

Head and Neck Injuries in Athletes

The Sports Medicine Core Curriculum Lecture Series
Sponsored by an ACEP Section Grant
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Lecture Goals

Discuss head injuries, c-spine injuries, neck injuries occurring in contact sports

Review acute management

Concussion and cervical spine injuries

Discuss Treatment options

Including experimental

Demonstrate proper removal of football helmet and pads.

Sports Associated with Catastrophic Injuries

Football

Ice Hockey

Soccer

Basketball

Rugby

Gymnastics

Pole Vaulting

Diving

Case

19 y.o. male, playing soccer

Hit right fronto-parietal head on another's skull

Unconscious for 20 sec

Brought to ED with amnesia for event, but normal neuro exam

Right frontal scalp contusion

Developed seizure, responded to Ativan

Admitted for observation

Slight psychomotor slowing with slurred speech

Possibly related to Ativan and seizure?

8 hours later developed N/V, and headache

Repeat CT showed development of interval epidural bleed

Head Injuries

Severe: GCS <8

25% require NS intervention

Moderate: GCS 9-13

“talk and deteriorate” 75% SDH or EDH.

- Worse prognosis than when presenting initially with GCS<8

Minor: GCS 14-15

Sports related account for 5-10% seen in ED.

3% deteriorate unexpectedly

<1% require neurosurgical intervention

Types of head injuries

Subdural hematoma

Epidural hematoma

Subarachnoid hemorrhage

Intracranial hemorrhage

Cerebral contusion

Diffuse axonal injury

Concussion

Pathophysiology

Direct Impact

Skull fracture

Energy transmitted via shock waves

- Distort/disrupt contents, altering ICP

Indirect Injury

Acceleration/deceleration injury

- Bridging subdural vessels strained → SDH

Diffuse Axonal Injury

Concussion

Contrecoup contusion

Pathophysiology

Primary brain injury: mechanical irreversible damage

- Brain laceration

- Contusion (microvascular injury)

- Tissue avulsion

Secondary brain injury

- Depolarization of brain cells and ionic shifts

- Free radical scavengers overwhelmed

Secondary Systemic Insults

- Hypotension (SBP<90), anemia, hypoxia

Pediatric Considerations

Fewer traumatic hemorrhagic lesions

Fewer contusions

More diffuse brain swelling

More axonal injury

Deterioration more likely 2°/2 edema

Concussion

Concussus- (Latin) “to shake violently”

300,000 US athletes with concussion yearly reported

3-8% high school football players have concussions annually (~150,000/yr)

Up to 19% contact sports players have one concussion per year

Pathophysiology

Alterations in glutamate, potassium and calcium transport

Relative decrease in cerebral blood flow in the setting of an increased requirement for glucose

Symptoms of Concussion

Confusion

Amnesia

Loss of consciousness

Disorientation

Feeling in a 'fog'

Vacant stare

Inability to focus

Delayed verbal and motor

Slurred speech

Drowsiness

Headache

Fatigue

Dizziness

Nausea/Vomiting

Photophobia

Phonophobia

Emotional lability

Irritability

Most athletes are symptom free within 15min. Why not return to activity?

Decreased mental ability- judgment, memory

Decreased physical ability- balance, coordination

Re-injury rate high within 10 days of initial injury: 4-6X

Second impact syndrome

Long-term cognitive difficulties

Relationship to depression in retired NFL players?

