Sports Related Concussion

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The Montana Academy of Family Physicians
Big Mountain Medical Conference
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SELECTS

Learning Objectives

- ➔ Discuss concussion diagnosis and management
  - On the field
  - In the clinic
- ➔ Learn about the process of clearance
  - Hailey Craig Lopp, DPT, NCS
  - Neurologic Clinical Specialist Physical Therapist

TLDR–too long, didn't read

- Concussion is a Traumatic Brain Injury (TBI)
- Repeat concussion has serious consequences
- Primary treatment is avoidance of repeat concussion,relative rest and graduated return to school/play
- "When in doubt, sit them out."
- By Montana Law, a concussed athlete cannot return to play until cleared by a qualified healthcare provider.

Sports Related Concussion aka mTBI

-a traumatic brain injury sustained during sports

-”mild” because it does not appear on imaging

-diagnosed by signs and symptoms presenting within 72 hours of injury

-vestibular and oculomotor findings may be present

-most athletes recover within days or a few weeks

Table 1. Signs and Symptoms of Concussion or Mild Traumatic Brain Injury.

Domain	Symptoms	Signs
Cognitive	Confusion, feeling "in a fog" or "zoned out," inability to focus	Anterograde amnesia, retrograde amnesia, loss of consciousness, disorientation, delayed verbal and motor responses, vacant stare, slurred or incoherent speech
Somatic	Headache, dizziness, nausea or vomiting, visual disturbances, photophobia or blurry or double vision, phonophobia	Balance disruption, abnormal eye tracking, abnormal vestibulo-ocular reflex, abnormal near-point convergence
Affective	Emotional lability, irritability, fatigue, anxiety, sadness	Irritable behavior, flat affect
Sleep disturbance	Trouble falling asleep, sleeping more or less than usual	Excessive drowsiness

The NEW ENGLAND JOURNAL of MEDICINE

Persisting Post Concussion Symptoms aka Post Concussion Syndrome

-Persistent symptoms beyond 4 weeks

-Estimated to occur in about 30 % of untreated adolescents

-Confounding factors including pre injury physical and mental health factors

Second Impact Syndrome

- ★ Rare but potentially catastrophic
- ★ Second head injury sustained when not recovered from first
- ★ Rapid, diffuse cerebral edema and brain herniation
- ★ 50% mortality possible

> MMWR Morb Mortal Wkly Rep. 2017 Jan 6;65(52):1465-1469. doi: 10.15585/mmwr.mm6552a2.

Traumatic Brain and Spinal Cord Fatalities Among High School and College Football Players - United States, 2005-2014

Kristen L Kucera, Rebecca K Yau, Johna Register-Mihalik, Stephen W Marshall, Leah C Thomas, Susanne Wolf, Robert C Cantu, Frederick O Mueller, Kevin M Guskiewicz

PMID: 28056008 DOI: 10.15585/mmwr.mm6552a2

Free article

Abstract

An estimated 1.1 million high school and 75,000 college athletes participate in tackle football annually in the United States. Football is a collision sport; traumatic injuries are frequent (1,2), and can be fatal (3). This report updates the incidence and characteristics of deaths caused by traumatic brain injury and spinal cord injury (4) in high school and college football and presents illustrative case descriptions. Information was analyzed from the National Center for Catastrophic Sport Injury Research (NCCSIR). During 2005-2014, a total of 28 deaths (2.8 deaths per year) from traumatic brain and spinal cord injuries occurred among high school (24 deaths) and college football players (four deaths) combined. Most deaths occurred during competitions and resulted from tackling or being tackled. All four of the college deaths and 14 (58%) of the 24 high school deaths occurred during the last 5 years (2010-2014) of the 10-year study period. These findings support the need for continued surveillance and safety efforts (particularly during competition) to ensure proper tackling techniques, emergency planning for severe injuries, availability of medical care onsite during competitions, and assessment that it is safe to return to play following a concussion.

Case-Sideline

-You are volunteering at your local rugby club as sideline medical personnel.

-One of the girls takes a hard tackle and is very slow to get up.

-You run onto the field.

NEXUS Criteria for C-Spine Imaging

Favorite Share

Clears patients from cervical spine fracture clinically, without imaging.

