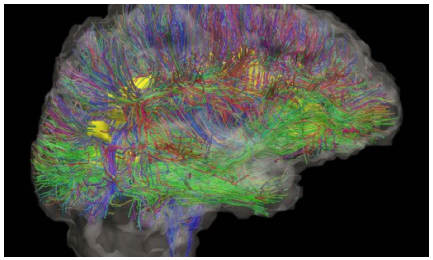
Concussion (mTBI)- Claremont HS PAC



Concussion

- Mild Traumatic brain injury caused by a direct blow to the **head, neck or body** resulting in an impulsive force being transmitted to the brain
- This initiates a neurotransmitter and metabolic cascade, with possible axonal injury, blood flow change and inflammation affecting the brain.
- Symptoms and signs may present immediately, or evolve over minutes or hours, and commonly resolve within days, but may be prolonged.

Incidence

- In 2019/20, approximately 19,000 British Columbians visited the emergency department for concussion.
- These figures likely under-report injury incidence because many either do not seek medical assessment or are seen in community-based clinics.
- In 2018, 11.0% of students in grades 6 to 10 reported a medically diagnosed concussion within the past year.
- Children aged 0-14 years have the highest rate of emergency department visits for concussion
- Concussion hospitalization rates were highest among 10-14 year olds (19.8/100,000) and second highest among teens 15-19 years (17.1/100,000).

Incidence

- Evidence suggests that children and adolescents take longer than adults to recover following a concussion.
- While most patients recover well, one in four youth and at least one in six adults have persisting symptoms (i.e., those that remain >4 weeks) and concussion-related disability
- High initial symptom severity is the strongest, most reliable predictor of persisting symptoms
- High school and amateur athletes who sustained two or more concussions exhibit greater impairment on neuropsychological and memory tests than athletes with a history of only a single concussion
- Helmets don't prevent concussions

Concussion Symptoms

Physical symptoms:
Headaches/post traumatic migraines, dizziness/vertigo, nausea, balance problems, sensitivity to light, and/or sensitivity to noise, fatigue, Autonomic nervous system dysregulation (POTS, exertional symptoms), motion sensitivity (dizziness with quicker head movements)
- Vision problems

Difficulty with reading, working on screens triggers symptoms, busy environments trigger increased symptoms

Cognitive symptoms:
feeling slowed down, "mental (brain) fog," difficulty concentrating and/or memory problems, difficulty multi-tasking, difficulty sequencing cognitive tasks

Emotional symptoms:
uncharacteristic emotional lability and/or irritability

Concussion Assessment

- No abnormality on standard structural neuro-imaging studies is typically seen in concussion (MRI, CT scans)
- Loss of consciousness (LOC) not required for a concussion to occur
- No tests and measures other than standardized and validated symptom rating scales are valid for diagnosing persisting symptoms after concussion
- So there are no reliable objective tests to determine if someone has sustained a concussion or not

Assessment

- On the field - Concussion Recognition Tool CRT6
  https://completeconcussions.com/wp-content/uploads/2023/06/Concussion-Recognition-Tool-CRT6.pdf

- <72 hours – Sport Concussion Assessment Tool (SCAT).
  See Adult SCAT6 and Child SCAT6.

- >72 hours – Sport Concussion Office Assessment Tool (SCOAT).
  See Adult SCOAT6 and Child SCOAT6

- Baseline testing using any tool or combination of tools is not required to provide post-injury care of those who sustain a suspected or diagnosed concussion and mandatory pre-season testing is not recommended[ONF, 2024]

The Concussion Recognition Tool 6 (CRT6)

Ruben J Echemendia, [1,2] Osman Hassan Ahmed, [3,4] Christopher M Bailey, [5,6] Jared M Bruce, [7] Joel S Burma, [8] Gavin A Davis, [9,10] Gerry Gioia, [11] David R Howell, [12] Gordon Ward Fuller, [13] Christina L. Master, [14] Jacqueline van Ierssel, [15] Jamie Pardini, [16,17] Kathryn J Schneider, [18,19,20] Samuel R Walton, [21] Roger Zemek, [22,23] Jon S Patricios [24]

CRT6™
Concussion Recognition Tool
To Help Identify Concussion in Children, Adolescents and Adults

What is the Concussion Recognition Tool?