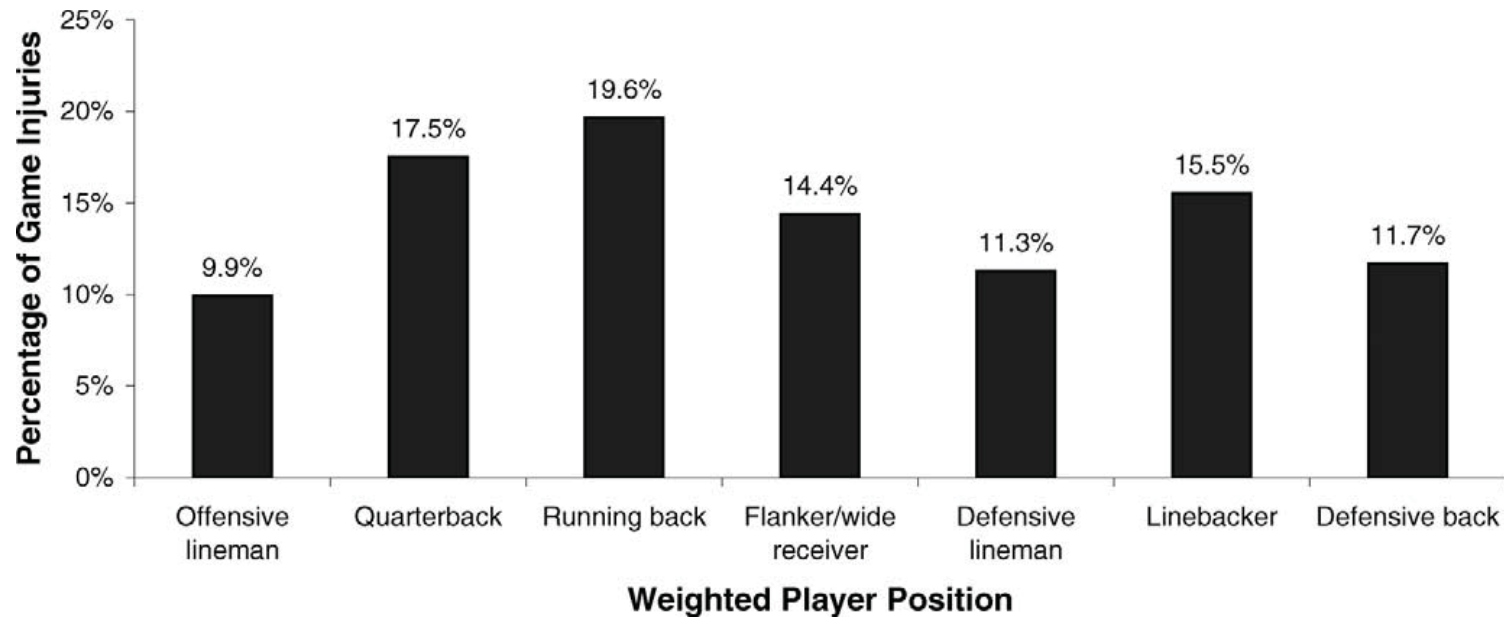
Second Impact Syndrome

Second, often minor head trauma, occurred before symptoms from first injury have resolved.

Loss of autoregulation of brain blood supply → vascular engorgement → herniation and death.

Controversial (difficult to prove: only case studies)

College Football Data Concussion Risk by Position

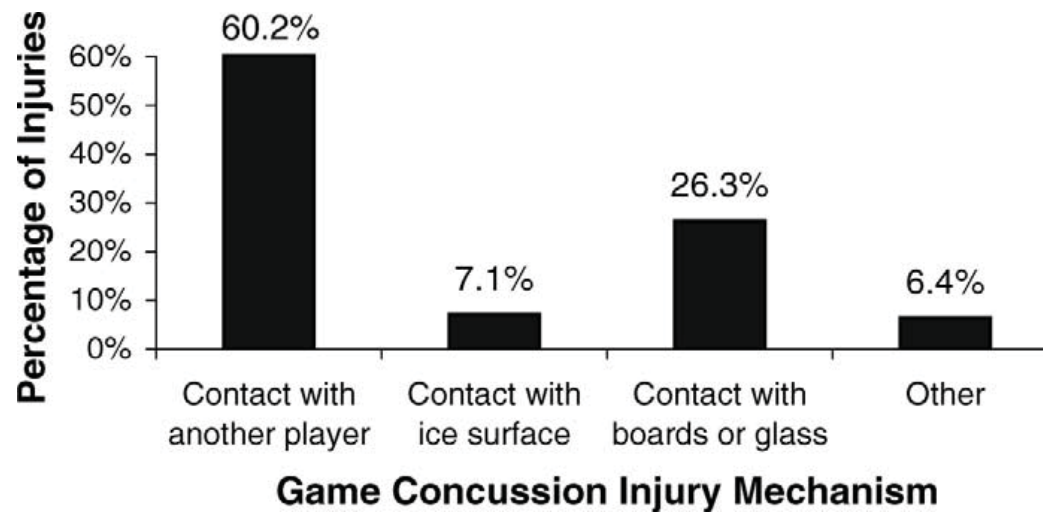


Dick, et al. Descriptive Epidemiology of College Football Injuries 1989-1998. JATA 2007;42(2):221-233

Copyright JAT.

College Hockey Data

Game Concussion Mechanism



Agel, et al. Descriptive Epidemiology of College Hockey Injuries. J Athl Train. 2007 Apr–Jun; 42(2): 241–248.

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Concussion Grading

Cantu Grading System

Roberts Grading System

Torg Grading System

American Academy of Neurology 1997

All segregate severity by loss of consciousness which does not clinically correlate with severity of symptoms

All recommend return to play guidelines based upon duration of symptoms or loss of consciousness

To CT or not CT

Goal to Find:

1. clinically relevant head injuries
2. injuries requiring neurosurgery intervention

New Orleans Criteria:

1. Headache
2. Vomiting
3. Older than 60yrs
4. Drugs or EtOH
5. Persistent anterograde amnesia
6. Visible trauma above clavicle
7. Seizure

Canadian CT Head Rules:

1. GCS <15 2hr after event
2. Suspected open/depressed skull Fx
3. Sign of basilar skull Fx
4. 2 or more episodes of vomiting
5. >65 yr old
6. Amnesia of >30 min prior to event
7. Dangerous mechanism.