When to Use | Pearls/Pitfalls | Why Use

Focal neurologic deficit present	No 0	Yes +1
Midline spinal tenderness present	No 0	Yes +1
Altered level of consciousness present	No 0	Yes +1
Intoxication present	No 0	Yes +1
Distracting injury present	No 0	Yes +1

If none of the above criteria are present, the C-Spine can be cleared clinically by these criteria.

Imaging is not required.

Copy Results | Next Steps

» Next Steps | Evidence | Creator Insights

About the Creator

Dr. Jerome Hoffman

Also from MDCalc...

Related Calcs

- Canadian C-Spine Rule
  Clinically clears cervical spine fracture without imaging in alert, stable trauma patients.
- New Orleans Head CT Rule
  Criteria for which patients are unlikely to require imaging after head trauma.
- NDI
  Assesses disability in patients with neck pain.

You might be interested in...

Partner Content

Calculated Decisions: NEXUS C-Spine Rule

Canadian C-Spine Rule

Clinically clears cervical spine fracture without imaging in alert, stable trauma patients.

When to Use | Pearls/Pitfalls | Why Use

Age ≥65 years, extremity paresthesias, or dangerous mechanism Fall from ≥3 ft (0.9 m) / 5 stairs, axial load injury, high speed MVC/rollover/ejection, bicycle collision, motorized recreational vehicle	**No** / Yes
Low risk factor present Sitting position in the ED, ambulatory at any time, delayed (not immediate onset) neck pain, no midline tenderness. Simple rearend motor vehicle collision (MVC) (not simple if pushed into traffic, hit by bus/large truck, rollover, hit by high-speed vehicle)	No / **Yes**
Able to actively rotate neck 45° left and right	No / **Yes**

Low risk

C-spine can be cleared clinically by these criteria. No imaging is required.

Copy Results | Next Steps

About the Creator

Dr. Ian Stiell

Also from MDCalc...

Related Calcs

- NEXUS C-Spine Rule
  Clears patients from cervical spine fracture clinically, without imaging.
- PECARN C-Spine Imaging Rule
  Evaluates necessity and choice of imaging in pediatric cervical spine blunt trauma.
- NDI
  Assesses disability in patients with neck pain.

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Partner Content

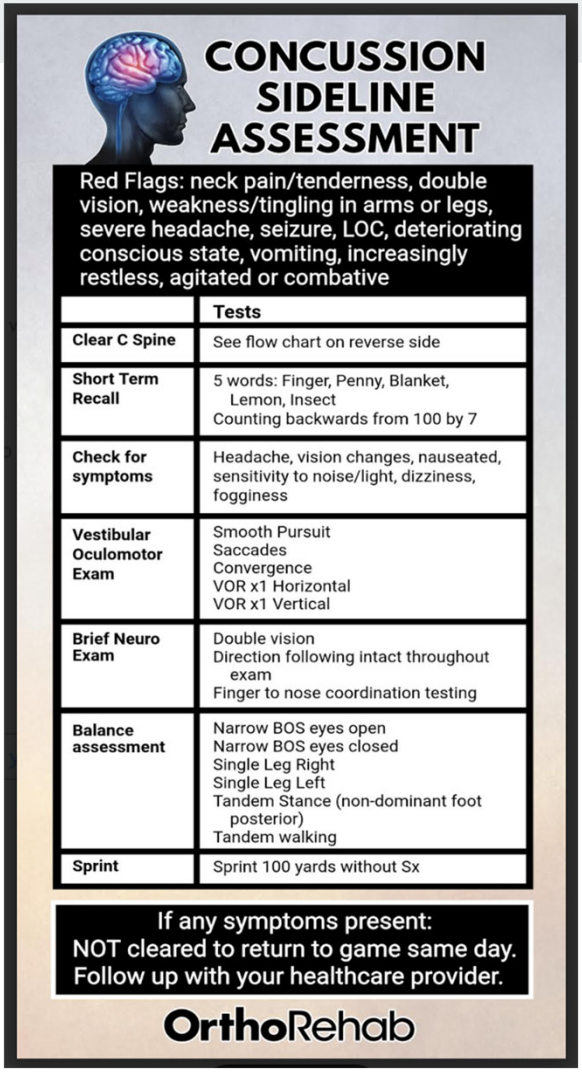
Calculated Decisions: Canadian C-Spine Rule