A concussion is a brain injury. The Concussion Recognition Tool 6 (CRT6) is to be used by non-medically trained individuals for the identification and immediate management of suspected concussion. It is not designed to diagnose concussion.

Recognise and Remove

Red Flags: CALL AN AMBULANCE

If **ANY** of the following signs are observed or complaints are reported after an impact to the head or body the athlete should be immediately removed from play/game/activity and transported for urgent medical care by a healthcare professional (HCP):

- Neck pain or tenderness
- Seizure, 'fits', or convulsion
- Loss of vision or double vision
- Loss of consciousness
- Increased confusion or deteriorating conscious state (becoming less responsive, drowsy)
- Weakness or numbness/tingling in more than one arm or leg
- Repeated Vomiting
- Severe or increasing headache
- Increasingly restless, agitated or combative
- Visible deformity of the skull

Remember

- In all cases, the basic principles of first aid should be followed: assess danger at the scene, check airway, breathing, circulation; look for reduced awareness of surroundings or slowness or difficulty answering questions.
- Do not attempt to move the athlete (other than required for airway support) unless trained to do so.
- Do not remove helmet (if present) or other equipment.
- Assume a possible spinal cord injury in all cases of head injury.
- Athletes with known physical or developmental disabilities should have a lower threshold for removal from play.

If there are no Red Flags, identification of possible concussion should proceed as follows:

Concussion should be suspected after an impact to the head or body when the athlete seems different than usual. Such changes include the presence of **any one or more** of the following: visible clues of concussion, signs and symptoms (such as headache or unsteadiness), impaired brain function (e.g. confusion), or unusual behaviour.

CRT6™

Developed by: The Concussion in Sport Group (CISG)
Supported by:

Correspondence to Dr Ruben J Echemendia, Psychology, Psychological and Neurobehavioral Associates, Inc., Port Matilda, Pennsylvania, USA; rechemendia@comcast.net

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**:

Initial management

- no same day return to play
- Historically patients were advised to rest until asymptomatic – cognitive and physical rest
- Currently relative rest is indicated for 2 to 3 days but not longer
- Clinicians are encouraged to recommend early (after 24–48 hours) return to physical activity as tolerated (eg. walking or stationary cycling while avoiding the risk of contact, collision or fall)
- The best data on cognitive exertion show that reduced screen use in the first 48 hours after injury is warranted but may not be effective beyond that
- Patients need to start activity as tolerated (sub symptom levels of activity)
- Education of the patient and family is important
- Each patient is different so the recommendations may vary

Return to activity and play

- Multiple guidelines exist but they all generally follow the same protocols
- Example https://pedsconcussion.com/return-to-activity-sport-school/
- missing more than one week of school is not generally recommended
- General rule of return to play (not everyone agrees with this)
  – athlete needs to be symptom free for the same amount of time that they had symptoms prior to returning to contact sports
- Children and youth are managed more conservatively, return to school before return to sport is generally recommended
- The most recent Consensus Statement indicted a paucity of data with respect to children
  Patricios J. 2022

Appendix A: Return to Sport Protocol

BCGuidelines.ca

Return to Sport | This tool is a guideline for managing an individual's return to sport following a concussion and does not replace medical advice. Timelines and activities may vary based on direction from a doctor, nurse practitioner, or licensed healthcare professional with relevant training.
Begin Step 1 within 24 hours of injury, with progression through each subsequent step taking a minimum of 24 hours.

