Management of Acute Cervical Spine Injury in Athletes

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Learning Objectives

1. Identify pre-planning strategies in the on-site management of cervical spine injuries in athletes.
2. Discuss the unique challenges that athletes involved in equipment intensive sports present in the stabilization of acute cervical spine injuries.
3. Apply several techniques and methods, based on the current evidence-based literature, of on-site stabilization and transfer of care of the acute cervical spine injured athlete.
4. Examine the roles of the entire healthcare team, from the field to the emergency department, in managing the acute cervical spine injured athlete.

Agenda

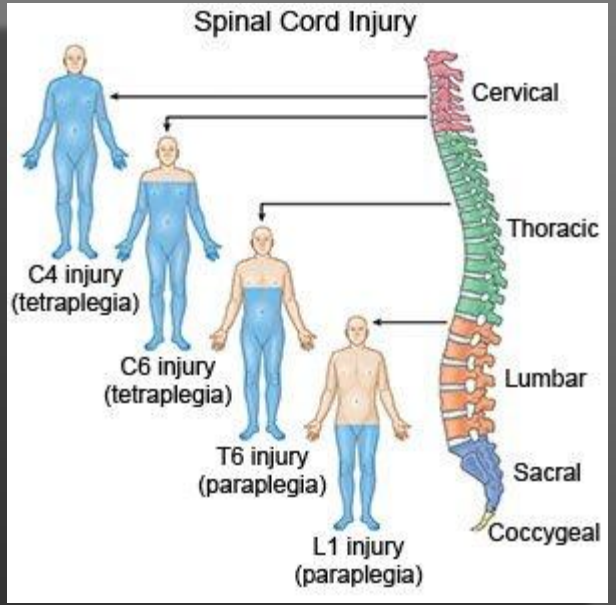
1. Epidemiology of spinal cord injury (SCI) Overall and in Sports
2. Differences between SCI and Cervical Spine Injury (CSI)
3. Epidemiology of CSI in Sports & Mechanics for injury incidents
4. Prevention and Pre-Planning Strategies
5. On-field assessment, stabilization and transfer of care

Traumatic Spinal Cord Injury

Internationally, Spinal Cord Injuries (SCI), falls and vehicle accidents prominent mechanism for SCI

- Sports-related common, but not most prevalent

Complete= No function
Incomplete= Some function
Tetraplegic= Paralysis, neck and below
Paraplegic= Paralysis, torso and below



(Chan et al., 2016)

Spinal Cord Injury in Sports- Global

Sport-related SCI:

- Diving
- Skiing
- Rugby
- Horseback riding

Individual sports risk of SCI:

- Horseback riding
- Hockey
- Skiing
- Snowboarding
- Diving
- American Football

- Systematic Review: 25 countries- 54 epidemiological studies
  - Highest proportion of SCI (Sports)
    - Russia (32.9%)
    - Fiji (32%)
    - New Zealand (20%)
    - Iceland (18.8%)
    - France (15.8%)
    - Canada (13.1%)

(Chan et al., 2016)

Spinal Cord Injury in Sports- Global

Neurological Level:

- Horseback riding
  - Cervical, Thoracic, Lumbo-sacral
- Snowboarding
  - Thoracic, Lumbo-sacral
- Hockey, Rugby (C4-C6), Skiing, Diving (C4), American Football
  - Cervical

Sport-Related SCI Outcomes:

- Incomplete tetraplegia (46.9%)
- Complete tetraplegia (37.4%)
- Incomplete paraplegia (5.9%)
- Complete paraplegia (5.7%)
- Normal: <1% complete recovery at discharge

(Chan et al., 2016)

Spinal Cord Injury in Sports- National

Common mechanism for SCI since 2015:

- Motor vehicle accidents (38.2%)
- Falls (32.3%)
- Sports (7.8%)

SCI Outcomes (all cause since 2015):

- Incomplete tetraplegia (47.4%)
- Complete tetraplegia (12.4%)
- Incomplete paraplegia (19.7%)
- Complete paraplegia (19.9%)
- Normal: 0.6% complete recovery at discharge