Case 1-Red Flags

- Increasing confusion or irritability
- Vomiting or nausea
- Seizure
- Weakness or tingling/burning in arms or legs or decreased coordination
- Deteriorating consciousness
- Severe or increasing headache
- Unusual behavior changes
- Double vision
- Anisocoria
- Slurred speech
- Cannot recognize people or places
- LOC-even if very brief

Sideline Assessment

- ★ History
  - Mechanism
  - Symptoms
  - Prior TBI/concussion
- ★ Physical Exam
  - Cognition
  - Balance
  - Vestibulo-Occular



CONCUSSION SIDELINE ASSESSMENT

Red Flags: neck pain/tenderness, double vision, weakness/tingling in arms or legs, severe headache, seizure, LOC, deteriorating conscious state, vomiting, increasingly restless, agitated or combative

	Tests
Clear C Spine	See flow chart on reverse side
Short Term Recall	5 words: Finger, Penny, Blanket, Lemon, Insect Counting backwards from 100 by 7
Check for symptoms	Headache, vision changes, nauseated, sensitivity to noise/light, dizziness, fogginess
Vestibular Oculomotor Exam	Smooth Pursuit Saccades Convergence VOR x1 Horizontal VOR x1 Vertical
Brief Neuro Exam	Double vision Direction following intact throughout exam Finger to nose coordination testing
Balance assessment	Narrow BOS eyes open Narrow BOS eyes closed Single Leg Right Single Leg Left Tandem Stance (non-dominant foot posterior) Tandem walking
Sprint	Sprint 100 yards without Sx

If any symptoms present:
NOT cleared to return to game same day.
Follow up with your healthcare provider.

OrthoRehab

SCAT 5

3.5 point drop has a sensitivity and specificty of 96% and 81% for TBI

Post injury score of 74.5 or below has a sensitivty and specificty of 83% and 91%

Sideline Assessment

- ★ History
  - Dizzy or foggy
  - Headache
  - Vision changes
  - Nausea
- ★ Physical Exam
  - Cognition
  - Vestibulo-Occular

CRT6 Concussion Recognition Tool

To Help Identify Concussion in Children, Adolescents and Adults

1: Visible Clues of Suspected Concussion

Visible clues that suggest concussion include:

- Loss of consciousness or responsiveness
- Lying motionless on the playing surface
- Falling unprotected to the playing surface
- Disorientation or confusion, staring or limited responsiveness, or an inability to respond appropriately to questions
- Dazed, blank, or vacant look
- Seizure, fits, or convulsions
- Slow to get up after a direct or indirect hit to the head
- Unsteady on feet / balance problems or falling over / poor coordination / wobbly
- Facial injury

2: Symptoms of Suspected Concussion

Physical Symptoms
Headache
"Pressure in head"
Balance problems
Nausea or vomiting
Drowsiness
Dizziness
Blurred vision
More sensitive to light
More sensitive to noise
Fatigue or low energy
"Don't feel right"
Neck Pain

Changes in Emotions
More emotional
More Irritable
Sadness
Nervous or anxious

Changes in Thinking
Difficulty concentrating
Difficulty remembering
Feeling slowed down
Feeling like "in a fog"

Remember, symptoms may develop over minutes or hours following a head injury.

3: Awareness

(Modify each question appropriately for each sport and age of athlete)

Failure to answer any of these questions correctly may suggest a concussion:

"Where are we today?"

"What event were you doing?"

"Who scored last in this game?"

"What team did you play last week/game?"

"Did your team win the last game?"

Any athlete with a suspected concussion should be - IMMEDIATELY REMOVED FROM PRACTICE OR PLAY and should NOT RETURN TO ANY ACTIVITY WITH RISK OF HEAD CONTACT, FALL OR COLLISION, including SPORT ACTIVITY until ASSESSED MEDICALLY, even if the symptoms resolve.

Athletes with suspected concussion should **NOT**:

- Be left alone initially (at least for the first 3 hours). Worsening of symptoms should lead to immediate medical attention.
- Be sent home by themselves. They need to be with a responsible adult.
- Drink alcohol, use recreational drugs or drugs not prescribed by their HCP
- Drive a motor vehicle until cleared to do so by a healthcare professional

CRT-6

-Where are we?

-What event were you doing?

-Who scored last?

-What team did you play last game?

-Did you win?