STEP 1:	STEP 2:		STEP 3:	STEP 4:	STEP 5:	STEP 6:
Activities of daily living and relative rest* • Maximum of 24-48 hours • Activities at home such as social interactions and light walking that do not result in more than mild and brief** exacerbation (worsening) of concussion symptoms. **Examples:** • Preparing meals • Housework • Light walking • Minimize screen time for first 24-48 hours following concussion.	**2A: Light effort aerobic exercise** • Up to approximately 55% of maximum heart rate (predicted according to age - i.e. 220-age). • In a safe and controlled environment, engage in light aerobic exercise. **Examples:** • Stationary cycling • Walking at slow to medium pace • Light resistance training that does not result in more than mild and brief** exacerbation (worsening) of concussion symptoms.	**2B: Moderate effort aerobic exercise** • Up to approximately 70% of maximum heart rate (predicted according to age - i.e. 220-age). • Take a break and modify activities as needed with the aim of gradually increasing tolerance and the intensity of aerobic activities.	**Individual sport-specific activities** **(that do not have a risk of inadvertent head impact)** • Addition of individual sport-specific activities that are supervised by a teacher/coach/parent. **Examples:** • Skating drills (hockey) • Running drills (soccer) • Change of direction drills • Individual gym class activities **It is important to get medical clearance before returning to training that involves any risk of inadvertent head impact.**	**Non-contact training drills and activities** • Progress to exercises at high intensity, including more challenging drills and activities. **Examples:** • Passing drills • Multi-player training • Supervised non-contact gym class activities • Practices without body contact	**Return to all non-competitive activities** • Return to all non-competitive activities, all gym class activities, and full-contact practices • Participate in higher-risk activities including normal training activities, all school gym-class activities, and full-contact sports practices and scrimmages. Avoid competitive gameplay.	**Return to sport** Back to normal, unrestricted competitive game play, school gym class, and physical activities. **Note: Returning to full contact, competitive play or high-risk activities before you have recovered increases the risk of delayed recovery and for sustaining another more severe concussion or serious injury.**
Activities of daily living, as tolerated	**Increase heart rate**		**Increase intensity of aerobic activities and introduce low-risk sport-specific movements and changing of directions**	**Resume usual intensity of exercise, coordination, and activity-related cognitive skills**	**Return to activities that have a risk of falling or body contact, restore game-play confidence, and have coaches assess functional skills.**	
After a maximum of 24-48 hours after injury, **BEGIN STEP 2**	If can tolerate moderate aerobic exercise, **BEGIN STEP 3**		If medically cleared and have fully returned to school, **BEGIN STEP 4**	If can tolerate usual intensity of activities, **BEGIN STEP 5**	If can tolerate non-competitive, high-risk activities, **BEGIN STEP 6**	

Medical determination of readiness to return to at-risk activities should occur prior to returning to any activities that pose risk of contact, collision, or fall.

If more than mild exacerbation (worsening) of symptoms (i.e., more than 2 points on a 0-10 scale***) occurs during Steps 1-3, stop the activity, and attempt to exercise the next day. Individuals experiencing concussion 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 medical clearance should be provided before unrestricted Return to Sport as directed by local laws and/or sporting regulations.

*Relative rest: activities of daily living including walking and other light physical and cognitive activities are permitted as tolerated.
Mild exacerbation (worsening) of symptoms: No more than a 2-point increase when compared with the pre-activity value on a 0-10-point symptom severity scale.* "Brief" exacerbation of symptoms: Worsening of symptoms for up to 1 hour.
***0-10 point symptom severity scale: Please see the Visual Analog Scale for an example of a 0-10 symptom severity scale.

www.cattonline.com

Adapted from: Zemek, R., Reed, N., Dawson, J., et al . "Living Guideline for Pediatric Concussion Care." www.pedsconcussion.com (*the PedsConcussion protocol was modified with permission from the Amsterdam International Consensus Statement on Concussion in Sport*)

CATT | CONCUSSION AWARENESS TRAINING TOOL
BC INJURY research and prevention unit
www.injuryresearch.bc.ca