(National Spinal Cord Injury Statistical Center, 2021)

Spinal Cord Injury in Sports- National

Sport-related SCI:

- Diving
- Skiing
- Winter Sports
- Other Sports
- Horseback riding
- Football
- Surfing
- Wrestling
- Gymnastics
- Baseball/Softball
- Basketball/Volleyball

SCI by Age and Sex:

- 2,537 < 30 years old
- Male

SCI 2015-2021

- 354 (7.8%) Sport-related SCI

(National Spinal Cord Injury Statistical Center, 2021)

SCI and CSI

- Spinal Cord Injury (SCI)
  - Damage to the cord or surrounding structures
  - Changes in function to sensory, motor signals below site of injury

(Agarwal, Thakkar, & Than. American Association of Neurological Surgeons, 2021)

SCI and CSI

- Cervical Spine Injury (CSI)
  - Minor to severe
  - Severe can lead to spinal cord injury (fractures, dislocations)
  - With or without neurological symptoms
  - Spinal contusion
    - Transient neurological symptoms
    - Numbness, tingling
    - Burning sensation
  - Peripheral nerve injury (unilateral)

(Agarwal, Thakkar, & Than. American Association of Neurological Surgeons, 2021)

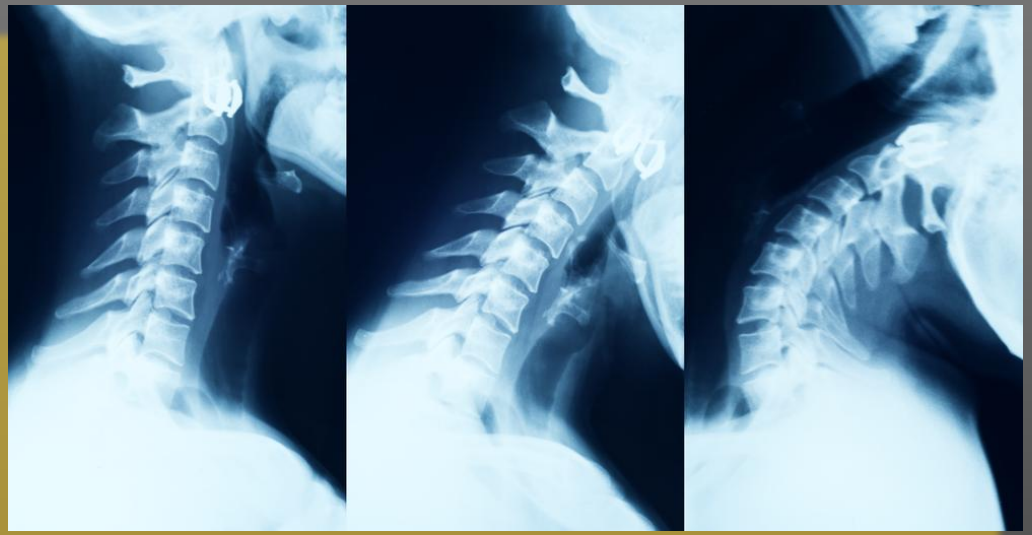
Cervical Spine Injury

- Spinal Cord
- Dislocations
- Fractures
- Brachial Plexus injury
- Muscular strains
- Whiplash

(Agarwal, Thakkar & Than. American Association of Neurological Surgeons, 2021)

Mechanism of Injury to Cervical Spine

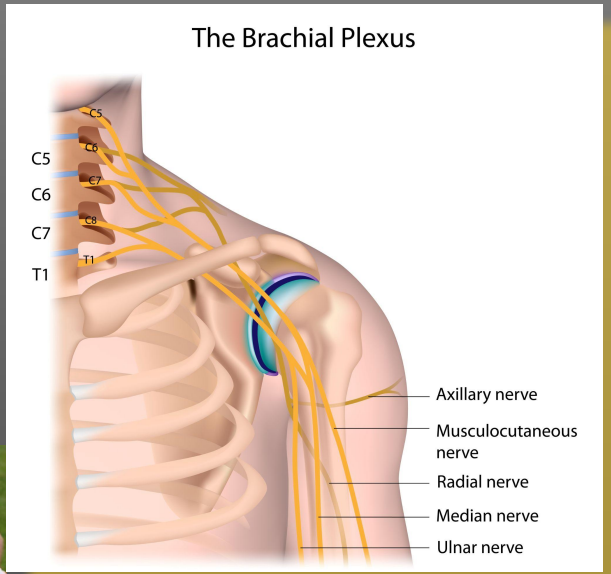
- Axial load (cervical flexion~ 30°)
- Buckling of the vertebrae
- Injury occurs before observed movement of the head
  - Spinal cord contusion
  - Fractures
  - Dislocations