Sideline Assessment-Vestibulo-Ocular

- ★ Smooth Pursuit
  - Follow My Finger
  - Must be smooth without jerky movements
  - 1 beat of nystagmus is normal, more is not
  - Assess for symptoms

**Abnormal eye movements or symptoms =

FAIL

- ★ Complex Tandem Gait
  - "Drunk Driving Test"
    - Walk a straight line
    - 5 steps
      - Forward eyes open
      - Forward eyes closed
      - Backward eyes open
      - Backward eyes closed

**Fall off line or sway or arms up >4 times=

FAIL

CONCUSSION SIDELINE ASSESSMENT

Red Flags: neck pain/tenderness, double vision, weakness/tingling in arms or legs, severe headache, seizure, LOC, deteriorating conscious state, vomiting, increasingly restless, agitated or combative

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Sprint	Sprint 100 yards without Sx

If any symptoms present:
NOT cleared to return to game same day.
Follow up with your healthcare provider.

OrthoRehab

Bottom Line

Any disruption in neurologic function = out for the game

-”bell rung”

-”blacked out for just a second”

-”kind of out of it”

-”a little dizzy”

-”a little off balance”

WHEN IN DOUBT, SIT THEM OUT

Case 2-Clinic

-17 year-old male presents to clinic Monday morning for “sports clearance”

-Reports he was diagnosed with a concussion at his football game on Friday.

-Wants to play on Friday but admits to headache, poor sleep and nausea.

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Clinic Physical Exam-Vestibulo-Ocular

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  - Follow My Finger
  - Must be smooth without jerky movements
  - 1 beat of nystagmus is normal, more is not
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    - Walk a straight line
    - 5 steps
      - Forward eyes open
      - Forward eyes closed
      - Backward eyes open
      - Backward eyes closed

**Fall off line or sway or arms up >4 times=

FAIL

Case 2-Treatment

-Relative rest for 24-72 hours

-Avoid “cocooning”

-Graduated return to school and play

-Athletic Trainer

-Specialized Physical Therapist

-Other knowledgeable clinician

-CDC

-Save the Brain-Logan Health

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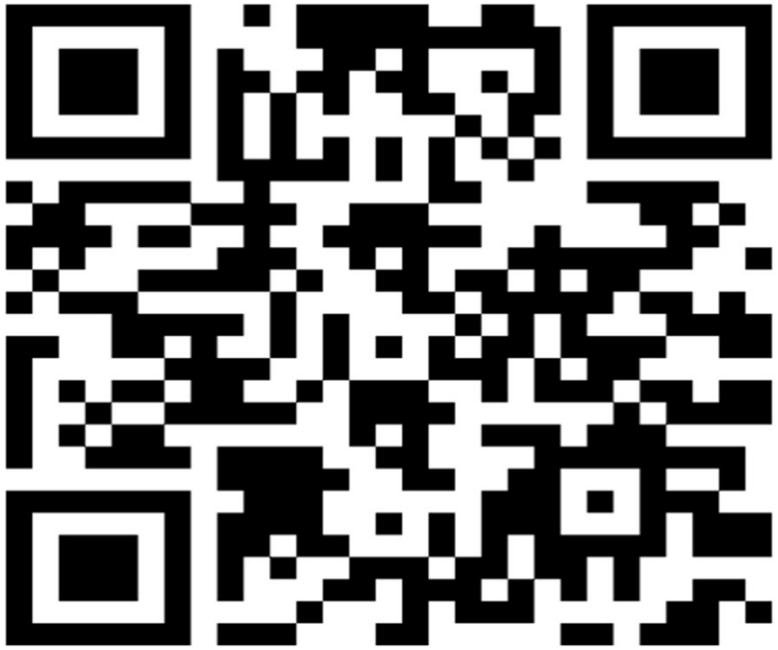
Resource Links

Visio-Vestibular Examination for ConcussionYouTube·Injury Research In Action·Jan 17, 2024

