness or Dysesthesias in > 1 limb for < 24-36 hours (3,4)

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4. Rosenthal, B et al. Return to Play for Athletes. Nrsg Clin N Am. 2017. 163-71.

Cervical Cord Neurapraxia (Transient Quadriplegia)

Return To Play IF …

- 1st episode (2,3,4)
- Symptom resolution < 24 hours (+/- Torg ratio < 0.8) (2,3,4)
- Normal Neck / Neuro Exam
  - Complete ROM / strength
  - No evidence of instability (subluxation, abnormal curvature)

Further Evaluation IF …

- Episode > 24 hours (+/- Torg ratio < 0.8) (2,3,4)
  - XR (dynamic, flexion / extension)
    - Assess for fractures / instability
  - MRI

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Cervical Cord Neurapraxia (Transient Quadriplegia)

Possible DQ IF …

- > 1 episode (2,3,4)
- Persistent symptoms or neurological deficits (> 36 hours) (2,3,4)
- Ligamentous instability (xr flexion / extension) (3,4)
- Abnormal imaging (cord signal abnormality [including edema], canal stenosis (AP diameter < 13 mm), functional canal stenosis (↓CSF around cord) (3)

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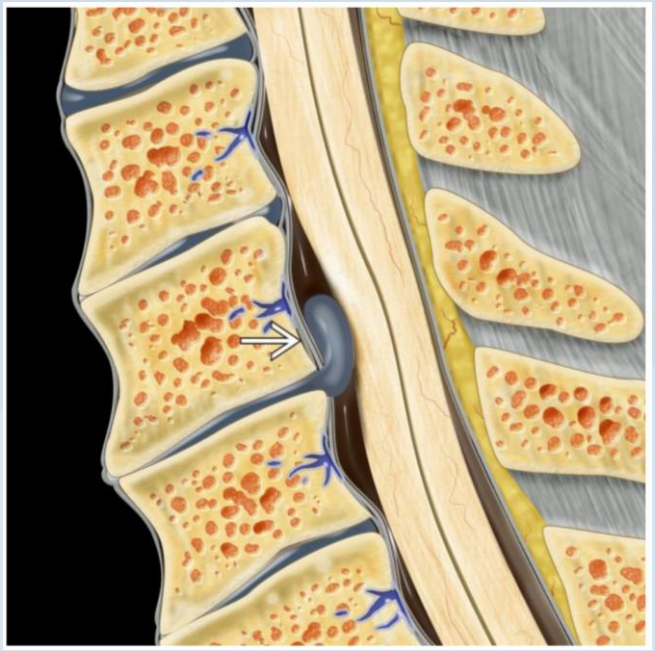
  - **Cervical Disc Herniation / Radiculopathy**
  - Cervical Fracture
  - Cervical Strain / Sprain

Cervical Disc Herniation / Radiculopathy

- Incidence
  - Athletes < 40 years old
    - 10% athletes have ASX cervical disc herniation (4)
  - NFL
    - 5.8% of cervical spine injuries (most common = C3/4, C4/5, C5/6) (3)



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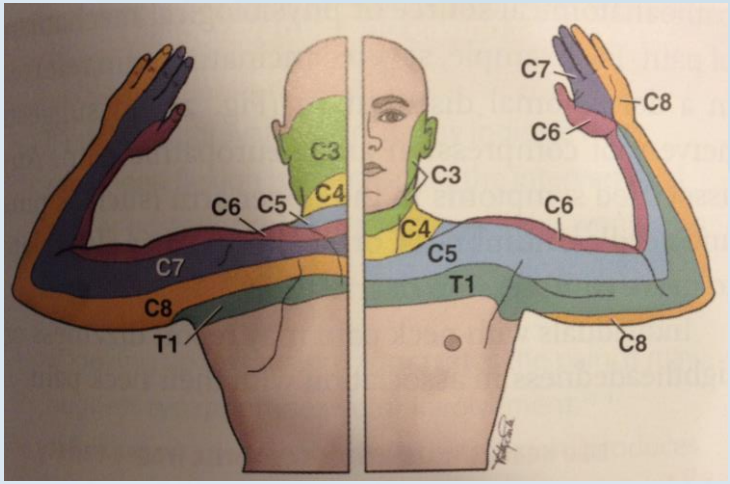
Cervical Disc Herniation / Radiculopathy

- Symptoms
  - Pain / paresthesias radiating from neck in a dermatomal pattern
  - C5/6 → periscapular / shoulder pain



Cervical Disc Herniation / Radiculopathy

Return To Play IF …

- Asymptomatic (+/- s/p 1-level ACDF) (1,2,3,4)
- Normal Neck / Neuro Exam
  - Complete ROM / strength
  - No evidence of instability (subluxation, abnormal curvature)

Further Evaluation IF …

- Persistent Symptoms
  - XR
  - MRI

1. Cantu, RC et al. Return to Play After Cervical Spine Injury in Sports. Curr Sports Med Rep. 2013;12:14-17.
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Cervical Disc Herniation / Radiculopathy

Possible DQ IF …

- s/p 1-level posterior cervical fusion or 2-level anterior or posterior cervical fusion (1,2,3,4)
- s/p cervical laminectomy (2,3,4)
- s/p 3-level anterior or posterior cervical fusion (2,3,4)

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Cervical Disc Herniation / Radiculopathy

- Treatment
  - Average RTP ~ 3 months
  - Operative vs Nonoperative Tx (2,3)
    - Increased RATE of RTP in operative tx
      - NO RTP in 28% operative (12-34%), 54% non-operatively
      - Complications = recurrent disc herniation, new spinal contusion, recurrent symptoms
    - No difference in sport performance