CT rough guidelines

All with GCS <15

Anterograde amnesia

LOC

Persistent vomiting

Seizure

Trauma above clavicles

Age >65

*Role for reliable observation instead of imaging

Neurocognitive Scoring

Baseline score at start of season



Head injury Occurs



Re-score when symptom free

Goal is to assist with return to play decision

ImPACT scoring sheet

High school athletes

Baseline testing (20min computerized test:
cognitive and motor skills/reaction time)

Re-test after injury on day 2, 7, 14.

ImPACT Conclusions

Concussion grade not related to recovery time

Some 'Grade 1' concussions took as long as 14 days to recover

Grading scale not consistent with neurocognitive scores

Amnesia better predictor for outcomes than loss of consciousness

Recovery may not be linear

Neurocognitive defects took longer to recover than self reported symptoms (speed, visual and verbal memory).

Consensus Conferences on Concussion

Vienna Conference 2001

Symptomatic athletes should be withheld from returning to play

No athlete should be returned to play until medically evaluated

Aubry M, Cantu RC, Dvorak J, et al: Summary and agreement statement of the 1st International Conference on Concussion in Sport, Vienna 2001. British J Sports Med 36(1): 6–10, 2002

Prague Consensus Guidelines 2004

Classify as Simple (resolves <10d) vs. Complex
(persistent symptoms, seizure, easy recurrence)

New SCAT card

Paul McCrory et al: Summary and Agreement Statement of the 2nd International Conference on Concussion in Sport, Prague 2004. Clin J Sport Med 15(2):48-55, 2005

Zurich Consensus Guidelines 2008

Review of evidence based medicine

Gradual step-wise return to play outlined

McCrory, P et al. Consensus Statement on Concussion in Sport 3rd International Conference on Concussion in Sport Held in Zurich, November 2008. CJSM 19(3): 185-200, 2009

Return to Play guidelines

Withhold from play immediately

Step-wise progression of activities

- 1) Complete rest.
- 2) Light aerobic exercise
- 3) Sports specific exercises with resistance training
- 4) Non-contact training drills
- 5) Full contact training/practice
- 6) Game play

Caution on side of withholding

(especially given high likelihood of underreporting of symptoms)

Utilization of scoring tests (need accurate baseline score)

Concussion discharge instructions

Where to get → cdc.gov

ACUTE CONCUSSION EVALUATION (ACE)

CARE PLAN
Gerard Gioia, PhD¹ & Micky Collins, PhD²
¹Children's National Medical Center
²University of Pittsburgh Medical Center

Patient Name: _____
DOB: _____ Age: _____
Date: _____ ID/MR# _____
Date of Injury: _____

You have been diagnosed with a concussion (also known as a mild traumatic brain injury). This personal plan is based on your symptoms and is designed to help speed your recovery. Your careful attention to it can also prevent further injury.

Rest is the key. You should not participate in any high risk activities (e.g., sports, physical education (PE), riding a bike, etc.) if you still have any of the symptoms below. It is important to limit activities that require a lot of thinking or concentration (homework, job-related activities), as this can also make your symptoms worse. If you no longer have any symptoms and believe that your concentration and thinking are back to normal, you can slowly and carefully return to your daily activities. Children and teenagers will need help from their parents, teachers, coaches, or athletic trainers to help monitor their recovery and return to activities.

Today the following symptoms are present (circle or check).				No reported symptoms
Physical		Thinking	Emotional	Sleep
Headaches	Sensitivity to light	Feeling mentally foggy	Irritability	Drowsiness
Nausea	Sensitivity to noise	Problems concentrating	Sadness	Sleeping more than usual
Fatigue	Numbness/Tingling	Problems remembering	Feeling more emotional	Sleeping less than usual
Visual problems	Vomiting	Feeling more slowed down	Nervousness	Trouble falling asleep
Balance Problems	Dizziness			

RED FLAGS: Call your doctor or go to your emergency department if you suddenly experience any of the following			
Headaches that <u>worsen</u>	Look <u>very</u> drowsy, can't be awakened	Can't <u>recognize</u> people or places	Unusual behavior change
Seizures	<u>Repeated</u> vomiting	Increasing confusion	Increasing irritability
Neck pain	Slurred speech	Weakness or numbness in arms or legs	Loss of consciousness

Returning to Daily Activities

1. Get lots of rest. Be sure to get enough sleep at night- no late nights. Keep the same bedtime weekdays and weekends.
2. Take daytime naps or rest breaks when you feel tired or fatigued.
3. **Limit physical activity as well as activities that require a lot of thinking or concentration. These activities can make symptoms worse.**
 - Physical activity includes PE, sports practices, weight-training, running, exercising, heavy lifting, etc.
 - Thinking and concentration activities (e.g., homework, classwork load, job-related activity).
4. Drink lots of fluids and eat carbohydrates or protein to maintain appropriate blood sugar levels.
5. As symptoms decrease, you may begin to **gradually** return to your daily activities. If symptoms worsen or return, lessen your activities, then try again to increase your activities gradually.
6. During recovery, it is normal to feel frustrated and sad when you do not feel right and you can't be as active as usual.
7. Repeated evaluation of your symptoms is recommended to help guide recovery.