(Swartz, Floyd, Cendoma, 2005)

Mechanism of Injury to Cervical Spine

- Brachial plexus
  - Peripheral nerve
  - Unilateral symptoms
  - Compression or stretching mechanism

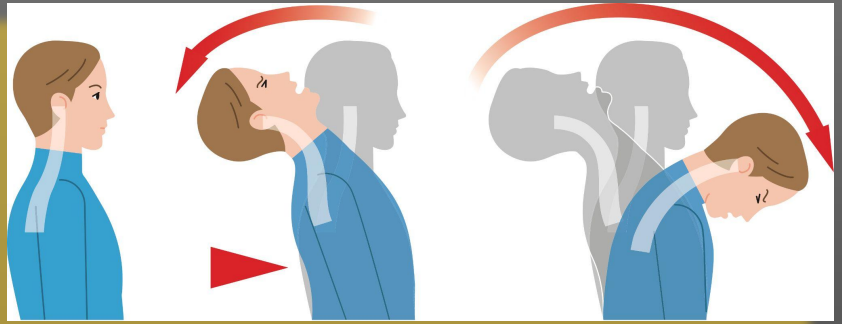


(Olson et al., 2007)

(Pujalte & Floranda, 2012)

Mechanism of Injury to Cervical Spine

- Whiplash
  - Force superior through cervical spine
  - Hyperextension- Flexion
  - Eccentric load on extensor musculature
  - Facet joint compression (vertebrae buckling)



(Swartz, Floyd, Cendoma, 2005)

(Chen,Wang, Yang, 2009)

Cervical Spine Injury in Sports

High School Sports:

- Football
- Wrestling
- Girls' Gymnastics

Common Mechanism:

- Contact (another player)
- Contact (playing surface)

Common Injury Type:

- Muscle injuries (63.1%)
- Nerve injuries (20.5%)
  - Football
- Fractures
  - Boy's Ice Hockey

(Meron et al., 2018)

Cervical Spine Injury in Sports

Collegiate Sports, Highest Rate of Injury to Neck and Cervical Spine:

- Football
- Women's Field Hockey
- In-Season
- Competition versus Practice

(Deckey et al., 2020)

NCAA Wrestling Competition versus practice

- Preseason, Postseason
- Contact mechanism
- Brachial plexus injury
- Required Surgery (1.3%)
- RTP 24 hours (33%)
- RTP within 6 days (25%)

(Brinkman et al., 2021)

Cervical Spine Injury in Sports

NCAA Football

- Stingers and Cervical Strains
- Preseason
- Direct-Contact (90.8%)
- Linebackers and Defensive lineman
- RTP 24 hours (64.4%)
- RTP > 21 days (2.8%)

(Chung et al., 2019)

NFL Football 2000-2010 Spine injuries: Cervical (44.7%)

- Blocking, Tackling
- Offensive Linebackers, Defensive lineman, Defensive backs
- Mean= 25.7 days lost

(Mall et al., 2012)

Preventing Cervical Spine Injuries in Sports

Equipment Standards

National Operating Committee on Standards in Athletic Equipment (NOCSAE)

- Sets performance standards
  - SEI/NOCSAE “Meets NOCSAE Standard” safety label on helmets

Ensure proper fit

Aids injury prevention

Impede cervical spine assessment, stabilization, and transport

(National Operating Committee on Standards in Athletic Equipment, 2021)