PedsConcussion
Living Guideline for Pediatric Concussion Care

Living Guideline Return to Activity/Sport Protocol

Step	Activity	Examples of activities
1	**Activities of daily living and relative rest*** (Maximum of 24-48 hours)	Activities at home such as social interactions and light walking that do not result in more than mild and brief** exacerbation (worsening) of concussion symptoms. Minimize screentime.
2	**Aerobic exercise** **Step 2A:** Light effort (up to approx 55% of maximum heart rate) **Step 2B:** Moderate effort (up to approx 70% of maximum heart rate)	Start with stationary cycling or walking at slow to medium pace. Take a break and modify activities as needed with the aim of gradually increasing tolerance and the intensity of aerobic activities. Light resistance training that does not result in more than mild and brief** exacerbation (worsening) of concussion symptoms. **Goal: increase the heart rate.**
3	**Individual sport-specific activities that do not have a risk of inadvertent head impact**	Sport-specific training away from the team sport environment (e.g., running, change of direction, and/or individual training drills and individual gym class activities that do not have a risk of head impact and are supervised by a teacher or coach). **Goal: Increase the intensity of aerobic activities and introduce low-risk sport-specific movements and changing of directions.**
Medical clearance and a full return to school are required to progress to Step 4		
4	**Non-contact training drills and activities**	Exercise to high intensity including more challenging training drills and activities (e.g., passing drills, multiplayer training, high-intensity exercises, supervised non-contact gym class activities, and practices without body contact). **Goal: Resume usual intensity of exercise, coordination, and activity-related cognitive skills**
5	**Return to all non-competitive activities, all gym class activities, and full-contact practices**	Participate in higher-risk activities including normal training activities, all school gym-class activities, and full-contact sports practices and scrimmages. Avoid competitive gameplay. **Goal: return to activities that have a risk of falling or body contact, restore game-play confidence, and have coaches assess functional skills.**
6	**Return to sport**	Normal, unrestricted competitive gameplay, school gym class, and physical activities

This return-to-activity/sport table was modified with permission from the Amsterdam International Consensus Statement on Concussion in Sport)

Instructions:

Begin Step 1 (i.e., relative rest) within 24 hours of injury, with progression through each subsequent step taking a minimum of 24 hours. If more than mild exacerbation (worsening) of symptoms (i.e., more than 2 points on a 0-10 scale***) occurs during Steps 1-3, stop the activity and attempt to exercise the next day. People 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 medical clearance should be provided before unrestricted Return to Sport as directed by local laws and/or sporting regulations.

Definitions:

- *Relative rest: activities of daily living including walking and other light physical and cognitive activities are permitted as tolerated.
- **Mild exacerbation (worsening) of symptoms: No more than a 2-point increase when compared with the pre-activity value on a 0-10-point symptom severity scale***. "Brief" exacerbation of symptoms: Worsening of symptoms for up to 1 hour.
- ***0-10 point symptom severity scale: Please see the Visual analog scale for an example of a 0-10 symptom severity scale.

These definitions were harmonized with and modified with permission from the Amsterdam International Consensus Statement on Concussion in Sport)

www.pedsconcussion.com Date Updated: Sept 2023

PedsConcussion
Living Guideline for Pediatric Concussion Care

Living Guideline Return to School/Learn Protocol

Step	Activity	Examples of activities
1	**Activities of daily living and relative rest*** (Maximum of 24-48 hours)	Activities at home such as social interactions and light walking that do not result in more than mild and brief** exacerbation (worsening) of concussion symptoms. Minimize screentime.
2	**School activities with encouragement to return to school as soon as possible (as tolerated)**	Reading or other cognitive activities at school or at home. Goal: Increase tolerance to cognitive work, and connect socially with peers. Take breaks and adapt activities if concussion symptom exacerbation (worsening) is more than mild and brief**. **Clearance from your doctor is not required to return to low-risk in-person or at-home school activities.** **A complete absence from the school environment for more than one week is not generally recommended.**
3	**Part-time or full days at school with academic accommodations if needed**	Gradual reintroduction of school work. May require partial school days with access to breaks throughout the day, or with academic accommodations to tolerate the classroom or school environment. Gradually reduce accommodations and increase workload until full days without concussion-related accommodations are tolerated.
4	**Return to school full-time.** No academic accommodations (related to concussion)	Return to full days at school and academic activities without requiring concussion-related accommodations. **Medical clearance is NOT required to return to school.**