Returning to Work

1. Planning to return to work should be based upon careful attention to symptoms and under the supervision of an appropriate health care professional.
2. Limiting the amount of work you do soon after your injury, may help speed your recovery. It is very important to get a lot of rest. You should also reduce your physical activity as well as activities that require a lot of thinking or concentration.

Do not return to work. Return on (date) _____
Return to work with the following supports. Review on (date) _____

Schedule Considerations

- Shortened work day _____ hours
- Allow for breaks when symptoms worsen
- Reduced task assignments and responsibilities

Safety Considerations

- No driving
- No heavy lifting or working with machinery
- No heights due to possible dizziness, balance problems



Returning to School

1. If you (or your child) are still having symptoms of concussion you may need extra help to perform school-related activities. As your (or your child's) symptoms decrease during recovery, the extra help or supports can be removed gradually.
2. Inform the teacher(s), school nurse, school psychologist or counselor, and administrator(s) about your (or your child's) injury and symptoms. School personnel should be instructed to watch for:
 - Increased problems paying attention or concentrating
 - Increased problems remembering or learning new information
 - Longer time needed to complete tasks or assignments
 - Greater irritability, less able to cope with stress
 - Symptoms worsen (e.g., headache, tiredness) when doing schoolwork

-Continued on back page-

This form is part of the "Heads Up: Blast Injury in Your Practice" tool kit developed by the Centers for Disease Control and Prevention (CDC).

Returning to School (Continued)

Until you (or your child) have fully recovered, the following supports are recommended: *(check all that apply)*

- No return to school. Return on (date) _____
- Return to school with following supports. Review on (date) _____
- Shortened day. Recommend ___ hours per day until (date) _____
- Shortened classes (i.e., rest breaks during classes). Maximum class length: _____ minutes.
- Allow extra time to complete coursework/assignments and tests.
- Lessen homework load by ____%. Maximum length of nightly homework: _____ minutes.
- No significant classroom or standardized testing at this time.
- Check for the return of symptoms (use symptom table on front page of this form) when doing activities that require a lot of attention or concentration.
- Take rest breaks during the day as needed.
- Request meeting of 504 or School Management Team to discuss this plan and needed supports.

Returning to Sports

1. **You should NEVER return to play if you still have ANY symptoms** – (Be sure that you do not have any symptoms at rest and while doing any physical activity and/or activities that require a lot of thinking or concentration.)
2. Be sure that the PE teacher, coach, and/or athletic trainer are aware of your injury and symptoms.
3. It is normal to feel frustrated, sad and even angry because you cannot return to sports right away. With any injury, a full recovery will reduce the chances of getting hurt again. It is better to miss one or two games than the whole season.

The following are recommended at the present time:

Do not return to PE class at this time

Return to PE class

Do not return to sports practices/games at this time

Gradual return to sports practices under the supervision of an appropriate health care provider (e.g., athletic trainer, coach, or physical education teacher).

- Return to play should occur in gradual steps beginning with aerobic exercise only to increase your heart rate (e.g., stationary cycle); moving to increasing your heart rate with movement (e.g., running); then adding controlled contact if appropriate; and finally return to sports competition.
- Pay careful attention to your symptoms and your thinking and concentration skills at each stage of activity. Move to the next level of activity only if you do not experience any symptoms at the each level. If your symptoms return, let your health care provider know, return to the first level, and restart the program gradually.

Gradual Return to Play Plan

1. No physical activity
2. Low levels of physical activity (i.e., *symptoms do not come back during or after the activity*). This includes walking, light jogging, light stationary biking, light weightlifting (lower weight, higher reps, no bench, no squat).
3. Moderate levels of physical activity with body/head movement. This includes moderate jogging, brief running, moderate-intensity stationary biking, moderate-intensity weightlifting (reduced time and/or reduced weight from your typical routine).
4. Heavy non-contact physical activity. This includes sprinting/running, high-intensity stationary biking, regular weightlifting routine, non-contact sport-specific drills (in 3 planes of movement).
5. Full contact in controlled practice.
6. Full contact in game play.

*Neuropsychological testing can provide valuable information to assist physicians with treatment planning, such as return to play decisions.

Neck injuries

Fractures (stable vs unstable):

Compressive-flexion (teardrop)

Vertical compression (burst)

Subluxation/Dislocation

Vascular injury

Intervertebral disk herniation

Brachial plexus injury

Nerve root injury

Spinal Cord Injury:

Transverse myelopathy

Central cord syndrome

Anterior spinal cord syndrome

Brown-Sequard syndrome

Posterior spinal cord syndrome

Transient quadriplegia

Spinal Cord Lesions

Complete

Mimicked by spinal shock (<24hr)

Check for sacral sparing (central cord)

Incomplete

Central cord

- UE >LE
- Older (OA) with hyperextension

Brown-Sequard

- Penetrating most common
- Ipsilateral motor, contralateral sensory

Anterior Cord

- Hyperflexion
- Cord contusion → bony fragments or disk
- Preservation of position, touch, proprioception