Preventing Cervical Spine Injuries in Sports

Coaching Proper Tackling Techniques

- Avoid head down
  - Cervical flexion, axial load
- Avoid “across the bow”
  - contact between shoulder and helmet
  - Stretch or compression at brachial plexus

Education- “Heads Up”

Enforcement of Rules in Sports to Prevent SCI/CSI

- Spearing in Football
- Boarding in Hockey

(Heck et al., 2004)

Emergency Action Plan for Cervical Spine Injuries

Emergency Action Plan (EAP)

- Comprehensive, practical
- Involve all personnel involved in emergency and their roles (AT, EMS, MD, ED, AD, Coaches, Students)
- Written plan with at the least annual training/rehearsal
- Equipment needed and where located (i.e. spine board, AED)
- Specific to venue, specific for conditions (CSI)
- Identify emergency care center for transport

(Anderson et al., 2002)

Emergency Action Plan for Cervical Spine Injuries

Spine Injury Protocol

- Sports medicine team, EMS, other healthcare providers who may be involved
- EAP development, practice at least annually
- Specific to sport venue (stadium, arena, field)
- Review post-incident, documentation
- Education, scenarios, training

(Courson et al., 2020)

Planning Strategy- Medical Timeout

Pre-Event/Practice Meeting:

- Home Team and Visiting Team Athletic Trainers and Students
- EMS and Healthcare Providers identified for roles via EAP
- Location of emergency equipment and hand signals to retrieve AED, Spine board
- Landing area for EMS helicopter
- Pertinent phone numbers, contact information of personnel

*Assign Cervical Spine Control at the Head and Protocol for SMR

(“Medical Timeout”. Korey Stringer Institute, n.d.)

Cervical Spine Injuries- EMS Protocol

- Reduce the use of long spine board
- Pain, pressure sores, long-term side effects of spine board in stable patients
- Unnecessary radiology
- Penetrating trauma
- Patient ambulatory, can self-extricate at scene
- Certain conditions warrant use of spine board but remove as soon as possible when able
- Spinal motion restriction (SMR)

(White et al., 2014; Fischer et al., 2018; Pervis, Carlin, Driscoll, 2020; Moscati et al., 2015)

Planning Strategy- EAP and EMS Protocol

Communicate with local EMS prior to event to review EAP

Knowledge of EMS Spine Board protocols at the local, state level

WV DHHR EMT Treatment Protocol 6102: Selective Spinal Immobilization

Plan and rehearse spine protocol EAP prior to events

- Including several techniques for transfer of CSI athlete
- What equipment will EMS have on-scene at event
- What equipment Sports Medicine Team have on scene at event
- Spine board protocol based on physical exam findings

Primary goal: avoid additional movement and injury to the spinal cord during immobilization and transfer= Spinal Motion Restriction (SMR)

(WV DHHR Office of Emergency Medical Services EMT Protocols, 2021)

Spinal Motion Restriction (SMR)

- Reduce movement of the injured spine
- Spine in alignment, application of cervical collar
- SMR equipment:
  - Spine board
  - Ambulance cot
  - Vacuum splint mattress
  - Kendrick Extrication Device (KED)
  - Scoop stretcher
- Protective equipment on + SMR, may reduce cervical motion
  - >250lbs, spine board more stable than vacuum splint during SMR (Etier et al., 2017)

SMR Indications

- Blunt trauma, mechanism for spine injury
- Altered level of consciousness
- Pain or tenderness in the midline spine area
- Deformity of spine
- Neurological signs/symptoms: bilateral, motor or sensory loss
- Distracting injury, intoxication, cannot communicate

*No indicators above, cervical collar applied, SMR not necessary

(Fischer et al., 2018)

On-Field Management

Control the scene

Level of consciousness

Circulation, Airway, Breathing

Spinal deformity present?