CDC Head Up

Logan Health Save the Brain

CRT6-Concussion Recognition Tool



Physical Therapy & Concussion Clearance

Hailey Craig Lopp, DPT, NCS

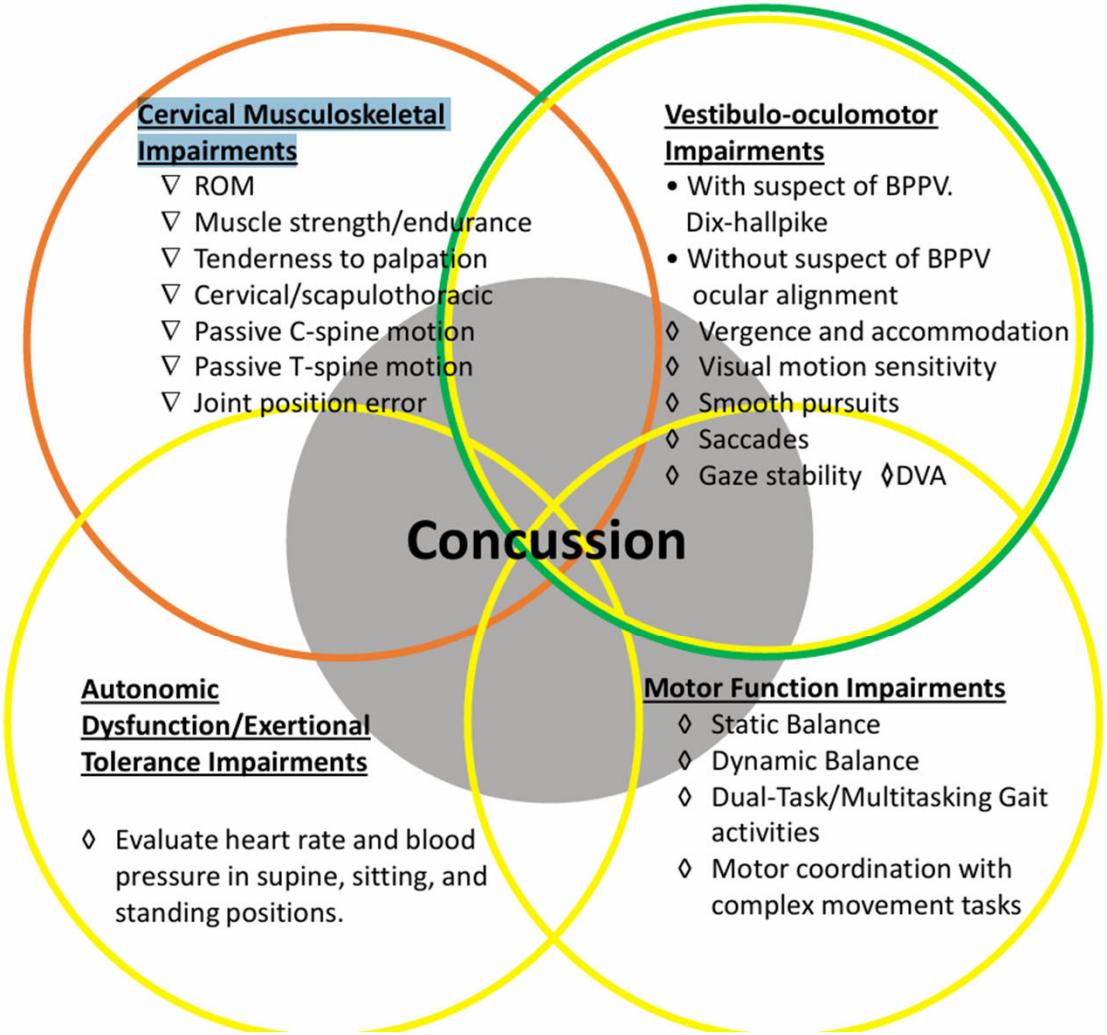
Physical therapy assessment

- Vestibulo-ocular impairments
- Cervical and thoracic musculoskeletal impairments
- Autonomic Dysfunction
- Gross motor function
- Other:
  - Sleep
  - Anxiety/mood regulation

Sleep Hygiene

- Go to bed and wake up at the same time every day, including weekends
- Avoid napping more than 30 minutes during the day
- Blackout your room at night and use white noise (apps, fan, etc.)
- Relax 30 minutes before bed and prepare body to sleep
- Avoid bright lights (minimize electronics in bed and 30 min before bed, or at least use night mode)
- Practice mindfulness daily (App suggestions: Calm, Headspace)
- Turn down temperature or sleep with fan (Cooler temperature facilitate sleep)
- Exercise 6-7 days a week. Try to avoid exercising within 3 hrs of bedtime.
- Exercise regardless of time is better than no exercise.