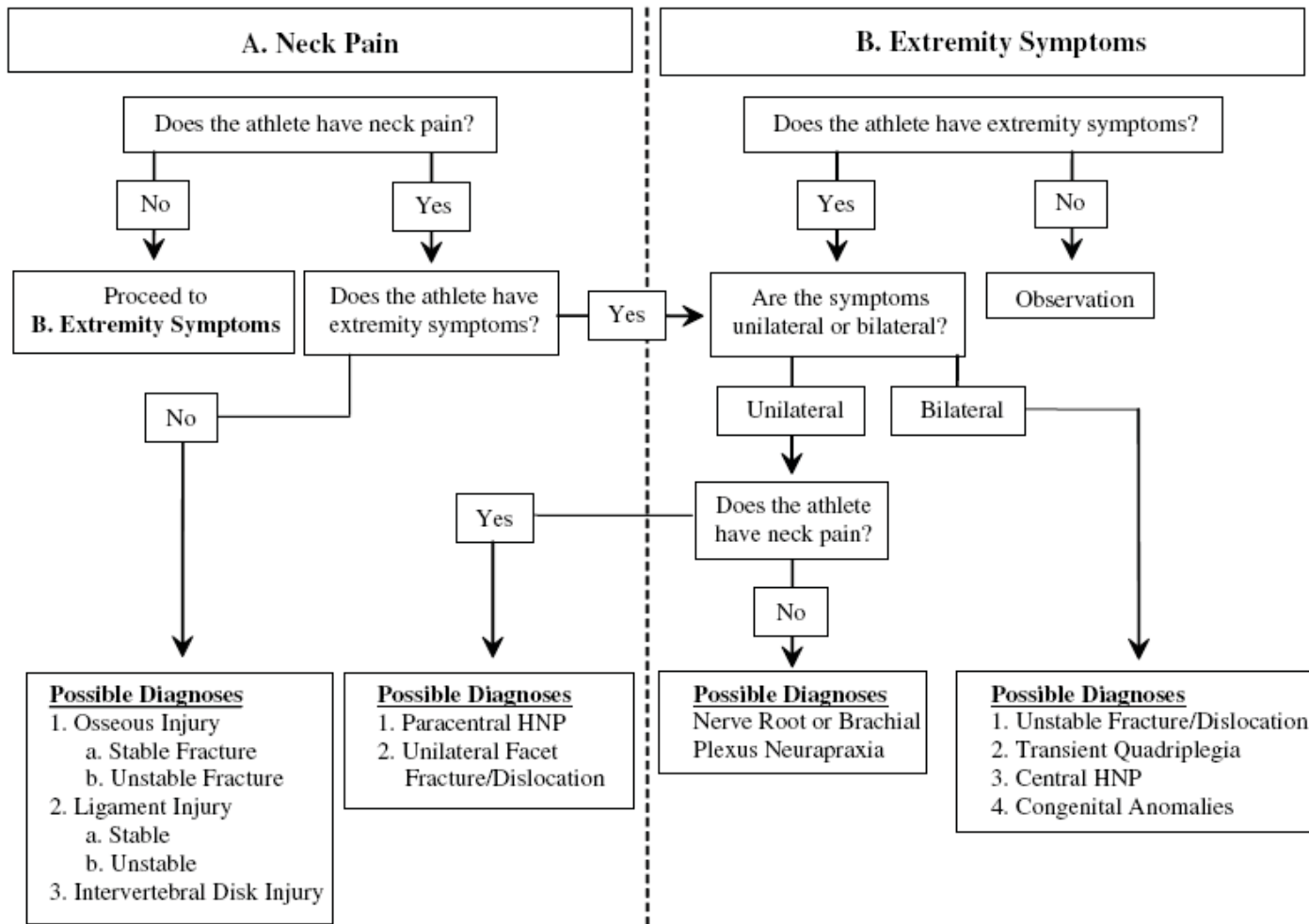


Figure 9, p1085. Algorithm for work up of neck injury. Rahul Banerjee, Mark A. Palumbo and Paul D. Fadale Catastrophic Cervical Spine Injuries in the Collision Sport Athlete, Part 1. *Am J Sports Med* 2004 32: 1077

Case

HPI:

17 y.o. high school football linebacker

Intermittent stinging/"lightening" pain down right arm with some tackles

Started last season, but is more frequent now

PE:

Healthy appearing

RUE: No muscle wasting, and normal sensation to light touch, temperature, and pain, transiently weaker strength in proximal arm

“Stingers”

Key points:

Unilateral

Symptoms are temporary

Full recovery of normal function

No neck pain noted

C5-6 dermatome most often involved- traction or compression of brachial plexus or cervical nerve root

