



# Head-Injuries Annual Update

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Helping athletes achieve their maximum performance naturally

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## Objectives:



Concussion Definition

Head Injury Pathophysiology

SCAT6

SCOAT6

Return-to-Learn and Return-to-Sport

Reduce, Reconsider, Retire



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## Concussion Occurrences

(Eliason et al, 2023; Schneider et al, 2023)



- Concussion is among the most commonly occurring injuries in sport
- Globally, there is a **one in five lifetime risk** of concussion.
- An estimated 3 million people (50% children and adolescents) sustain a concussion in North America annually
  - **30% are recurrent**
  - **30% remain symptomatic for more than 1 month.**
- SRC reportedly accounts for 36%–60% of concussions in children and adolescents.
- In Canada, one in nine adolescents sustain a concussion annually.



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## Current Concussion Definition

(Patricios et al, 2023a)

- In preparation for the Amsterdam International Consensus Conference on Concussion in Sport, the Scientific Committee considered that the Berlin definition required modification to align with more recent scientific evidence relating to advances in our understanding of SRC pathophysiology
- The conceptual definition, accepted as a majority decision (78.6%) but not reaching an 80% consensus, is:



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## Current Concussion Definition

(Patricios et al, 2023a)

“Sport-related concussion is a traumatic brain injury caused by a direct blow to the head, neck or body resulting in an impulsive force being transmitted to the brain that occurs in sports and exercise-related activities. 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. No abnormality is seen on standard structural neuroimaging studies (computed tomography or magnetic resonance imaging T1- and T2-weighted images), but in the research setting, abnormalities may be present on functional, blood flow or metabolic imaging studies. Sport-related concussion results in a range of clinical symptoms and signs that may or may not involve loss of consciousness. The clinical symptoms and signs of concussion cannot be explained solely by (but may occur concomitantly with) drug, alcohol, or medication use, other injuries (such as cervical injuries, peripheral vestibular dysfunction) or other comorbidities (such as psychological factors or coexisting medical conditions).”



References: 7, 8, 14, 16 WEH THEIR OPTIMAL PERFORMANCE NATURALLY

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## Concussion vs. mTBI

(Davis et al, 2023)

- Sport-related concussion (SRC) has long-endured the **absence of a universally accepted definition**, complicated by different terminology such as ‘concussion’ and ‘mild traumatic brain injury’ (mTBI)
- Concurrently, while the CISG prepared for the 6th International Conference on Concussion in Sport, between 2018 and 2022, the Mild Traumatic Brain Injury Task Force of the American Congress of Rehabilitation Medicine (ACRM) Brain Injury Special Interest Group undertook an update of the 1993 ACRM definition for mTBI.

CISG definition <sup>7</sup>	*ACRM diagnostic criteria <sup>8</sup>
<p>Sport-related concussion is a traumatic brain injury caused by a direct blow to the head, neck or body resulting in an impulsive force being transmitted to the brain that occurs in sports and exercise-related activities. 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.</p> <p>No abnormality is seen on standard structural neuroimaging studies (CT or MRI T1-weighted and T2-weighted images), but in the research setting, abnormalities may be present on functional, blood flow or metabolic imaging studies. Sport-related concussion results in a range of clinical symptoms and signs that may or may not involve loss of consciousness. The clinical symptoms and signs of concussion cannot be explained solely by (but may occur concomitantly with) drug, alcohol or medication use, other injuries (such as cervical injuries, peripheral vestibular dysfunction) or other comorbidities (such as psychological factors or coexisting medical conditions).</p>	<p>Mild traumatic brain injury (mTBI) is diagnosed when, following a biomechanically plausible mechanism of injury (criterion 1) one or more of the criteria listed below are met.</p> <ol style="list-style-type: none"> <li>One or more clinical signs (criterion 2) attributable to brain injury.</li> <li>At least two acute symptoms (criterion 3) and at least one clinical examination or laboratory finding (criterion 4) attributable to brain injury.</li> <li>Neuroimaging evidence of TBI, such as unambiguous trauma-related intracranial abnormalities on CT or structural magnetic resonance imaging (criterion 5).<sup>§</sup></li> </ol> <p>Confounding factors do not fully account for the clinical signs, acute symptoms, and clinical and laboratory findings that are necessary for the diagnosis (criterion 6).</p> <p>Suspected Mild TBI: A mild TBI is suspected when, following a biomechanically plausible mechanism of injury (criterion 1), one or more of the three criteria listed below are met.</p> <ol style="list-style-type: none"> <li>At least two acute symptoms (criterion 3) and the person does not meet other criteria sufficient for diagnosing mild TBI.</li> <li>At least two clinical examination or laboratory findings (criterion 4) but the person does not meet other criteria sufficient for diagnosing mild TBI.</li> <li>It is unclear whether signs (criterion 2), acute symptoms (criterion 3), and available clinical examination or laboratory findings (criterion 4) are accounted for by confounding factors (ie, it is unclear if criterion 5 is met).</li> </ol>



WEH \*Adapted with permission from ACRM. Definitions and explanatory notes are described in detail in the ACRM diagnostic criteria paper.<sup>6</sup>  
<sup>7</sup>Loss of consciousness, alteration of mental status, complete or partial amnesia for events immediately following the injury, other acute neurological signs).  
<sup>8</sup>Cognitive, balance or oculomotor impairment on acute clinical examination; elevated blood biomarker(s) indicative of intracranial injury.  
<sup>§</sup>With Glasgow Coma Score 13–15. For further details, including definitions, explanatory notes and qualifiers, see the ACRM diagnostic criteria paper.<sup>8</sup>  
 ACRM, American Congress of Rehabilitation Medicine; CISG, Concussion in Sport Group.

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## Concussion vs. mTBI

(Davis et al, 2023)

- Only 16/28 (57.1%) of the expert panel voted to incorporate the ACRM diagnostic criteria directly into the CISG consensus statement (consensus agreement defined a priori as  $\geq 80\%$ ).
- **A point of divergence was the scenario where an athlete with a biomechanically plausible mechanism of injury presents with acute symptoms of SRC but no clinical signs.**
  - It was recognised by the CISG expert panel that in this situation the ACRM diagnostic criteria classified the athlete with a 'suspected mTBI'.
- However, **the CISG has consistently maintained that clinical signs of concussion may frequently be absent, and that in such cases, the diagnosis of SRC can be established by the presence of symptoms alone.**



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## Concussion Pathophysiology (Patricios et al, 2023a; Giza et al, 2017)

A direct blow to the head, neck or body results 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



No abnormality is seen on standard structural neuroimaging studies, but in the research setting, abnormalities may be present on functional, blood flow or metabolic imaging studies.



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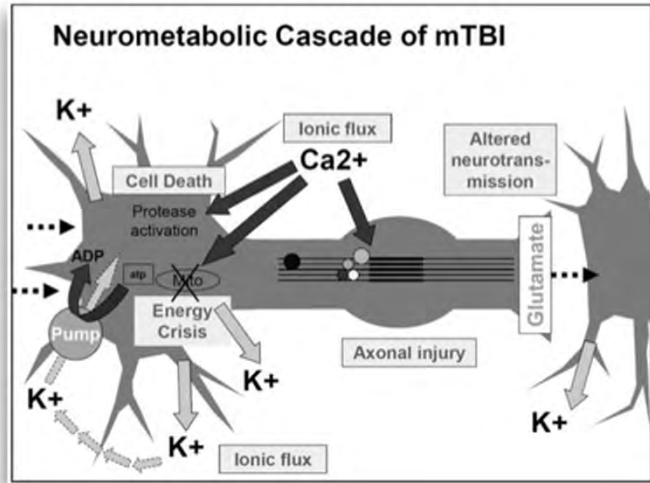
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# Neurometabolic Cascade of Concussion

(Giza & Hovda, 2014)

1. Ionic Flux and Glutamate Release
2. Energy Crisis
3. Cytoskeletal Damage
4. Axonal Dysfunction
5. Altered Neurotransmission
6. Inflammation
7. Cell Death



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# Neurometabolic Cascade of Concussion

(Giza & Hovda, 2014)

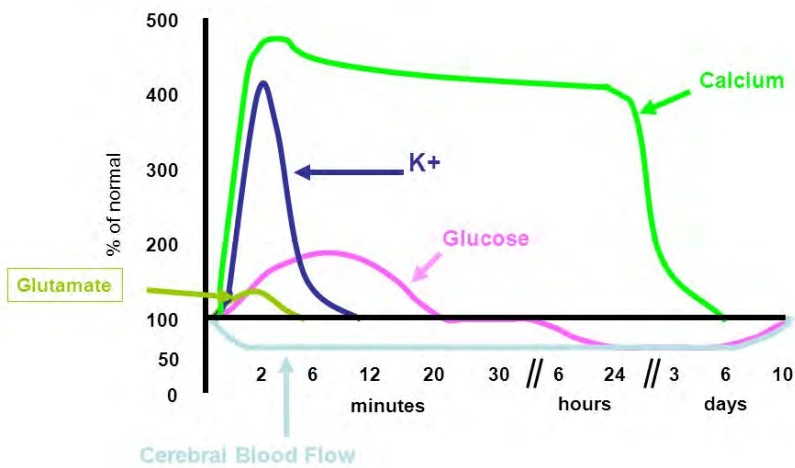


Image taken from: <https://slideplayer.com/slide/6990331/>



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## Associated Signs and Symptoms

- Most Common Symptoms:
  - Headache
  - Dizziness
- 22 Possible Symptoms
- SCAT6 Office or Off-Field Assessment
  - Step 2: Symptom Evaluation
  - Aka, Post Concussion Symptom Scale