Concussion Clinical Practice Guidelines: Recommendations for Examination



Buffalo Concussion Treadmill Test

Patient name:_____ Date: _____

Age predicted Max HR: 220-age= _____

Speed: 3.2 mph = 5ft 5in or less, 3.6 mph = Taller than 5ft 5 in.

Time/stage	MPH	Grade	HR	BP	VAS (0-10)	RPE	Notes
Pre-test	-	-					
1	3.2 / 3.6	0	-	-			
2	3.2 / 3.6	1					
3	3.2 / 3.6	2	-	-			
4	3.2 / 3.6	3					
5	3.2 / 3.6	4	-	-			
6	3.2 / 3.6	5					
7	3.2 / 3.6	6	-	-			
8	3.2 / 3.6	7					
9	3.2 / 3.6	8	-	-			
10	3.2 / 3.6	9					
11	3.2 / 3.6	10	-	-			
12	3.2 / 3.6	11					
13	3.2 / 3.6	12	-	-			
14	3.2 / 3.6	13					
15	3.2 / 3.6	14	-	-			
16	3.2 / 3.6	15					
17	+ 0.4	15	-	-			
18	+ 0.4	15					
19	+ 0.4	15	-	-			
20	+ 0.4	15					
21	+ 0.4	15	-	-			
22	+ 0.4	15					

Threshold HR Range: _____ x .80 = Low Rx HR: _____
Threshold HR Range: _____ x .90 = High Rx HR: _____

RATE OF PERCEIVED EXERTION (RPE)

BORG RPE	MODIFIED RPE	BREATHING	TRAINING ZONE	% of MHR*	EXERCISE TYPE
6	0	No Exertion	1	50%-60%	Warm up
7		Very Light			
8	1				
9					
10	2	Deeper but comfortable breathing. Able to hold a conversation.	2	60%-70%	Recovery
11					
12	3				
13		Aware that breathing is harder; able to talk but difficult to hold conversation	3	70%-80%	Aerobic
14	4				
15	5	Starting to breathe hard and getting uncomfortable	4	80%-90%	Anaerobic
16	6				
17	7	Deep and forceful breathing. Uncomfortable and not wanting to talk	5	90-100%	$V0^2$ Max
18	8				
19	9	Extremely hard			
20	10	Maximum exertion			

* % of maximum heart rate

Typical Recommendations at Eval

- Light aerobic exercise OK 24-48 hrs after injury, only mild exacerbation of symptoms is allowed
    - Mild = 2 point increase on a 0 -10 point scale with return to baseline symptoms in less than 60 min.
- Sleep Hygiene tips
- Additional home exercises pending examination findings

Case Example

Athlete presents to PT following lifting injury 3 days ago. Complains of headaches, dizziness, brain fog, neck pain

Assessment found: Impaired near point accommodation, cervical neck range of motion

Initiated: Monocular Brock string exercises, pencil pushups, cervical isometrics and supine neck range of motion

Progressed to binocular eye stabilization, wall rolls, Buffalo Concussion treadmill test

Return to sport in 2.5 weeks

Sport Concussion Clearance Check-off

- [ ] 1. Controlled oculomotor function without corrective saccades or deviations.
- [ ] 2. Near Point Convergence (6-40 yo)
  - 6 cm (+/- 2 cm) or less
  - Brock string hold 30 sec with diplopia
- [ ] 3. Near Point Accommodation (Right and Left Eye)
  - WNL for age (See chart below)

Age	Norms in cm
10	8
11	8.16
12	8.33
13	8.5
14	8.69
15	8.88
16	9.09
17	9.3
18	9.5
19	9.75
20	10
21	10.25
22	10.52
23	10.81
24	11.11
25	11.42

Age	Norms in cm
26	11.76
27	12.12
28	12.5
29	12.9
30	13.33
31	13.79
32	14.28
33	14.81
34	15.38
35	16
36	16.66
37	17.39
38	18.18
39	19.04
40	20
41	21.05

Age	Norms in cm
42	22.22
43	23.5
44	25
45	26.67
46	28.57
47	30.77
48	33.33
49	36.36
50	40