*Up to 50% football players have an episode

Treatment of Stingers

Conservative treatment

Sling, Rest, Ice

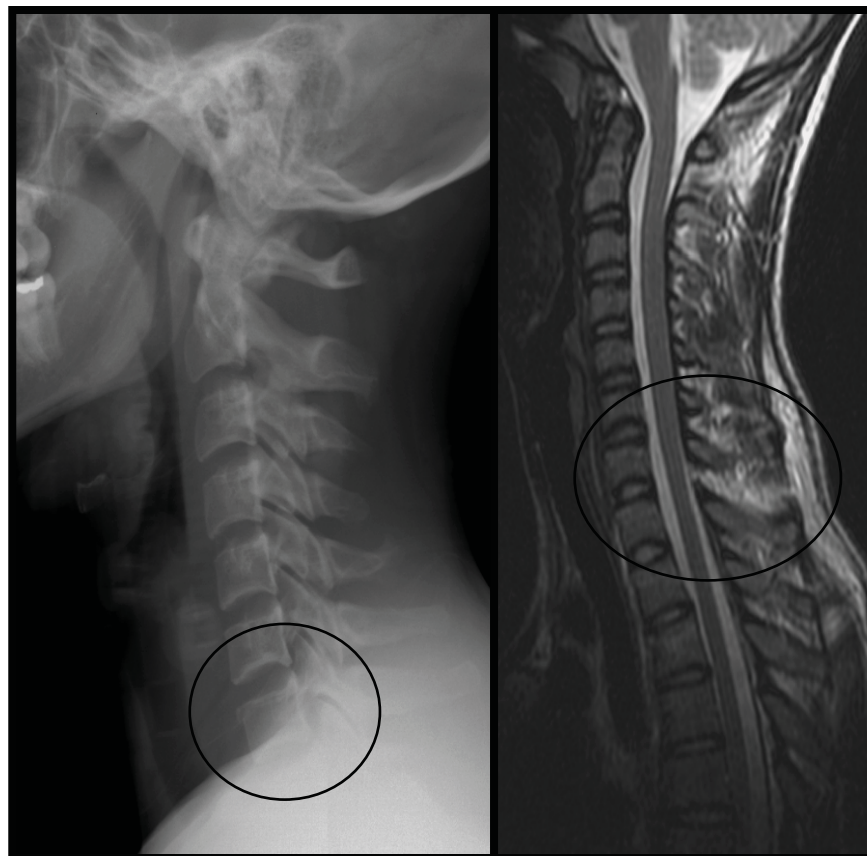
Return to play:

Full cervical range of motion

Normal strength

No symptoms

Case: 18 yo F college gymnast falls onto head coming off of vault c/o neck pain- backboard and c-collar on site



'Injuries to the Cervical Spine in American Football Players'

1965 – 1974
40 fatalities

1975 – 1984
14 fatalities

1985 – 1994
5 fatalities

*primarily due to tackling

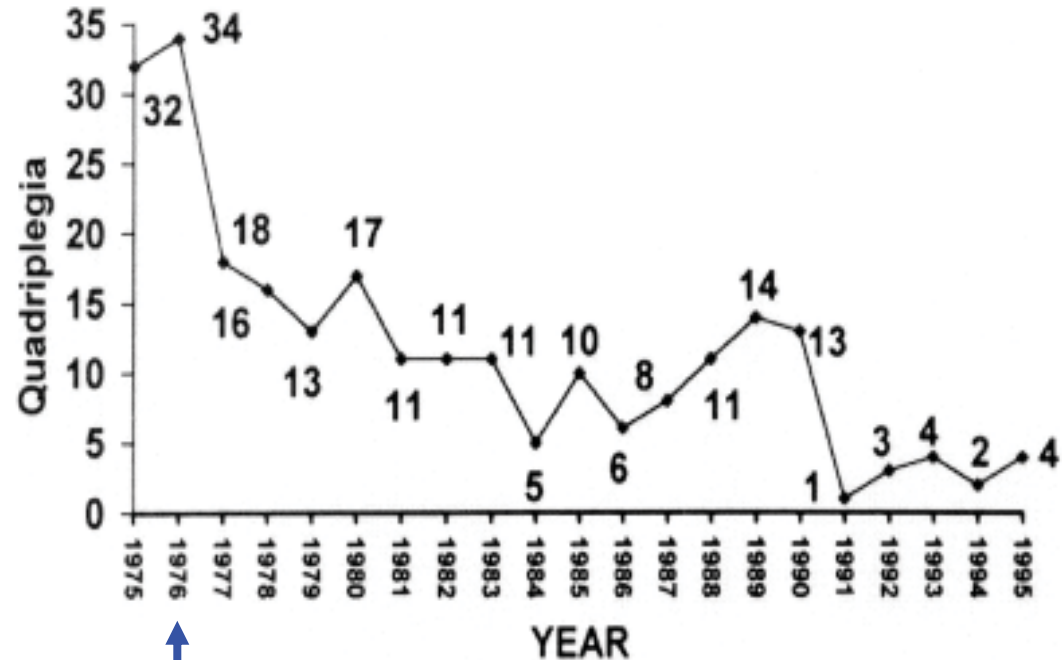


Fig. 4

The effect of the 1976 rule changes banning spearing and head-impact playing techniques was dramatic, with a sustained decrease in the number of players who sustained permanent cervical quadriplegia.