Symptom	Rating
Headaches	0 1 2 3 4 5 6
Pressure in head	0 1 2 3 4 5 6
Neck pain	0 1 2 3 4 5 6
Nausea or vomiting	0 1 2 3 4 5 6
Dizziness	0 1 2 3 4 5 6
Blurred vision	0 1 2 3 4 5 6
Balance problems	0 1 2 3 4 5 6
Sensitivity to light	0 1 2 3 4 5 6
Sensitivity to noise	0 1 2 3 4 5 6
Feeling slowed down	0 1 2 3 4 5 6
Feeling like "in a fog"	0 1 2 3 4 5 6
"Don't feel right"	0 1 2 3 4 5 6
Difficulty concentrating	0 1 2 3 4 5 6
Difficulty remembering	0 1 2 3 4 5 6
Fatigue or low energy	0 1 2 3 4 5 6
Confusion	0 1 2 3 4 5 6
Drowsiness	0 1 2 3 4 5 6
More emotional	0 1 2 3 4 5 6
Irritability	0 1 2 3 4 5 6
Sadness	0 1 2 3 4 5 6
Nervous or anxious	0 1 2 3 4 5 6
Trouble falling asleep (if applicable)	0 1 2 3 4 5 6



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Clinicians and athletes can expect a minimum of 1 week to complete the full rehabilitation strategy, **but typical unrestricted RTS can take up to 1 month post-SRC**. The time frame for RTS may vary based on individual characteristics, necessitating an individualised approach to clinical management. (Patricios et al, 2023a)

- Up to 30% of adolescents experience persisting postconcussive symptoms (PPCS) beyond 1 month (Leddy et al, 2023)



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(Patricios et al, 2023a)

- The Amsterdam expert consensus specific recommendations include the use of the term **'persisting symptoms'** to be used for symptoms that persist > 4 weeks across all age groups (children, adolescents and adults)

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(Patricios et al, 2023a)

- Symptoms attributed to concussion are non-specific, commonly also reported by healthy individuals and those with conditions other than concussion, and can be exacerbated by a variety of biopsychosocial factors aside from concussion, which should be assessed in the context of persisting symptoms.
- Other problems may exist prior to injury (but can be exacerbated by a concussion), co-occur with persisting symptoms or mimic persisting symptoms but do not arise from concussion.


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(Patricios et al, 2023a)

- **A multimodal clinical assessment**, is indicated to characterise individuals with persisting symptoms, including the types, pattern and severity of symptoms, and any associated conditions or other factors that may be causing or contributing to the symptoms.
  - mental health issues;
  - learning or attention difficulties;
  - visual, oculo-motor, cervical and vestibular problems;
  - headache disorders and migraine;
  - sleep disturbance;
  - dysautonomia, including orthostatic intolerance and postural orthostatic tachycardia syndrome;
  - pain.

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SCAT6

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# “On-Field” Assessment (Echemendia et al, 2023)

## SCAT6: Sport Concussion Assessment Tool 6

- Endorsed and created by the 6<sup>th</sup> International Concussion Symposium
- **Cannot be performed correctly in < 10-15 mins**
- Intended to be used in the acute phase
  - **Ideally within 72 hours and up to 7 days**
- If >7 days post-injury, use the SCAT6



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# “On-Field” Assessment (Davis et al, 2023)

## Child SCAT6

- Endorsed and created by the 6<sup>th</sup> International Concussion Symposium
- For Children ages 8-12 years
- **Cannot be performed correctly in < 10-15 mins**
- Intended to be used in the acute phase
  - **Ideally within 72 hours and up to 7 days**



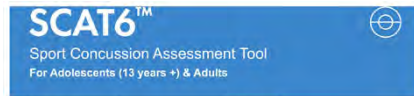
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# SCAT6

(Echemendia et al, 2023)

- Free evidence based tool for use by Health Care Professionals (HCPs)
- Cannot be performed correctly in < 10-15 mins
- Intended to be used in the acute phase
- **The diagnosis of concussion is a clinical determination made by a HCP**
- **The SCAT6 should NOT be used by itself to make, or exclude, the diagnosis of concussion**
  - It is important to note that an athlete may have a concussion even if their SCAT6 assessment is WNL



**What is the SCAT6?**  
The SCAT6 is a standardized tool for evaluating concussions designed for use by Health Care Professionals (HCPs). The SCAT6 cannot be performed correctly in less than 10-15 minutes. Except for the symptoms scale, the SCAT6 is intended to be used in the acute phase, ideally within 72 hours (2 days) and up to 7 days following injury. If greater than 7 days post-injury, consider using the SCAT6/SCAT5.

**Key Points**  
Any athlete with suspected concussion should be REMOVED FROM PLAY, medically assessed, and monitored for injury-related signs and symptoms, including deterioration of these clinical features.  
No athlete diagnosed with concussion should return to play on the day of injury.  
In an athlete suspected of having a concussion, until medical personnel are not immediately available, the athlete should be removed or transported if needed to a medical facility for assessment.  
Athletes with suspected or diagnosed concussion should not take medications such as aspirin or other anti-inflammatories, acetaminophen or naproxen, drink alcohol or use recreational drugs, and should not drive a motor vehicle until cleared to do so by a medical professional.  
Concussion signs and symptoms may evolve over time, it is important to monitor the athlete for ongoing, worsening, or the development of additional concussion-related symptoms.  
The diagnosis of concussion is a clinical determination made by an HCP.  
The SCAT6 should NOT be used by itself to make, or exclude, the diagnosis of concussion. It is important to note that an athlete may have a concussion even if their SCAT6 assessment is within normal limits.

**Recognise and Remove**  
A head impact by either a direct blow or indirect transmission of force to the head can be associated with serious and potentially life-threatening injuries. If there are significant concerns, which may include any of the Red Flags listed in box 1, the athlete requires urgent medical attention, and if a qualified medical professional is not available for immediate assessment, then activation of emergency procedures and urgent transport to the nearest hospital or medical facility should be arranged.

**Completion Guide**  
Please: Document part of assessment

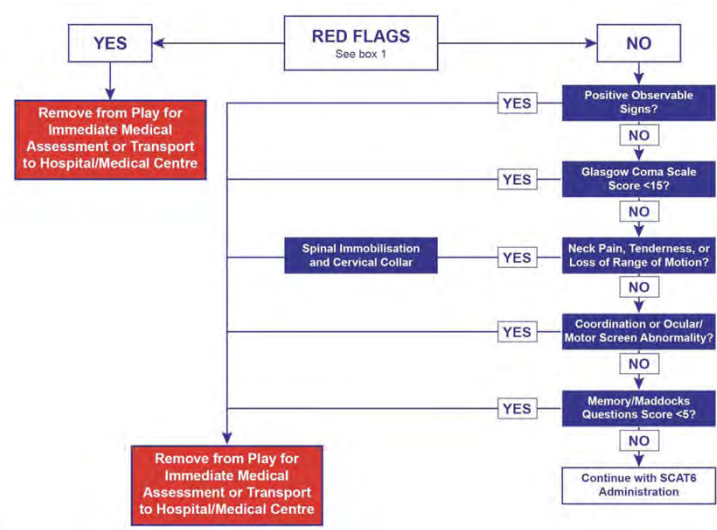


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## Immediate Assessment/Neuro Screen

(Echemendia et al, 2023)



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## Box 1: RED FLAGS (Echemendia et al, 2023)

- Neck pain or tenderness
- Seizure or convulsion
- Double vision
- Loss of consciousness
- Weakness or tingling/burning in more than 1 arm or in the legs
- Deteriorating conscious state
- Vomiting
- Severe or increasing headache
- Increasingly restless, agitated or combative
- GCS <15
- Visible deformity of the skull



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Image taken from: <https://www.flickr.com/photos/virtualsugar/4084734655>

## Step 1: Observable Signs (Echemendia et al, 2023)

	Witnessed <input type="checkbox"/>	Observed on Video <input type="checkbox"/>
Lying motionless on playing surface	Y	N
Falling unprotected to the surface	Y	N
Balance/gait difficulties, motor incoordination, ataxia: stumbling, slow/laboured movements	Y	N
Disorientation or confusion, staring or limited responsiveness, or an inability to respond appropriately to questions	Y	N
Blank or vacant look	Y	N
Facial injury after head trauma	Y	N
Impact seizure	Y	N
High-risk mechanism of injury (sport-dependent)	Y	N



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## Step 2: Glasgow Coma Scale


(Echemendia et al, 2023)

Typically, GCS is assessed once. Additional scoring columns are provided for monitoring over time, if needed.


Time of Assessment: \_\_\_\_\_

Date of Assessment: \_\_\_\_\_

Best Eye Response (E)			
No eye opening	1	1	1
Eye opening to pain	2	2	2
Eye opening to speech	3	3	3
Eyes opening spontaneously	4	4	4
Best Verbal Response (V)			
No verbal response	1	1	1
Incomprehensible sounds	2	2	2
Inappropriate words	3	3	3
Confused	4	4	4
Oriented	5	5	5
Best Motor Response (M)			
No motor response	1	1	1
Extension to pain	2	2	2
Abnormal flexion to pain	3	3	3
Flexion/withdrawal to pain	4	4	4
Localized to pain	5	5	5
Obeys commands	6	6	6
<b>Glasgow Coma Score (E + V + M)</b>			



Video taken from:  
<https://www.ems1.com/ems-products/education/videos/how-to-perform-the-glasgow-coma-scale-assessment-GyRQfuXVold6HIYe/>



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## Step 3: Cervical Spine Assessment

(Echemendia et al, 2023)

In a patient who is not lucid or fully conscious, a cervical spine injury should be assumed and spinal precautions taken.