- [ ] 4. Dynamic Visual Acuity Test
  - Computerized at least 98% accuracy
  - Snellen chart
- [ ] 5. Cervical Proprioception
  - Only if cervical pain or poor head/neck coordination (i.e. VOR, etc)
- [ ] 6. Functional Movement Screen
  - [ ] 3x Wall Rolls with a recovery of 5-6 sec or less
  - [ ] Tolerate sport specific work out with multi-level & planar movements well (ie. Burpees, Broad Jump, Running, Skipping, shuffle, rotation, etc.)
- [ ] 7. Pass Exertion Test
  - [ ] Buffalo Treadmill Test
  - [ ] Buffalo Bike Test
  - [ ] Custom
- [ ] 8. Full Return to Learn

Once all items have been checked off, please refer back to physician as needed.

Concussion Spot

Table 1 Return-to-learn (RTL) strategy

Step	Mental activity	Activity at each step	Goal
1	Daily activities that do not result in more than a mild exacerbation* of symptoms related to the current concussion	Typical activities during the day (eg, reading) while minimising screen time. Start with 5–15 min at a time and increase gradually.	Gradual return to typical activities
2	School activities	Homework, reading or other cognitive activities outside of the classroom.	Increase tolerance to cognitive work
3	Return to school part time	Gradual introduction of schoolwork. May need to start with a partial school day or with greater access to rest breaks during the day.	Increase academic activities
4	Return to school full time	Gradually progress in school activities until a full day can be tolerated without more than mild* symptom exacerbation.	Return to full academic activities and catch up on missed work

Following an initial period of relative rest (24–48 hours following an injury at Step 1), athletes can begin a gradual and incremental increase in their cognitive load. Progression through the strategy for students should be slowed when there is more than a mild and brief symptom exacerbation.
*Mild and brief exacerbation of symptoms is defined as an increase of no more than 2 points on a 0–10 point scale (with 0 representing no symptoms and 10 the worst symptoms imaginable) for less than an hour when compared with the baseline value reported prior to cognitive activity.

Table 2 Return-to-sport (RTS) strategy—each step typically takes a minimum of 24 hours

Step	Exercise strategy	Activity at each step	Goal
1	Symptom-limited activity	Daily activities that do not exacerbate symptoms (eg, walking).	Gradual reintroduction of work/school
2	Aerobic exercise **2A—Light** (up to approximately 55% maxHR) **then** **2B—Moderate** (up to approximately 70% maxHR)	Stationary cycling or walking at slow to medium pace. May start light resistance training that does not result in more than mild and brief exacerbation* of concussion symptoms.	Increase heart rate
3	Individual sport-specific exercise Note: If sport-specific training involves any risk of inadvertent head impact, medical clearance should occur prior to Step 3	Sport-specific training away from the team environment (eg, running, change of direction and/or individual training drills away from the team environment). No activities at risk of head impact.	Add movement, change of direction
Steps 4–6 should begin after the resolution of any symptoms, abnormalities in cognitive function and any other clinical findings related to the current concussion, including with and after physical exertion.			
4	Non-contact training drills	Exercise to high intensity including more challenging training drills (eg, passing drills, multiplayer training) can integrate into a team environment.	Resume usual intensity of exercise, coordination and increased thinking
5	Full contact practice	Participate in normal training activities.	Restore confidence and assess functional skills by coaching staff
6	Return to sport	Normal game play.	

*Mild and brief exacerbation of symptoms (ie, an increase of no more than 2 points on a 0–10 point scale for less than an hour when compared with the baseline value reported prior to physical activity). Athletes may begin Step 1 (ie, symptom-limited activity) within 24 hours of injury, with progression through each subsequent step typically taking a minimum of 24 hours. If more than mild exacerbation of symptoms (ie, more than 2 points on a 0–10 scale) occurs during Steps 1–3, the athlete should stop and attempt to exercise the next day. Athletes experiencing concussion-related symptoms during Steps 4–6 should return to Step 3 to establish full resolution of symptoms with exertion before engaging in at-risk activities. Written determination of readiness to RTS should be provided by an HCP before unrestricted RTS as directed by local laws and/or sporting regulations.

Clinical Pearls

- Athletes referred to Physical Therapy/Occupational Therapy and started within 3 days of injury have improved outcomes
- Typically at least 7 days for return to play following concussion
- Cervical and ocular assessment are vital to recovery
- Objective measures used by PT to assess readiness for RTP protocol

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