Mechanics of injury

Axial loading with cervical flexion (30°)

Excessive forces -> segmental buckling, fractures or dislocation

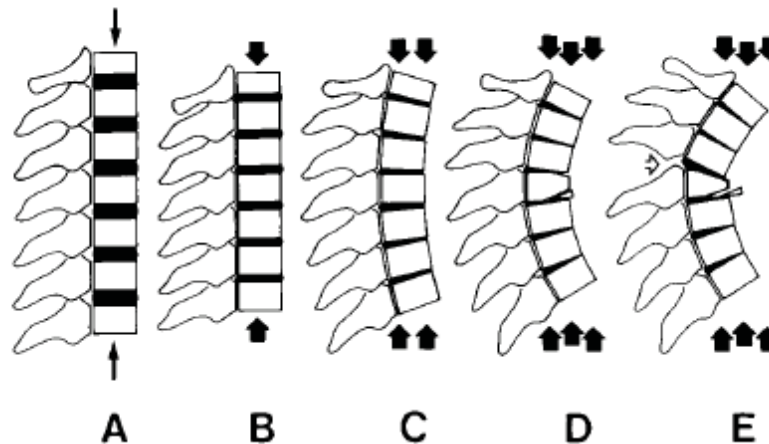


Figure 5. (A) Axial loading of the cervical spine (B) first results in compressive deformation of the intervertebral discs. As the energy input continues and maximum compressive deformation is reached, angular deformation and buckling occur (C). The spine fails in a flexion mode, with resulting fracture, dislocation, or subluxation (D and E).

When to Image Neck Injuries?

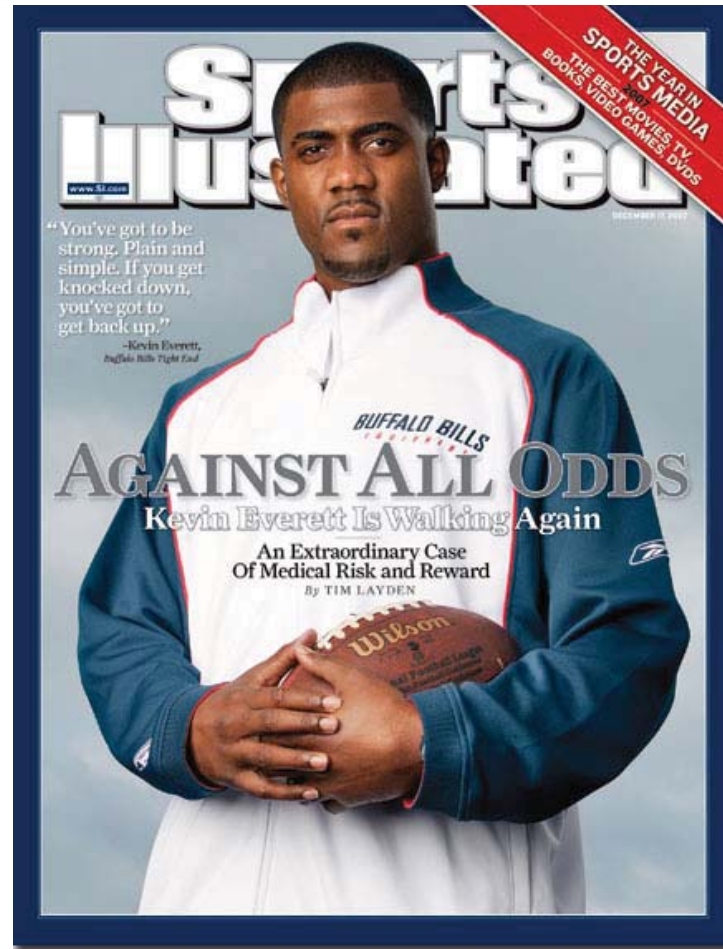
NEXUS Low-risk Criteria

- No posterior midline cervical tenderness
- No intoxication
- Normal mental status
- No focal neurologic deficits
- No painful distracting injuries

Canadian C-Spine Guidelines

- Midline tenderness
- Age >65
- Dangerous mechanism
- Neurologic symptoms
- Supine position
- Immediate onset of neck pain
- Able to rotate neck

Does Hypothermia Work?



Moderate Hypothermia

Hyperthermia following trauma or ischemia aggravates brain injury

Neuroprotective effects of cooling demonstrated

Theoretically, moderate hypothermia reduces inflammation that can cause secondary injury

Moderate Hypothermia

Cooling to 33 degrees Celsius (92 F)

Maintain for 48 hours

Gradually rewarm (1 degree/8 hours)

Moderate Hypothermia

Experimental

Unknown who (if anyone) benefits

Unknown who may be harmed

NOT recommended as routine treatment

Everett = case of 1

Vertebrae 3, 4 fracture/dislocation

On-field care

Hypothermia, steroids

Top-notch surgical treatment

Special Teams Plays

1 head down contact per 1.8 kick returns

Education on proper tackling technique

All head down contact at risk for cervical spine injury

Heck et al.:

Risk of head down in high school football:

all plays = 25%, kick returns 38%

See NATA video “Heads Up: Reducing the Risk of Head and Neck Injuries in Football video”

<http://www.nata.org/consumer/headsup.htm>



Treatment options

Neurosurgical involvement

Halo: spinal traction

Facet relocation/spinal fusion

High dose steroids?:

Methylprednisone 30mg/kg over 15min,

then 5.4mg/kg/hr over next 23hr if treated within 3hr.