<b>Does the athlete report neck pain at rest?</b>	Y	N
<b>Is there tenderness to palpation?</b>	Y	N
<b>If NO neck pain and NO tenderness, does the athlete have a full range of ACTIVE pain free movement?</b>	Y	N
<b>Are limb strength and sensation normal?</b>	Y	N



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## Step 4: Coordination & Ocular/Motor Screen

(Echemendia et al, 2023)

<b>Coordination: Is finger-to-nose normal for both hands with eyes open and closed?</b>	Y	N
<b>Ocular/Motor: Without moving their head or neck, can the patient look side-to-side and up-and-down without double vision?</b>	Y	N
<b>Are observed extraocular eye movements normal? If not, describe:</b>	Y	N



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## Step 5: Maddocks Questions

(Echemendia et al, 2023)

- Memory assessment
- *"I am going to ask you a few questions, please listen carefully and give your best effort. First, tell me what happened?"*
- **Note:** Appropriate sport-specific questions may be substituted



Image taken from:

<https://thenewdaily.com.au/sport/sport-focus/2017/07/28/concussion-tests/>



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## Imaging (Echemendia et al, 2023)



No abnormality is seen on standard structural neuroimaging studies (computed tomography or magnetic resonance imaging T1- and T2-weighted images)



In the research setting, abnormalities may be present on functional, blood flow or metabolic imaging studies.



Should be utilized to exclude any red flag symptoms but should not be used in all patients who present with head trauma.

## Indications for Imaging (Stiell et al, 2001; Stiell et al, 2002)

Acute- The Canadian Cervical Spine	Acute - Canadian CT Head Rule	Delayed symptomatology
<ul style="list-style-type: none"> <li>• <u>High Risk Factors Present?</u> <ol style="list-style-type: none"> <li>1. Age &gt; 65</li> <li>2. Dangerous Mechanism of Injury (i.e. fall &gt; 1m or 5 stairs, axial load to head, high-speed motor vehicle accident, motorized recreational vehicle, bicycle collision)</li> <li>3. Paresthesias in extremities</li> </ol> </li> <li>• <u>Low Risk Factors that allow safe assessment of range of motion?</u> <ol style="list-style-type: none"> <li>1. Simple rear-end motor accident</li> <li>2. Normal sitting posture in emergency department</li> <li>3. Ambulatory at any time since injury</li> <li>4. Delayed onset of neck pain and absence of midline tenderness</li> </ol> </li> <li>• <u>Is the patient able to actively rotate the neck &gt; 45 degrees to the right and the left?</u></li> </ul>	<ul style="list-style-type: none"> <li>• GCS score &lt;15 at 2 h after injury</li> <li>• Suspected open or depressed skull fracture</li> <li>• Any sign of basal skull fracture (haemotympanum, 'raccoon' eyes, Cerebrospinal fluid otorrhoea/rhinorrhoea, Battle's sign)</li> <li>• Vomiting two episodes</li> <li>• Age 65 years</li> <li>• Medium risk (for brain injury on CT)</li> <li>• Amnesia before impact &gt;30 min</li> <li>• Dangerous mechanism (pedestrian struck by motor vehicle,</li> <li>• Occupant ejected from motor vehicle, fall from height &gt;3 feet or five stairs)</li> <li>• Minor head injury is defined as witnessed loss of consciousness, definite</li> <li>• amnesia, or witnessed disorientation in a patients with a GCS score of 13–15.</li> </ul>	<ul style="list-style-type: none"> <li>• Advanced imaging is suggesting the brain is physiologically not recovering for &gt;30 days (one recent paper suggesting 45 days)</li> </ul>

# Off-Field Assessment

(Patricios et al, 2023a)

- The recognition of concussion is the first step to initiating the management of SRC.
- **Removal of a player from the field of play should be done if there is suspicion of a possible concussion** to avoid further potential injury.
  - This may be based on a player's symptoms or signs observed by other players, medical staff or officials (on the field or video).
- **Signs that warrant immediate removal from the field include actual or suspected loss of consciousness, seizure, tonic posturing, ataxia, poor balance, confusion, behavioural changes and amnesia.**
- **Maddocks' questions** remain part of a useful and brief on-field screen for athletes >12 years of age without clear on-field signs of a concussion
  - incorrect answers warrant a more comprehensive off-field evaluation as does any clinical suspicion of concussion.
- Symptoms and signs of a concussion may evolve over minutes, hours or days. **Whether acute concussion is suspected or confirmed, the player should be serially re-evaluated in the coming hours and days**



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# Off-Field Assessment

(Echemendia et al, 2023)

Sport Concussion Assessment Tool 6 - SCAT6™  
**Off-Field Assessment**  
 Please note that the cognitive assessment should be done in a distraction-free environment with the athlete in a resting state after completion of the Immediate Assessment/Neuro Screen.

**Step 1: Athlete Background**

Has the athlete ever been:

Hospitalised for head injury? (if yes, describe below)	Y N	Diagnosed with attention deficit hyperactivity disorder (ADHD)?	Y N
Diagnosed/treated for headache disorder or migraine?	Y N	Diagnosed with depression, anxiety, or other psychological disorder?	Y N
Diagnosed with a learning disability/dyslexia?	Y N		

Notes: \_\_\_\_\_  
 Current medications? If yes, please list: \_\_\_\_\_

**Step 2: Symptom Evaluation**

Baseline:  Suspected/Post-injury:  Time elapsed since suspected injury: \_\_\_\_\_ min/hours/days

The athlete will complete the symptom scale (below) after you provide instructions. Please note that the instructions are different for baseline versus suspected/post-injury evaluations.

Baseline: Say "Please rate your symptoms below based on how you usually feel with '1' representing a very mild symptom and '5' representing a severe symptom."

Post-injury: Say "Please rate your symptoms below based on how you feel now with '1' representing a very mild symptom and '5' representing a severe symptom."

PLEASE HAND THE FORM TO THE ATHLETE

Symptom	Rating	
Headaches	0 1 2 3 4 5 6	Do your symptoms get worse with physical activity? Y N
Pressure in head	0 1 2 3 4 5 6	Do your symptoms get worse with mental activity? Y N
Nausea/vomiting	0 1 2 3 4 5 6	If 100% in feeling perfectly normal, what percent of normal do you feel?
Dizziness	0 1 2 3 4 5 6	If not 100%, why?          
Blurred vision	0 1 2 3 4 5 6	
Balance problems	0 1 2 3 4 5 6	
Sensitivity to light	0 1 2 3 4 5 6	
Sensitivity to noise	0 1 2 3 4 5 6	
Floating/dazed state	0 1 2 3 4 5 6	
Feeling like "in a fog"	0 1 2 3 4 5 6	
"Don't feel right"	0 1 2 3 4 5 6	
Difficulty concentrating	0 1 2 3 4 5 6	
Difficulty remembering	0 1 2 3 4 5 6	
Fatigue or low energy	0 1 2 3 4 5 6	
Confusion	0 1 2 3 4 5 6	
Drowsiness	0 1 2 3 4 5 6	
Weakness	0 1 2 3 4 5 6	
Instability	0 1 2 3 4 5 6	
Sleepiness	0 1 2 3 4 5 6	
Nervous or anxious	0 1 2 3 4 5 6	
Trouble feeling asked (if applicable)	0 1 2 3 4 5 6	

PLEASE HAND THE FORM BACK TO THE EXAMINER

Check the athlete has completed marking all symptom items. It may be useful for the clinician to recall items that were endorsed positively to gather more detail about each symptom.

Total number of symptoms: \_\_\_\_\_ of 22      Symptom severity scores: \_\_\_\_\_ of 132

- The cognitive assessment should be done in a distraction-free environment with the athlete in a resting state after completion of the Immediate Assessment/Neuro Screen
- Step 1: Athlete Background
- Step 2: Symptom Evaluation



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# Step 3: Cognitive Screening

(Echemendia et al, 2023)

- Based on Standardized Assessment of Concussion (SAC)
  - Orientation
  - Immediate Memory
  - Concentration
    - Digits Backwards
    - Months in Reverse Order

Sport Concussion Assessment Tool 4 - (SCAT5)<sup>SM</sup>

**Step 3: Cognitive Screening (Based on Standardized Assessment of Concussion; SAC)**

**Orientation**

What month is it?  /

What is the date today?  /  /

What is the day of the week?

What year is it?

What time is it right now? (within 1 hour)

Concentration Errors:  of 10

**Immediate Memory**

All 20 items must be remembered (regardless of the number correct on Trial 1). Submission of the side of one word per second.

**Trial 1:** Say "I'm going to read your memory. I will read you a list of words and when I am done, repeat back as many words as you can remember in any order."

**Trials 2 and 3:** Say "I am going to repeat the same list. Repeat back as many words as you can remember in any order, even if you said the word before a previous trial."

Word list used	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Apple																										
Banana																										
Cherry																										
Orange																										
Pineapple																										
Raspberry																										
Strawberry																										
Watermelon																										
Yogurt																										

Immediate Memory Score:  of 20

Time Last Trial Completed:

Sport Concussion Assessment Tool 4 - (SCAT5)<sup>SM</sup>

**Step 3: Cognitive Screening (Continued)**

**Digits Backwards**

Attention: At the side of one digit per second reading DOWN the unbracketed column. If a string is completed correctly, move on to the next column with the higher number of digits. If the string is completed incorrectly, use the alternate string with the same number of digits. If the list is over, end the test.