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Cervical Fractures

- Incidence
  - Least frequently sustained cervical injury in NFL (1.8%) (3)
- Fracture Patterns
  - Spinous process fx, Jefferson fx (ant/post C1 arch), compression fx, chance fx (flexion-distraction injury), burst fx
- Mechanism
  - Avulsion, direct blow, hyperflexion → **Spinous process fractures** ("clay-shoveler's fractures") (2)
  - Axial load → **Burst / compression fracture of C1 (Jefferson) or C2 (hangman's)** (2)

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Cervical Spine Sideline Evaluation

- If
  - **Cervical point tenderness**, neck stiffness, **bony deformity**, fear of moving his/her head and/or c/o a heavy head → **spine board immobilization**
- Else
  - Remove from competition and perform physical examination

Cervical Fractures

Return To Play IF …

- Asymptomatic
- Normal Neck / Neuro Exam
  - Complete ROM / strength
  - No evidence of instability (subluxation, abnormal curvature)

Further Evaluation IF …

- Persistent Symptoms
  - XR (6)
    - AP/ Lat = osseous healing / complete fusion (if applicable)
    - Lat = Maintenance of cervical lordosis (Sw)
    - Flex / Ext = No instability (Sw)
  - MRI (3,6)

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Cervical Fractures

Possible DQ IF …

- S/p fusion involving occiput, C1-2 (unstable Jefferson), C2-3, or 3+ level fusions (6)
- C1-2 hypermobility with anterior dens interval of 4 mm or greater (3)
  - Healed C1 or C2 w/ normal ROM NOT contraindicated
- “Spear tackler’s spine” (loss of lordosis or progressive kyphosis)
  - Healed subaxial fractures w/o sagittal plan deformity NOT contraindicated (3,6)
- Posttraumatic or ligamentous kyphotic deformity or subaxial instability (>11° angulation or >3.5-mm translation) (3)

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Cervical Fractures

- Treatment (in general)
  - Stable → cervical collar immobilization (3,6)
    - Spinous process fx (clay shoveler's), unilateral lamina fx (6-12 weeks) (Sw)
  - Unstable → surgical fixation

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Cervical Fractures

- Prognosis
  - RTP > all other cervical injuries (average – 120 days) (3,6)

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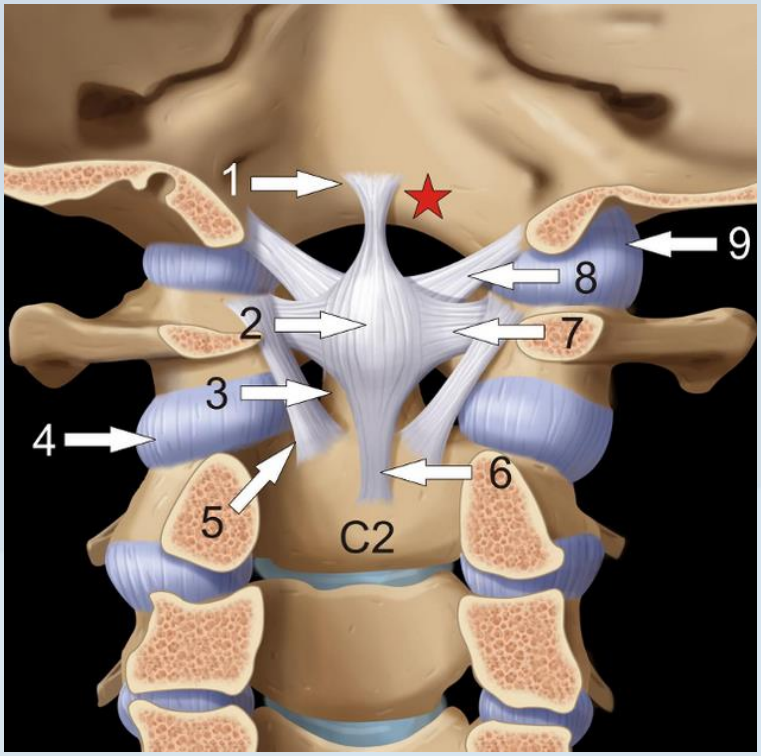

Cervical Strain / Sprain

- Incidence
  - NFL
    - 6.9% of all injuries (3)
    - ~ 37.2% of cervical spine injuries (4)
- Symptoms
  - Local pain, pain limiting ROM, tenderness, weakness in neck muscles
  - Absence of paresthesias

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Cervical Strain / Sprain

Return To Play IF …

- Asymptomatic
- Normal Neck / Neuro Exam
  - Complete ROM / strength

Further Evaluation IF …

- Persistent Symptoms
  - XR (Flex / Ext) IF point tenderness, decreased ROM / strength, or prior surgery (r/o instability) (initial visit, + 2 wks, +4 wks) (6)
    - Consider cervical collar x 2 weeks (7)
  - MRI IF range of motion is significantly limited or if radicular symptoms are present (Fryhofer)

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Cervical Strain / Sprain

- Treatment
  - Oral analgesics, modalities
  - +/- soft neck collar (< 48 hours)
  - +/- hard collar
    - if subluxation > 3.5mm OR angular displacement > 11˚ w/ rpt radiographs at 2 and 4 weeks

References

1. Cantu, RC et al. Return to Play After Cervical Spine Injury in Sports. *Curr Sports Med Rep.* 2013;12:14-17.
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Questions?