(If started at 3-8hr, continue for total of 48hrs)

Do not start if not within first 8hr

NFL guidelines: “use the institution’s standard”

Total body cooling (experimental)

Steroids

High dose methylprednisone for 24hr

Significant risk of detrimental outcome,
especially if extend treatment

“evidence of harmful side effects is more consistent than any
suggestion of clinical benefit.”

Transient quadraplegia

- Sensation: burning pain, numbness, tingling,
- Motor: weakness to complete paralysis.
- **Transient** and complete recovery usually 10-15min, although gradual resolution occurs over 36-48 hr rarely.
- Except for burning paresthesia, no neck pain
- Complete return of motor function and full, pain-free motion of the cervical spine.

Pincer effect

Adults: spinal stenosis

Children: spinal column mobility

Spinal Stenosis

Injuries related to congenital stenosis

Diameter: 18.4 mm

Spinal Stenosis: <14mm

Congenital or Acquired

- Degenerative osteophyte formation: repetitive trauma

Torg ratio: (vertebral canal/body) <0.8 is not a reliable measure

*Functional Reserve: CSF around cord better predictor

Facemask removal

Remove facemask in the field:
gain access to airway for transport

Leave helmet on, otherwise
pads elevate body causing extension of neck

NCAA recommends Xray/CT w/ Helmet On

MRI: too much artifact with metal from straps

Facemask Removal

New Riddell Revolution Helmet

Concussion: 5.4 % of Revolution wearers vs 7.6 % other

FM Extractor

Trainer's Angel

Cordless Screwdriver

less movement (any one plane, 2.8°–13.3°)
was faster (mean 42.1–68.8 seconds)

*Rust/damaged screw head 6%-8% failure



Helmet Removal

Only remove helmet/pads if absolutely necessary on field

Need to gain airway access

Broken equipment

Always remove both pads and helmet as a unit

Use team of experienced caregivers

(data on cervical spine movement)

Pad/Helmet removal

Cut Jersey in front and at sleeves

Cut straps on shoulder pads (front and sleeves)

One person maintains cervical alignment

Cut chin strap (do not unstrap)

Remove ear pads & release air from helmet

Place responders hands directly on skin in thoracic region, with additional people added down the body.

Head person removes helmet, rotating anteriorly, then shoulder pads by spreading apart front panels and pulling over the head.

Lower the patient, place c-collar.

Imaging

Initial lateral cervical spine film for athlete with a suspected neck injury: helmet and shoulder pads on or off? *Clin J Sports Med* 2002 Mar;12(2):123-6

The answer is on! *Clin J Sport Med* 2003 Jan;13(1):57-8

Management of the helmeted athlete with suspected spine injury. *Am J Sports Med* 2004 Jul-Aug;32(5):1331-50

Computed tomography is diagnostic in the cervical imaging of helmeted football players with shoulder pads. *J Athl Train* 2004 Sep;39(3):217-222

Preventative Measures

Helmets?

Increase mass.

Concussion data

Mouth guards

Rule Changes

Technique changes (head up tackling)

Take Home Points

- Do not return an athlete to competition the same day after sustaining even a mild transient concussion
- Keep the helmet and shoulder pads on for transport and initial imaging of head and neck injuries
- Be aware that symptoms of bilateral stingers require workup
- Hypothermia for spinal cord injuries is still experimental

Prehospital Care of the Spine-Injured Athlete



A Document From
the Inter-Association
Task Force For
Appropriate Care of
the Spine-Injured Athlete

NATA References

Heads Up: Reducing the Risk of Head and Neck Injuries in Football video

<http://www.nata.org/consumer/headsup.htm>

Prehospital Care of the Spine-Injured Athlete

<http://www.nata.org/statements/consensus/NATAPreHospital.pdf>

Additional Resources

Sport Concussion Assessment Tool

http://www.newamssm.org/SCAT_v13_-_Side_1.doc

http://www.newamssm.org/SCAT_v13_-_Side_2.doc

CDC Resources

<http://www.cdc.gov/ncipc/tbi/TBI.htm>

Heads Up: Concussion in High School Sports (for coaches)

http://www.cdc.gov/ncipc/tbi/Coaches_Tool_Kit.htm

Heads Up: Brain Injury in Your Practice (for physicians)

http://www.cdc.gov/ncipc/tbi/physicians_tool_kit.htm

Heads Up: Concussion in Youth Sports (for parents and coaches)

<http://www.cdc.gov/ConcussionInYouthSports/default.htm>

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