Date Updated: Sept 2023

Instructions:

Students should begin a gradual increase in their cognitive load with the goal of minimizing time away from the school environment. The return to school should not be restricted if the student is tolerating full days. Progression through the strategy may be slowed when there is more than a mild and brief symptom exacerbation**; however, missing more than one week of school is not generally recommended.

Definitions:

- *Relative rest: activities of daily living including walking and other light physical and cognitive activities are permitted as tolerated.
- **Mild exacerbation (worsening) of symptoms: No more than a 2-point increase when compared with the pre-activity value on a 0-10-point symptom severity scale***. "Brief" exacerbation of symptoms: Worsening of symptoms for up to 1 hour.
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These definitions and instructions were harmonized with and modified with permission from the Amsterdam International Consensus Statement on Concussion in Sport)

PedsConcussion
Living Guideline for Pediatric Concussion Care
www.pedsconcussion.com

Return to activity and play

- Historically it has been suggested that 80-90% of concussed patients recover spontaneously within 7-10 days
- Some studies indicate resolution of symptoms within 3 months, 6 months etc.
- The remaining 10% to 20% develop what is now termed Persistent Post-Concussive Symptoms (PPCS)
- A recent study indicated that whilst clinicians predicted 90% would fully recover by 6 months, only 50% achieved full functional and symptomatic recovery Korley FK, 2019
- Study in 2017 indicated "While duly noting the limitations of our scoping review and the addressed studies, our findings suggest that this number is likely a gross underestimation at least in relation to cognitive impairment" McInnes, 2017

Diagnostic Criteria for Persistent Post-Concussive Symptoms (PPCS)

- Symptoms in **3 or more** of the following categories:

  - Fatigue
  - Disordered sleep
  - Headache
  - Dizziness (occasionally vertigo)
  - Irritability or aggression with little or no provocation
  - Anxiety, depression or affective instability
  - Changes in personality
  - Apathy or lack of spontaneity

Other common complaints in PPCS

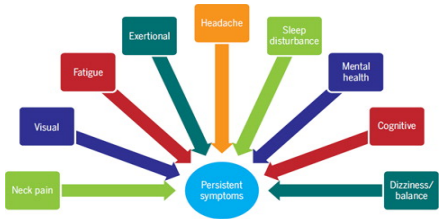
- Photophobia
- Noise sensitivity
- Word finding difficulties
- Trouble in busy environments
- Difficulty following conversation with several people
- Difficulty initiating tasks
- Perseverating on tasks

Concussion

- Dizziness is a frequent symptom (23% to 81% of cases) in the early days - typically the second most common complaint after headache Lau, 2009
- If a person initially presents with dizziness following a head injury, it may be a predictor of a protracted recovery Lau, 2009
- Individuals with mild or moderate TBI and dizziness had a higher incidence of depression and anxiety and were also less likely to return to work Chamelian, 2004
- There is evidence that after the acute stage of recovery, rehabilitation strategies for balance and dizziness symptoms may be of benefit Schneider 2014

Assessment & Treatment of PPCS

- Generally think of the following domains
- Vestibular system
- Vision system
- Somatosensory system (primarily the neck)
- Autonomic nervous system
- Central Nervous System (sensory processing)
- Mental health



- Sport-Related Concussion: Optimizing Treatment Through Evidence-Informed Practice K. Schneider,2016

Amsterdam 2022 Consensus statement
Consensus statement on concussion in sport: the 6th International Conference on Concussion in Sport Patricios J, 2022

- If dizziness, neck pain and/or headaches persist for more than 10 days, cervico-vestibular rehabilitation is recommended.
- If symptoms persist beyond 4 weeks in children and adolescents, active rehabilitation and collaborative care may be of benefit.
- For children, adolescents and adults with dizziness/balance problems, either vestibular rehabilitation or cervico-vestibular rehabilitation may be of benefit.
- The inclusion of sub-symptom threshold aerobic exercise in combination with other treatments should be considered.