Say "I'm going to read a string of numbers and when I am done, you repeat them back to me in reverse order of how I read them to you. You maximize. If they finish, you read one digit at a time. If you finish, I'll read them back to you."

Digit list used:  /  /

Digit list used	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
4-6-0	9-2-4	1-4-2	Y	X	X	Y																				
6-3-3	4-7-6	8-5-3	Y	X	X	Y																				
8-0-4	1-2-8	6-6-2	Y	X	X	Y																				
2-3-2	3-8-3	3-4-2	Y	X	X	Y																				
6-2-5-2	4-8-2-2	6-5-5-2	Y	X	X	Y																				
1-2-2-4	8-1-9-4-3	6-2-2-1	Y	X	X	Y																				
7-1-4-8-2	3-1-1-8-4	3-7-6-3-1-8	Y	X	X	Y																				
3-3-1-4-4	1-1-4-4-3-4	3-2-6-5-1-4	Y	X	X	Y																				

Digit Score:  of 10

**Months in Reverse Order**

Say "Now tell me the months of the year in reverse order as quickly as you can and as accurately as possible. Start with the last month and go backward. So you'll say December, November... go ahead!"

Start Month and End Month:  /

Start Month and End Month:  /

Time Taken to Complete (seconds):

Number of Errors:

Months Score:  of 1

Concentration Score (Digits + Months):



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# Step 4: Coordination and Balance Examination

(Echemendia et al, 2023)

**Modified BESS** (20 seconds each)

Double Leg Balance:  of 10

Tandem Balance:  of 10

Single Leg Balance:  of 10

Total Errors:  of 30

**On Foam (Optional)**

Double Leg Balance:  of 10

Tandem Balance:  of 10

Single Leg Balance:  of 10

Total Errors:  of 30

**Note:** If the mBESS yields normal findings then proceed to the Tandem Gait/Dual Task Tandem Gait.

If the mBESS reveals abnormal findings or clinically significant difficulties, Tandem Gait is not necessary at this time. (Both the Tandem Gait and optional Dual Task component may be administered later in the office setting as needed (per SCQCATS).)

**Timed Tandem Gait**

Place a 3-meter-long line on the foam/firm surface with athletic tape. The tape should be lined. Please complete all 3 trials.

Say "Please walk heel-to-toe quickly to the end of the line, turn around and come back as fast as you can without stepping off the line."

Time to Complete Tandem Gait (Walking) (seconds)				
Trial 1	Trial 2	Trial 3	Average 3 Trials	Fastest Trial

**Dual Task Gait (Optional, Timed Tandem Gait must be completed first)**

Place a 3-meter-long line on the foam/firm surface with athletic tape. The tape should be lined.

Say "Now, while you are walking heel-to-toe, I will ask you to count backwards out loud by 7s. For example, if we started at 100, you would say 100, 93, 86, 79. Let's practice counting. Starting with 93, count backward by seven until I say 'stop.' You take the practice only once, counting backwards."

**Dual Task Practice:** Circle correct responses; record number of subtraction counting errors.

Task	Errors	Time (Clock Test)											
Practice	93	86	72	65	58	51	44	37					
Trial 1	88	81	74	67	60	53	46	39	32	25	18	11	4
Trial 2	96	89	76	63	52	45	41	34	27	20	13	6	
Trial 3	98	91	84	77	70	63	56	49	42	35	28	21	14

Alternate double number starting integers may be used and recorded below:

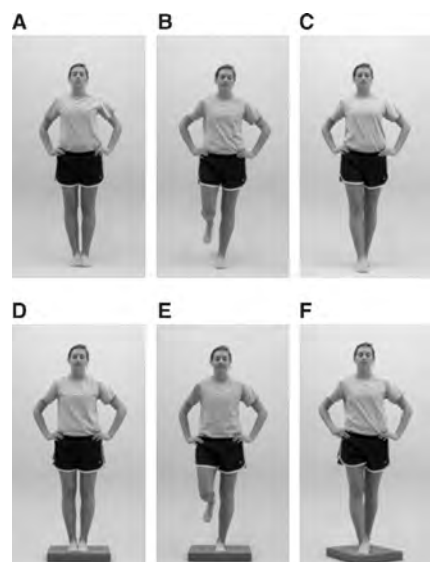


Image taken from: [https://www.researchgate.net/figure/Balance-Error-Scoring-System-BESS-performed-on-the-firm-surface-A-C-and-the-foam\\_fig1\\_26775223](https://www.researchgate.net/figure/Balance-Error-Scoring-System-BESS-performed-on-the-firm-surface-A-C-and-the-foam_fig1_26775223)



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# Step 5: Delayed Recall

(Echemendia et al, 2023)

**Step 5: Delayed Recall**

The Delayed Recall should be performed after at least 5 minutes have elapsed since the end of the Immediate Memory section. Score 1 point for each correct response.

Say "Do you remember that list of words I read a few times earlier? Tell me as many words from the list as you remember in any order."

Time started: \_\_\_\_\_

Word list used: A  B  C

List A		Score	Alternate Lists	
Item	Score		List B	List C
Jacket	0 1		Finger	Baby
Arrow	0 1		Penny	Monkey
Pepper	0 1		Blanket	Perfume
Cotton	0 1		Lemon	Sunset
Movie	0 1		Insect	Iron
Dollar	0 1		Candle	Elbow
Honey	0 1		Paper	Apple
Mirror	0 1		Sugar	Carpet
Saddle	0 1		Sandwich	Saddle
Anchor	0 1		Wagon	Bubble
<b>Delayed Recall Score</b>		of 10		

**Total Cognitive Score**

Orientation: \_\_\_\_\_ of 5

Immediate Memory: \_\_\_\_\_ of 30

Concentration: \_\_\_\_\_ of 5

Delayed Recall: \_\_\_\_\_ of 10

Total: \_\_\_\_\_ of 50

If the athlete was known to you prior to their injury, are they different from their usual self?

Yes  No  Not applicable  (If different, describe why in the [clinical notes](#) section)

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**Step 6: Decision**

Domain	Date:	Date:	Date:
	Normal/Abnormal	Normal/Abnormal	Normal/Abnormal
Neurological Exam (Acute Injury evaluation only)			
Symptom number (of 22)			
Symptom Severity (of 132)			
Orientation (of 5)			
Immediate Memory (of 30)			
Concentration (of 5)			
Delayed Recall (of 10)			
Cognitive Total Score (of 50)			
mBESS Total Errors (of 30)			
Tandem Gait fastest time			
Dual Task fastest time			

**Disposition**

Concussion diagnosed?

Yes  No  Deferred

**Health Care Professional Attestation**

I am an HCP and I have personally administered or supervised the administration of this SCAT5.

Name: \_\_\_\_\_

Signature: \_\_\_\_\_ Title/Specialty: \_\_\_\_\_

Registration/License number (if applicable): \_\_\_\_\_ Date: \_\_\_\_\_

**Additional Clinical Notes**

Note: Scoring on the SCAT5 should not be used as a stand-alone method to diagnose concussion, measure recovery, or make decisions about an athlete's readiness to return to sport after concussion. Remember: An athlete can score within normal limits on the SCAT5 and still have a concussion.

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# Step 6: Decision

(Echemendia et al, 2023)



# Off-Field Assessment

(Patricios et al, 2023a)

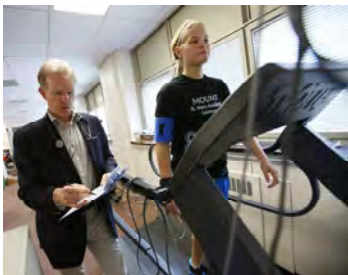
- Typically, the process of **conducting a multimodal screen to evaluate a potential concussion takes at least 10–15 min.**
- **Sport organisations are strongly advised to allow for at least that amount of time** for an adequate evaluation and to accommodate such an assessment off-field
- For athletes with potential signs of a concussion, any screening assessment short of a multimodal evaluation of symptoms, signs, balance, gait, neurological and cognitive changes associated with a potential concussion may be inadequate to allow continued sports participation.
- **Sports whose rules currently do not facilitate such evaluations should strongly consider enacting rule changes in the interest of player welfare.**



References: Zeigler & Ackley. WE HELP ATHLETES ACHIEVE THEIR OPTIMAL PERFORMANCE NATURALLY.

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SCOAT6



Return-to-Learn and Return-to-Sport

Reduce, Reconsider, Retire



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# SCOAT6

(Patricios et al, 2023a; Patricios et al, 2023b)

- The purpose of the SCOAT6 was to give HCPs a standardised, expansive and age-appropriate **clinical guide to a multidomain evaluation in the subacute phase** (72 hours to weeks postinjury)
- Various components **may assist the clinical assessment and guide individualised management**
- The SCOAT6 does not replace the HCP’s clinical acumen; rather, **it provides a standardised framework** that can be adapted to help inform the clinical evaluation in an office setting.
- The SCOAT6 is used for evaluating athletes aged 13 years and older
  - For children 12 years or younger, use the Child SCOAT6



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**SCOAT6™**  
Sport Concussion Office Assessment Tool  
For Adults & Adolescents (13 years +)

**What is the SCOAT6?**  
The SCOAT6 is a tool for evaluating concussion in a controlled office environment by Health Care Professionals (HCP) typically from 72 hours (2 days) following a sport-related concussion. Brief verbal instructions for some components of the SCOAT6 are included. Detailed instructions for use of the SCOAT6 are provided in an accompanying document. Please read through these instructions carefully before using the SCOAT6.