Tenderness at midline of spine

Sensory and Motor function

Positioning of Patient

(Courson et al., 2020)

Equipment-laden CSI Injured Athletes

Equipment-laden athletes present challenge:

- Access to airway
- Access to chest for CPR/AED
- Protective equipment impede c-collar application
- Achieving neutral spine requires multi-person effort if prone
- Achieving spinal motion restriction requires multi-person effort
- Equipment may change head position while on spine board
- Non-fitting equipment may create movement of head during stabilization

(Petschauer, Schmitz, Gill, 2010) (Waninger & Swartz , 2010) (Tierney, Mattacola, Sitler, Maldjian, 2002)

Techniques for Transfer

Log Roll

- Supine or prone
- Historical
- Rescuers needed
  - 4-5

Multi-person lift

- Supine
- Lift technique less movement of unstable cervical spine
- Rescuers needed
  - 7-9

(Courson et al., 2020)

Scoop Stretcher

- Supine
- Length adjustment
- Rescuers needed
  - 3

(Prasarn et al., 2015)

On-Field Transfer

Supine Patient

- C-spine control
- Facemask removal (equipment-laden)
- Multi-person lift
- Slide spine board underneath
- SMR
- Ambulance transport

(Courson et al., 2020)

On-Field Transfer

Prone patient

- C-spine control
- Multi-person push-pull log roll
- Spine board placement posterior
- Facemask removal (equipment-laden)
- SMR
- Ambulance transport

(Courson et al., 2020)

On-Field Transfer

Obstacle or Confined space

- Prone position
- Multi-person pull log roll
- Spine board placement posterior
- Facemask removal (equipment-laden)
- SMR
- Ambulance transport

(Courson et al., 2020)

Equipment Removal-Facemask

Access to Airway

Jaw thrust difficult with helmet on

Cordless screwdriver

Cutting Tool

*Helmets may have different facemasks

(Courson et al., 2020)

Equipment Removal-Facemask

- Quick release models efficient for face mask removal
- Cordless screwdriver with cutting tool backups
- Maintain spinal alignment

(Swartz et al., 2010)

(Gale, Decoster, & Swartz, 2008)

Equipment Removal- Helmet

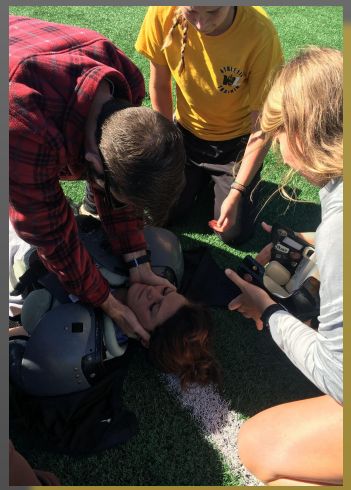
Airway cannot be accessed or maintained

Helmet not fitted (head moves within)

Facemask removal attempt is too long

C-spine control:

- Anterior-Posterior
- Medial-Lateral (pictured)



(Gale, Decoster, & Swartz, 2008)

(Courson et al., 2020)

Equipment Removal- Shoulder Pads

Access for chest compressions

“All or nothing” equipment removal

- Removing helmet only: increase head movement in sagittal plane (extension)
- C-spine control AP or ML

Supine: Flat torso, Torso tilt (contraindicated for Thoracic injury), Quick release shoulder pads (RipKord)

Prone: Cut posterior junction, log roll, cut anterior junction

(Courson et al., 2020)

Transfer to ED

Trauma Center or large community hospital- established in EAP

ED Board Certified Emergency Medicine Physicians

Personnel trained to remove equipment/SMR and Team Athletic Trainer or Physician assist

CT and MRI available for imaging and Spine surgeon consult or on-call within 30 minutes

24/7 Operating Room

Critical care

Rehabilitation services

Referral System in place

(Courson et al., 2020)

Prevention and Planning

- Communicate and collaborate- multiple healthcare providers and personnel
- Review and revise EAPs as protocols update
- Practice protocols using scenario based training at least annually with all personnel designated in EAP
- Equipment to standard and properly fitted
- Education for Coaches, Athletes, Parents to prevent SCI/CSI

(Courson et al., 2020)

Conclusion

- Equipment-laden athletes challenge SMR and transfer to ED
- Athletic Trainer establish relationship with EMS for protocols, SMR, and transport
- Athletic Trainer establish relationship with ED personnel and equipment removal training/education
- Healthcare providers who may cover athletic events have knowledge of EAP, spine injury protocols, and transfer techniques

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