Sub-Symptom Threshold exercise training SSTET[Leddy, J 2010]

- concussed athletes may have exaggerated or dysregulated ANS activity, increased HR & disturbed cerebral auto-regulation and blood flow (Autonomic Nervous System Dysautonia)
- Postural Orthostatic Tachycardia Syndrome (POTS) may be present
- Prolonged rest has negative physiological consequences while SSTET may normalize the physiological impairments
- Leddy, J. found significantly improved physiological function measures & PCS symptoms over baseline vs control
- moderate intensity exercise vs high intensity associated with better prognosis – exercise individuals at 80% of the HR that provokes symptoms, daily up to 20 to 30 minutes
- Increase duration of the exercises before intensity
- In this recent study, a 12 week aerobic ex program proved beneficial[Mercier L, 2024]

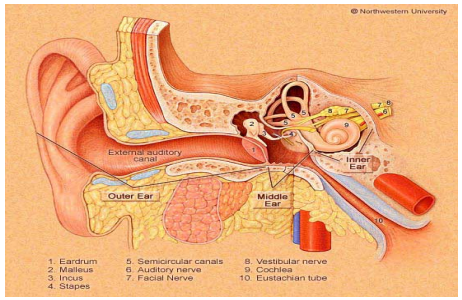
Vestibular System Assessment

- **Benign Paroxysmal Positional Vertigo (**BPPV)

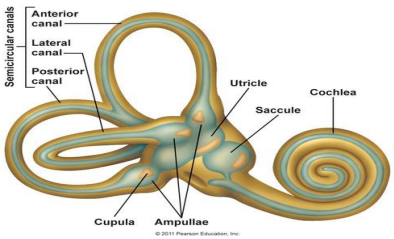
Dix-Hallpike test
Head Roll test
Side Lying test
Treatment - Particle repositioning maneuvers

Vestibular Rehabilitation
Vestibulo-Ocular Reflex (VOR)
Head Impulse test
Infrared camera systems to assess for vestibular system impairment
Motion sensitivity testing
Balance and postural control testing
Treatment - Exercise based programming

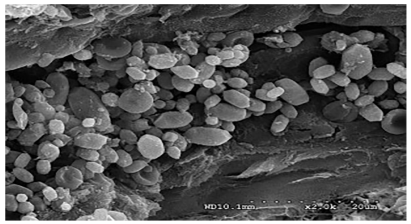
Peripheral Vestibular System



Membranous Labyrinth

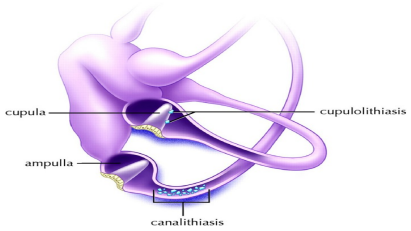


Otoconia - human

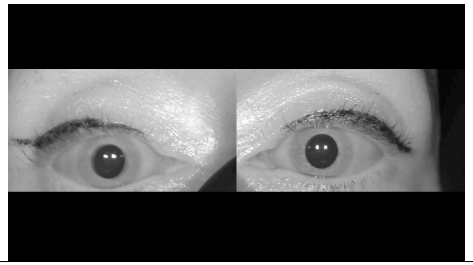


Benign Paroxysmal Positional Vertigo (BPPV)

BPPV Cupulolithiasis & Canalithiasis



BPPV Nystagmus Right PSCC



Right Epley Maneuver