The diagnosis of concussion is a clinical observation made by an HCP. The various components of the SCOAT6 are used to assist with the clinical assessment and help guide individualised management. The SCOAT6 is used for evaluating athletes aged 13 years and older. For children aged 12 years or younger, please use the Child SCOAT6.

This tool may be freely copied in its current form for distribution to individuals, teams, clinics, and organisations. Any alteration (including translations and digital re-formatting), re-branding, or sale for commercial gain is not permitted without the expressed written consent of FICS and the Concussion in Sport Group (CSG).

**Completion Guide**  
Blue: Complete only at first assessment | Green: Recommended part of Assessment | Orange: Outcomes of Assessment

Athlete's Name: \_\_\_\_\_  
Date of Birth: \_\_\_\_\_ Sex: Male  Female  Prefer Not To Say  Other   
Sport: \_\_\_\_\_  
Occupational or Educational Status: \_\_\_\_\_  
Current or Highest Educational Level or Qualification Achieved: \_\_\_\_\_  
Exposition: \_\_\_\_\_ Date of Examination: \_\_\_\_\_  
Referring Physician's Name: \_\_\_\_\_  
Referring Physician's Contact Details: \_\_\_\_\_

For use by Health Care Professionals Only

Developed by: The Concussion in Sport Group (CSG)  
Sponsored by: IOC, FIE, FIA, FIFA, IFA, IFA

# SCOAT6

(Patricios et al, 2023b)

- Step 1: History
- Step 2: Symptom Evaluation
- Step 3: Verbal Cognitive Tests
- Step 4: Examination
  - Orthostatic Vital Signs
  - Cervical Spine Assessment
  - Neurological Examination
  - Balance (mBESS)
  - Timed Tandem Gait
  - Complex Tandem Gait
  - Dual Task Gait
- Step 5: mVOMS
- Step 6: Anxiety, Depression, Sleep Screen
- Step 7: Delayed Word Recall
- Step 8: Computerised Cognitive Test Results (if used)
- Step 9: Graded Aerobic Exercise Test
- Step 10: Overall Assessment, Management & Follow-up Plan
- Step 11: Return-to-Learn & Return-to-Sport



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**SCOAT6™** Sport Concussion Office Assessment Tool  
For Adults & Adolescents (13 years +)

**Current Injury**

Removal From Play: Immediate  Continued to play for \_\_\_\_\_ mins   
Walked off  Assisted off  Stretchered off

Date of Injury: \_\_\_\_\_

Description - include mechanism of injury, presentation, management since the time of injury and trajectory of care since injury:  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
Date Symptoms First Appeared: \_\_\_\_\_ Date Symptoms First Reported: \_\_\_\_\_

**History of Head Injuries**

Date/Year	Description - include mechanism of injury, presentation, management since the time of injury and trajectory of care since injury	Management - including time off work, school or sport

**History of Any Neurological, Psychological, Psychiatric or Learning Disorders**

Diagnosis	Year Diagnosed	Management/Involving Medication
<input type="checkbox"/> Migraine		
<input type="checkbox"/> Chronic headache		
<input type="checkbox"/> Depression		
<input type="checkbox"/> Anxiety		
<input type="checkbox"/> Syncope		
<input type="checkbox"/> Epilepsy/seizures		
<input type="checkbox"/> Attention deficit hyperactivity disorder (ADHD)		
<input type="checkbox"/> Learning disorder/dyslexia		
<input type="checkbox"/> Other _____		



# Orthostatic Vital Signs

(Patricios et al, 2023a; Patricios et al, 2023b)

- Emerging evidence has associated concussion with changes in the ANS.
  - Postulated mechanisms including trauma to the hypothalamus, limbic cortex and midbrain nuclei, regions of the brain responsible for autonomic function.
- Orthostatic tachycardia has been described as being associated with a substantial subset of concussion clinic patients.**
- Significant orthostatic changes have been defined as:
  - symptomatic HR increase of at least 30 bpm in adults (40 bpm in adolescents)
  - in the absence of postural hypotension

**Systematic review**

### Beyond acute concussion assessment to office management: a systematic review informing the development of a Sport Concussion Office Assessment Tool (SCOAT6) for adults and children

Jon S Patricios, Geoff M Schneider, Jacqueline van Iersel, Laura K Purcell, Gavin A Davis, Ruben Echeverria, Pierre Fremont, Gordon Ward Fuller, Stanley A Henning, Kimberly G Harmon, Kristin Hults, Mike Loosemore, Michael Madros, Michael McCrea, William P Meehan, Patrick O'Halloran, Zahra Prent, Margot Putukian, Lisa Jordan Shaw, Michael Turner, Kenzie Vandenberg, Nick Webborn, Keith Owen Yeates, Kathryn J Schneider

**ABSTRACT**  
 Objectives: To systematically review the scientific literature regarding the assessment of sport-related concussion (SRC) in the subsequent phase (10-30 days) and provide recommendations for developing a Sport Concussion Office Assessment Tool (SCOAT6).  
 Data sources: MEDLINE, Embase, PsycInfo, Cochrane CENTRAL, CINAHL, SPORTDiscus and Web of Science searched from 2016 to 2022. Data extracted included study design, population, definition of SRC, diagnosis, outcome measured and health.  
 Eligibility criteria: 15 Original research, cohort studies, case-control studies, diagnostic accuracy and case series with samples >100 SRC, 10+ monitoring/technology that assessed SRC in the subsequent phase and 10+ days of SRC. 200 was determined only published English language peer-reviewed literature. Quality of evidence was evaluated using the Strength of Recommendation-Grading Classification.  
 Results: 27 RCTs (total n=30,000), 117 non-RCTs, assessing 12 monitoring domains. Results were summarized hierarchically. Studies of moderate (B) to high (A) quality were used to inform the SCOAT6. Having sufficient evidence for assessing the assessment of autonomic function, dual (opt) vestibular evoked myogenic potentials (VEMP) and neurophysiological (NPT) were included. VEMP and NPT were included as a standard clinical assessment in the subsequent phase of SRC may include patient education, individualized management, verbal neurophysiology, NPT, optical (opt) evaluation, neuropsychological, modified Balance Function System, computerized dual (opt) vestibular evoked myogenic potentials (VEMP) and/or computerized NPT. Studies to include: dizziness, anxiety and depression are recommended. Studies to include the psychometric properties, clinical feasibility in different environments and one theme are noted.  
 PROSPERO registration number: CRD4202215617

**WHAT IS ALREADY KNOWN?**  
 The Sport Concussion Assessment Tool (SCAT) and Child SCAT (CS-CAT) have evolved over five iterations having optimal utility in the first 72 hours (3 days) and up to 7 days following sport-related concussion (SRC).  
 The effects of SRC often last several days to weeks, with athletes returning to assessment (10-30 days) and up to 7 days following sport-related concussion (SRC).  
 Evaluation of SRC requires multimodal and other multiple time-point assessments to evaluate the domains involved and guide individualized management.  
 A truly accessible comprehensive office assessment tool can aid clinicians in identifying both and domains to be assessed when performing a multidimensional clinical assessment of athletes with SRC.

**WHAT ARE THE NEW FINDINGS?**  
 Several clinical tools are useful in distinguishing concussion-related symptoms from non-concussion controls in the days and weeks following SRC.  
 Most clinical tools require a specific domain potentially affected by concussion.  
 The Sport Concussion Office Assessment Tool (SCOAT6) combines clinical tests with multimodal utility for concussion in athletes (A) to perform a more comprehensive multimodal clinical assessment.  
 The SCOAT6 requires further validation to understand the validity and clinical utility at various timepoints and ages and in different age groups and clinical settings.

**INTRODUCTION**  
 The Concussion in Sport Group (CISG) described the concept of a standardized and systematic approach to SRC management in 2013 (1).



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## Postural Orthostatic Tachycardia Syndrome (POTS) and its relevance, and importance, in the management of persistent post-concussive symptoms: a case series.

### ABSTRACT

**Objective:** The purpose of this case series is to present the clinical assessment and diagnosis of postural orthostatic tachycardia syndrome (POTS) in three elite, professional athletes with persistent post-concussive symptoms (PPCS), and to describe and discuss the outcomes of an individualised and targeted, multi-system management approach provided by a chiropractor. **Clinical Features:** Three male elite, professional athletes, aged from 26 to 29 years old (mean age, 27.7 years), presented with PPCS which remained refractory to typical interventions. A clinical diagnosis of POTS, exertional intolerance, vestibulo-oculomotor dysfunction, motor coordination impairments, as well as cervical spine musculoskeletal impairments was made through synthesis of the patient history and detailed multi-system clinical assessment. **Intervention and Outcome:** Treatment addressed the specific dysfunctions and impairments identified on assessment in a hierarchical manner. The multi-system treatment and management approach for each patient was individualised, and first targeted and addressed the POTS and autonomic nervous system (ANS) dysfunction identified on clinical assessment. All three patients demonstrated significant decreases in PPCS symptoms and changes in mental health, as measured by the Post-Concussion Symptom Scale (PCSS), Rivermead Post-concussion Symptoms Questionnaire (RPQ) and 9-Item Patient Health Questionnaire (PHQ-9). All three patients had improvements in orthostatic vital signs, Infrared Video Goggle assessment, vestibulo-oculomotor assessment (including quantitative eye tracking technology), and motor coordination assessments (including balance via quantitative force plate technology). **Conclusion:** Three elite, professional athletes with PPCS which remained refractory to typical treatment, had quantitative subjective and objective improvements in symptoms and function following individualised, multi-system management that first targeted and addressed the POTS and ANS dysfunction identified on clinical assessment. Further research involving larger randomized controlled and clinical trials with long-term follow up are both required and warranted to clarify the effectiveness of a POTS and ANS hierarchically targeted, multi-system treatment approach in the management of PPCS.

**Keywords:** (MESH): Brain Concussion; Post-Concussion Syndrome; Postural Orthostatic Tachycardia Syndrome; Rehabilitation; Exercise Therapy

**Systematic review**

### assessment to office review informing the concussion Office for adults and children

Jacqueline van Iersel, Laura K Purcell, Pierre Fremont, Kimberly G Harmon, Michael Madros, Michael McCrea, William P Meehan, Patrick O'Halloran, Zahra Prent, Margot Putukian, Lisa Jordan Shaw, Michael Turner, Kenzie Vandenberg, Nick Webborn, Keith Owen Yeates, Kathryn J Schneider

**WHAT IS ALREADY KNOWN?**  
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 Evaluation of SRC requires multimodal and other multiple time-point assessments to evaluate the domains involved and guide individualized management.  
 A truly accessible comprehensive office assessment tool can aid clinicians in identifying both and domains to be assessed when performing a multidimensional clinical assessment of athletes with SRC.

**WHAT ARE THE NEW FINDINGS?**  
 Several clinical tools are useful in distinguishing concussion-related symptoms from non-concussion controls in the days and weeks following SRC.  
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 The SCOAT6 requires further validation to understand the validity and clinical utility at various timepoints and ages and in different age groups and clinical settings.

**INTRODUCTION**  
 The Concussion in Sport Group (CISG) described the concept of a standardized and systematic approach to SRC management in 2013 (1).



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# Orthostatic Vital Signs

(Patricios et al, 2023b)

### Orthostatic Vital Signs

The first blood pressure and heart rate measurements are taken after the patient lies supine on the examination table for at least 2 minutes. The patient is then asked to stand up without support and with both feet firmly on the ground and the second measurements are taken after standing for 1 minute. Ask the patient if they experience any dizziness or light-headedness upon standing (initial orthostatic intolerance) or by one minute (orthostatic intolerance).

Orthostatic Vital Signs	Supine	Standing (after 1 minute)
Blood Pressure (mmHg)		
Heart Rate (bpm)		
Symptoms <sup>1</sup>	No <input type="checkbox"/> Yes <input type="checkbox"/>	No <input type="checkbox"/> Yes <input type="checkbox"/>
• Dizziness or light-headedness	If yes: Description	If yes: Description
• Fainting		
• Blurred or fading vision		
• Nausea		
• Fatigue		
• Lack of concentration		
Results	<input type="checkbox"/> Normal <input type="checkbox"/> Abnormal	

Test results are deemed clinically significant if they include at least one of the following AND symptoms:  
 (1) systolic BP drop of ≥ 20mmHg or (2) diastolic BP drop of ≥ 10mmHg (3) HR decreases (4) HR increases by > 30bpm



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# Complex Tandem Gait

(Patricios et al, 2023a; Patricios et al, 2023b)

- Tandem gait is a validated and practical test, with **evidence suggesting that dual-task gait increases the sensitivity of SRC diagnosis.**
- Tandem gait (3 m marked with tape) combined with one of the following cognitive tasks:
  - (1) backward spelling of a 5-letter word;
  - (2) serial subtraction by 7 from a 2-digit number
  - or (3) reciting months in reverse
    - can distinguish between concussed and non-concussed athletes.
- Cues should be varied in subsequent visits to decrease the learning effect and normative values for adults can be referenced.

Systematic review

### Beyond acute concussion assessment to office management: a systematic review informing the development of a Sport Concussion Office Assessment Tool (SCOAT6) for adults and children

Jon S Patricios <sup>1</sup>, Geoff M Schneider <sup>2</sup>, Jacqueline van Rossum <sup>3</sup>, Laura K Purcell <sup>4</sup>, Gavin A Davis <sup>5</sup>, Ruben E Lohmeyer <sup>6</sup>, Pierre Fremont <sup>7</sup>, Gordon Ward Fuller <sup>8</sup>, Stanley A Henning <sup>9</sup>, Kimberly G Harmon <sup>10</sup>, Kirsten Hüter <sup>11</sup>, Mike Loosemore <sup>12</sup>, Michael Mikulski <sup>13</sup>, Michael McCrea <sup>14</sup>, William P Akshof <sup>15</sup>, Patrick O'Flaherty <sup>16</sup>, Zahra Pheasant <sup>17</sup>, Margot Putukian <sup>18</sup>, Aja Jordan Skib <sup>19</sup>, Michael Turner <sup>20</sup>, Kenzie Vandenberg <sup>21</sup>, Nick Webborn <sup>22</sup>, Keith Owen Yeates <sup>23,24,25</sup>, Kathryn J Schneider <sup>26</sup>

**ABSTRACT**  
 Objectives: To systematically review the scientific literature regarding the assessment of sport-related concussion (SRC) in the subacute phase (30 days) and to provide recommendations for developing a Sport Concussion Office Assessment Tool (SCOAT6).  
 Data sources: MEDLINE, Embase, PsycINFO, Cochrane CENTRAL, CINAHL, SPORTDiscus and Web of Science searched from 2012 to 2022. Data extracted included study design, population, definition of SRC diagnosis, outcome measures, diagnostic accuracy and user acceptability. 102 SRC (25 cross-sectional), 104 SRC (24 longitudinal) studies were included.  
 Eligibility criteria: (1) English language, (2) SRC diagnosis, (3) diagnostic accuracy and (4) user acceptability. 102 SRC (25 cross-sectional), 104 SRC (24 longitudinal) studies were included.  
 Results: Of 102 SRC studies reviewed, 112 met PRISMA screening 12 overlapping domains. Results were heterogeneous. Studies of diagnostic accuracy (10) or user acceptability (10) were included for synthesis. The most common outcomes were diagnostic accuracy (10/102) and user acceptability (10/104).  
 Conclusions: Current SRC tests have limited utility. Future SRC tests should include a combination of clinical assessment in the subacute phase of SRC, may include symptom evaluation, physical examination, central nervous system, vestibular/ocular/head/neck/ear/ear/nose/throat (VOR) and/or functional assessment.  
 PROSPERO registration number: CRD4202119187.  
 Keywords: Sport Concussion, SRC, Diagnostic Accuracy, User Acceptability, SCOAT6.

**WHAT IS ALREADY KNOWN?**  
 The Sport Concussion Assessment Tool (SCAT) and the Sport Concussion Assessment Tool (SCAT) and the Sport Concussion Assessment Tool (SCAT) have replaced the previous Concussion Assessment Tool (COT) in the field of concussion assessment. However, the current SCAT tool is not designed to be used in a clinical setting and is not designed to be used in a clinical setting.  
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**WHAT ARE THE NEW FINDINGS?**  
 Several clinical tests are useful in distinguishing concussed athletes from non-concussed athletes in the days and weeks following SRC.  
 Most clinical tests require a specific amount of time to perform.  
 The current SCAT tool is not designed to be used in a clinical setting and is not designed to be used in a clinical setting.  
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**INTRODUCTION**  
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## Complex Tandem Gait

(Patricios et al, 2023b)

**Complex Tandem Gait**

**Forward**

Say "Please walk heel-to-toe quickly five steps forward, then continue forward with eyes closed for five steps" 1 point for each step off the line, 1 point for truncal sway or holding onto an object for support.

Forward Eyes Open                      Points:

Forward Eyes Closed                      Points:

Forward Total Points:

**Backward**

Say "Please walk heel-to-toe again, backwards five steps eyes open, then continue backwards five steps with eyes closed." 1 point for each step off the line, 1 point for truncal sway or holding onto an object for support.

Backward Eyes Open                      Points:

Backward Eyes Closed                      Points:

Backward Total Points:

Total Points (Forward + Backward):



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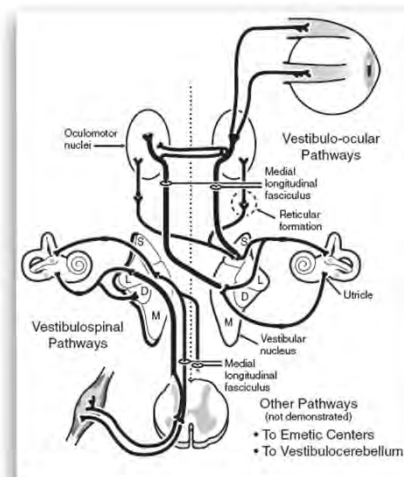
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## Modified Vestibular Ocular Motor Screening

### mVOMS for Concussion

(Patricios et al, 2023a; Patricios et al, 2023b)

- **Symptom provocation with VOR and VMS tests appear to be associated with concussion.**
- The modified VOMS (mVOMS) has the same diagnostic accuracy and applicability as the original VOMS.
- It is important to recognise that **if symptoms are reproduced during the VOMS this does not 'rule in' the presence of a vestibular or oculomotor problem.**



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## mVOMS for Concussion

(Patricios et al, 2023b; Mucha et al, 2014)

### Modified Vestibular/Ocular-Motor Screening (mVOMS) for Concussion

For detailed instructions please see the Supplement.

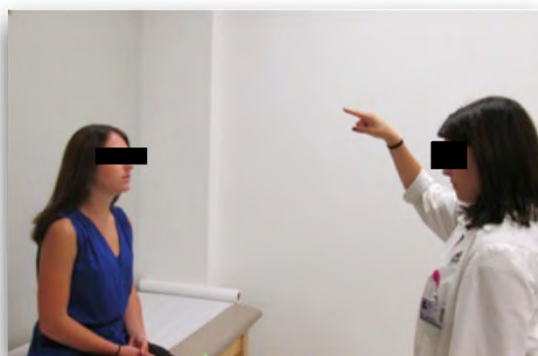
mVOMS	Not Tested	Headache	Dizziness	Nausea	Fogginess	Comments
Baseline symptoms	N/A					
Smooth pursuits (2 horizontal and 2 vertical, 2 seconds to go full distance right-left and back; up-down and back)						
Saccades – Horizontal (10 times each direction)						
VOR – Horizontal (10 repetitions) (metronome set at 180 beats per minute – change direction at each beep, wait 10 secs to ask symptoms)						
VMS (x 5, 80° rotation side to side) (at 50 bpm, change direction each beep, wait 10 secs to ask symptoms)						

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## mVOMS – Smooth Pursuits

(Mucha et al, 2014)

- Patient is instructed to maintain focus on a target (3 ft. from patient) as the examiner moves the target smoothly in the horizontal direction 1.5 ft. to the right and left of midline.
  - Target moved at a rate of ~2 seconds from one-side-to-the-other
- Perform 2 repetitions
- Repeat the test in a vertical direction
  - **Record:**
    - Headache, Dizziness, Nausea & Fogginess ratings after the test
  - **Observe for:**
    - Saccadic eye movements; Evidence of a cranial nerve deficit. (Ellis et al, 2015)



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## mVOMS – Saccades

(Mucha et al, 2014)

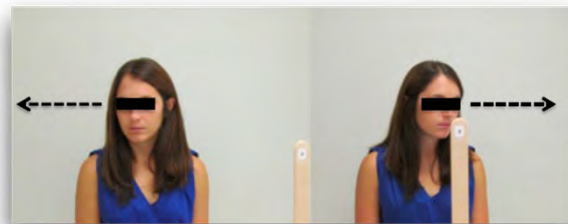


- The examiner holds two single targets (fingertips) *horizontally* at a distance of 3 ft. from the patient, and 1.5 ft. to the right and 1.5 ft. to the left of midline
- Instruct the patient to move their eyes as quickly as possible from target to target
- Perform 10 repetitions each direction
  - **Record:**
    - Headache, Dizziness, Nausea & Fogginess ratings after each test
  - **Observe for:**
    - Overshooting; > 2 saccadic corrections; Gross dysconjugate eye movements (Ellis et al, 2015)

## mVOMS – VOR

(Mucha et al, 2014)

- Examiner holds a target in front of the patient in midline at a distance of 3 ft.
- The patient is asked to rotate their head *horizontally* while maintaining focus on the target.
  - The head is moved at an amplitude of 20° to each side and a metronome 180 bpm to ensure the speed of rotation (one beat in each direction).
- Perform 10 repetitions
  - **Record:**
    - Wait 10 secs then record Headache, Dizziness, Nausea & Fogginess after the test
  - **Observe for:**
    - Ability to maintain gaze stability (Casa Della et al, 2014)



## mVOMS – Visual Motion Sensitivity

(Mucha et al, 2014)



- The patient stands with feet shoulder width apart (facing a busy area of the clinic) with their arm outstretched and focusing on their thumb.
- Maintaining focus on their thumb, the patient rotates - together as a unit - their head, eyes and trunk at an amplitude of 80° to the right and left.
- A metronome 50 bpm to ensure the speed of rotation (one beat in each direction).
- Perform 5 repetitions
  - **Record:**
    - Wait 10 sec and record Headache, Dizziness, Nausea & Fogginess after the test

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“...it is important to emphasize that the VOMS was not designed as a comprehensive tool for vestibular and oculomotor function and may not encompass all of the screening strategies necessary to examine all aspects of vestibular and oculomotor dysfunction. Therefore, it may be useful as a screening tool, but is not appropriate as a replacement for a comprehensive vestibular and oculomotor assessment.”

- Quartman-Yartes et al, 2020

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# Graded Aerobic Exercise Test

(Leddy et al, 2023; Patricios et al, 2023a)

- Exercise testing should be performed only when the athlete reports the general resting concussion symptom burden is not >7/10 on a 0–10 visual analogue scale (VAS).
- Clinicians can **prescribe targeted HR aerobic exercise treatment based on 90% of the individual's HRT** at the more-than-mild symptom exacerbation point
- Subsymptom threshold aerobic exercise treatment can be progressed systematically based on the determination of the new HRT on repeat exercise testing (every few days to every week).

**Systematic review**

**Beyond acute concussion assessment to office management: a systematic review informing the development of a Sport Concussion Office Assessment Tool (SCOAT6) for adults and children**

Jon S Patricios <sup>1</sup>, Geoff M Schneider <sup>2</sup>, Jacqueline van Kerck <sup>3</sup>, Laura K Purcell <sup>4</sup>, Gavin A Davis <sup>5</sup>, Ruben E Lohmeyer <sup>6</sup>, Pierre Frenomey <sup>7</sup>, Gordon Ward Fuller <sup>8</sup>, Stanley A Herring <sup>9</sup>, Kimberly G Harmon <sup>10</sup>, Kirsten Holte <sup>11</sup>, Mike Lossemore <sup>12</sup>, Michael Makdissi <sup>13</sup>, Michael McCrea <sup>14</sup>, William P Meehan <sup>15</sup>, Patrick O'Halloran <sup>16</sup>, Zana Preng <sup>17</sup>, Margot Putukian <sup>18</sup>, Ista Jordan Shill <sup>19</sup>, Michael Turner <sup>20</sup>, Kenzie Vandenberg <sup>21</sup>, Nick Webborn <sup>22</sup>, Keith Owen Yeates <sup>23</sup>, Kathryn J Schneider <sup>24</sup>

**ABSTRACT**  
 Objectives: To systematically review the scientific literature regarding the assessment of sport-related concussion (SRC) in the subacute phase (3–30 days) and provide recommendations for developing a Sport Concussion Office Assessment Tool (SCOAT6).  
 Data source: MEDLINE, Embase, PsycINFO, Cochrane CENTRAL, CINAHL, SPORTDiscus and Web of Science searched from 2012 to 2022. Data extracted included study design, population, definition of SRC diagnosis, outcome measurement and results.  
 Eligibility criteria: 15 original research, cohort studies, case-control studies, diagnostic accuracy studies and case series with duration 3–30 days. 23 cross-sectional surveys that assessed SRC in the subacute phase and all 10 case-control studies. 102 were primarily non-scientific health care professionals. Network charts quality of evidence was evaluated using the Strength of Recommendation Taxonomy classification.  
 Results: 10 PRISMA studies screened, 117 not included, assessing 12 overlapping domains. Results were summarized narratively. Studies of acceptable SR1 or SR2 quality were used to inform the SCOAT6. Strong sufficient evidence to accept the assessment of autonomic function, dual-gait, vestibular ocular response screening (VORS) and mental health screening.  
 Conclusions: Current SRC tools have limited utility beyond clinical research. A validated clinical assessment in the subacute phase of SRC may include symptom burden, autonomic dysfunction, vestibular/oculomotor tests, serial cognitive evaluation, neuropsychological tests, modified Balance Error Scoring System, integrated task system task, modified VORS and appropriate serial tests. Criteria to allow diagnosis, entry and depression are recommended. Studies to evaluate the psychometric properties, clinical feasibility in different environments and time frames are needed.  
 PROSPERO registration number: CRD42021150167

**WHAT IS ALREADY KNOWN?**  
 The Sport Concussion Assessment Tool (SCAT) and GCS/SCAT have evolved over time. However, having optimal utility in the first 72 hours (3 days) and up to 30 days following sport-related concussion (SRC).  
 The effects of SRC often last several days to weeks, with athletes requiring the assessment to a range of healthcare professionals (HCPs).  
 Evaluation of SRC requires a multidisciplinary team to evaluate the domains involved and guide individualized management.  
 A body accessible comprehensive office assessment tool can aid clinicians in identifying both and domains to be assessed when performing a multidisciplinary clinical assessment of athletes with SRC.

**WHAT ARE THE NEW FINDINGS?**  
 Several clinical tools are useful in diagnosing concussion in the days and weeks following SRC.  
 Most clinical tools require a specific domain primarily affected by concussion.  
 The Sport Concussion Office Assessment Tool (SCOAT6) includes clinical tools with demonstrated utility for the assessment to evaluate the domains involved and guide individualized management.  
 CHIL variants combine clinical tools with demonstrated utility for the assessment to evaluate the validity and clinical utility at various lengths of time and in different age groups and clinical settings.  
 The SCOAT6 requires further evaluation to understand the validity and clinical utility at various lengths of time and in different age groups and clinical settings.

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# Graded Aerobic Exercise Test

(Leddy et al, 2023; Patricios et al, 2023a)

- Prescribed **subsymptom threshold aerobic exercise within 2–10 days of SRC is effective for reducing the incidence of persisting symptoms** after concussion (symptoms >1 month) and is also effective for facilitating recovery in athletes suffering from symptoms lasting longer than 1 month.

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## Graded Aerobic Exercise Test Buffalo Concussion Treadmill Test

(Clausen et al, 2016; Kozlowski et al, 2013; Leddy et al, 2013)

- Patient to walk on a treadmill initially set at **3.4 mph (5.5 km/h) at a 0.0° incline**
  - Speed can be altered if needed (increase speed a little to comfort for taller or athletic persons, and reduce the speed for shorter or sedentary persons)
- **Each minute, increase the incline grade by 1°**
- **Each minute record HR, Rating of Perceived Exhaustion (RPE, Borg Scale) and assess the presence of symptoms.** (Borg, 1982; Leddy et al, 2013)
- Once treadmill reaches maximum incline (e.g. 12° or 15°) speed is increased by 0.4 mph (0.6 km/h) each minute
- **Continue until patients reach maximum exertion (RPE 19.5), OR have onset of new symptoms, OR exacerbation of symptoms (3/10), OR patient reports an inability to continue the test safely**
- Upon test termination, immediately record final measurements



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## Graded Aerobic Exercise Test

(Patricios et al, 2023b)

### Graded Aerobic Exercise Test

Not Done

Exclude contra-indications: cardiac condition, respiratory disease, significant vestibular symptoms, motor dysfunction, lower limb injuries, cervical spine injury.

Protocol Used:



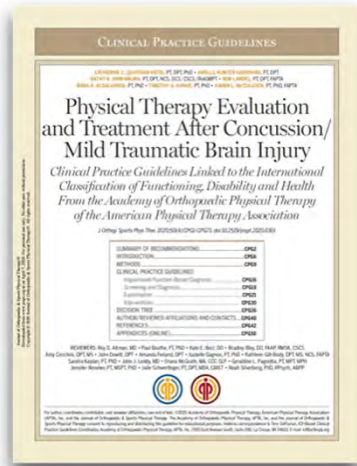
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## Multidomain Assessment Cervical Musculoskeletal / Sensorimotor Impairments

(Quatman-Yates et al, 2020)



- There is clear evidence to suggest that **the cervical spine should be examined after a concussive event, but there is limited evidence on examination procedures for cervical musculoskeletal dysfunction** specific to patients who have experienced a concussive event.
- Low-level evidence suggests that a concussive event can cause cervical injury, and that cervical musculoskeletal impairments can cause symptoms that are often reported after a concussive event.

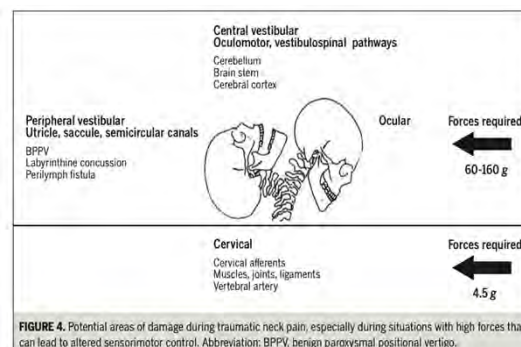
“Properly determining whether concussion or cervical injury is the source of symptoms is vital **because the management of each condition differs considerably.**”

- Cheever et al, 2016

## Different Forces, Different Systems

(Treleaven, 2017)

- **When higher forces or a direct blow to the head occur**, additional injuries, such as **concussion and/or damage to the CNS or visual or peripheral vestibular apparatus, are more likely**
- Up to 35% of those with **traumatic neck pain associated with higher forces may have peripheral vestibular damage** (eg, BPPV, damage to the endolymphatic sac, or a perilymph fistula).
- **Injuries induced by axial rotation versus linear acceleration during the accident may result in different types of neuro-otological injury.**



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## Cervical Musculoskeletal / Sensorimotor Impairments

### Deep Neck Flexor Endurance Test

(Domenech et al, 2011; Schneider et al, 2018; Schneider, 2019)

- The patient is in a crook lying position with their head resting on the table
- Instruct the patient to perform crano-cervical flexion (“chin tuck”), lift their head 2 finger widths off the table and hold this position for as long as possible
  - To fatigue or pain
- Stop the test if the patient’s occiput touches your hand for more than 1-sec, or they have a loss of chin skin folds (from losing the chin tuck)



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## Cervical Musculoskeletal / Sensorimotor Impairments

### Cervical Proprioception

(Jull et al, 2013; Hides et al, 2017; Treleaven, 2017)



#### Cervical Joint Position Error (JPE) Testing

- The patient is seated in a chair with a back support, with a headband with laser centred on the forehead. The patient is seated 90 cm from a wall and is instructed to sit with their head in their natural resting position
- Ask the patient to close their eyes – or use a blindfold – and memorize the position.
- Instruct the patient to perform full cervical rotation, then return their head to the start position.
  - The patient is to verbally indicate when they perceive they have returned to their start position - Record position
  - Give no feedback on accuracy
  - The practitioner manually adjusts the persons head to match original starting position.
- Repeat 6 times alternately to each side
- Calculate the average for the left and right trials

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## Cervical Musculoskeletal / Sensorimotor Impairments

### Smooth Pursuit Neck Torsion Test

(Treleaven, 2017; Treleaven, 2008)

- Ask patient to follow a slow moving target with their eyes while keeping their head still
- The target is moved  $\sim 20^\circ/\text{sec}$  through a visual angle of  $40^\circ$
- Perform with head and trunk in neutral
- Perform with 'neck torsion'
  - head neutral, trunk rotated  $45^\circ$  left
  - head neutral, trunk rotated  $45^\circ$  right
- **Note differences in neck torsion positions compared to neutral position:**
  - Catch up saccades
    - Particularly when target crosses midline
  - Symptom reproduction in 'neck torsion'



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# CSPR for Dizziness post mTBI

(Hammerle et al, 2019)

- **“Results suggest that patients with dizziness after mTBI and who had abnormal CSP assessments (JPE and/or SPNT) responded better to CSPR compared with those who received VRT”**
- Exclusion criteria included any patients who had:
  - **clear peripheral vestibular or consistent central signs on clinical vestibulo-ocular testing with or without visual suppression.**

## Retrospective Review: Effectiveness of Cervical Proprioception Retraining for Dizziness After Mild Traumatic Brain Injury in a Military Population With Abnormal Cervical Proprioception

Neven Hammerle, PT,<sup>1</sup> Alicia A. Swan, PhD,<sup>2</sup> Jeremy T. Nelson, PhD,<sup>1</sup> and Julia M. Treisman, PhD<sup>3</sup>

### ABSTRACT

**Objective:** This study aimed to assess the outcomes of 2 treatments for patients with dizziness after mild traumatic brain injury (mTBI) who demonstrated abnormal cervical spine proprioception (CSP).  
**Methods:** A retrospective records review was conducted on the medical charts of patients treated for dizziness after mTBI who received either standard care (vestibular rehabilitation therapy (VRT) or cervical collar proprioceptive retraining (CSPR) from 2015 to 2017. All patients included in the analysis were specifically matched with receiving dizziness after mTBI who had at least 1 abnormal CSP test. Patients were excluded for dizziness with a clear peripheral vestibular or central origin, neurological signs, or no CSP assessment, or both treatments were administered. Forty-eight total patients were included in the final dataset (22 VRT, 26 CSPR). Traditional VRT was compared with CSPR when abnormal CSP tests were present, regardless of the presence or absence of neck pain. A blinded review of records was used to determine improvement of dizziness based on patient reports of symptoms at discharge (relative to, no response for at least 2 weeks).  
**Results:** Patients who received CSPR were 30 times more likely to report improvement in dizziness symptoms compared with those who received VRT (adjusted odds ratio: 30.0; 95% confidence interval: 4.8–242.6; *P* = .002) when abnormal CSP tests were present. Patients with dizziness over 1 year were significantly less likely to improve.  
**Conclusion:** These results suggest that patients with dizziness after mTBI and who had abnormal CSP assessments responded better to CSPR compared with those who received VRT. (J Manipulative Physiol Ther 2019;42:399–406) **Key Indexing Terms:** Concussion; Cervical Concussion; Neck Pain; Cervicogenic; Postural Disturbance; Rehabilitation

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 Disclosure: The views expressed herein are those of the authors and do not reflect the official policy or position of Baylor Army Medical Center, the U.S. Army Medical Department, the U.S. Army Office of the Surgeon General, the Department of the Army, the Department of the Air Force, or the Department of Defense or the U.S. Government.  
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**INTRODUCTION**  
 Mild traumatic brain injury (mTBI) makes up 90% of brain injuries that US military personnel have sustained between 2000 and 2010.<sup>1</sup> Although most symptoms after mTBI resolve within 2 weeks, several can persist, including dizziness.<sup>2–7</sup> Dizziness that occurs after mTBI is not homogeneous, presenting with varied characteristics and several potential sources and mechanisms, including the inner ear, the brain, the cervical spine, and/or the integration of afferent input and timing within the vestibular control system.<sup>8,9</sup> Traditionally, vestibular rehabilitation therapy (VRT) aimed at central or peripheral vestibular origins has been used to treat persistent dizziness after mTBI.<sup>10</sup> It has recent attention from clinicians that provide the use of cervical spine posturocognitive dizziness.<sup>11</sup> Dizziness after mTBI has been shown to improve when manual therapy and specific neuromuscular control exercises for the cervical spine were added to standard care VRT.<sup>12</sup> Further, a growing body of



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“Understanding the pathophysiology of concussion proves especially critical for the 20–30% of concussed patients who develop persistent postconcussion symptoms (PPCS).”

- Callaway & Kosofsky, 2019



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## The SRC Clinician Network

(Patricios et al, 2023)

- Referral to clinicians with specialised knowledge and skills in concussion management should be considered for the targeted treatment of persisting symptoms
- This SRC clinician network may include:
  - sports medicine physicians
  - athletic trainers/therapists
  - physiotherapists
  - occupational therapists
  - **sports chiropractors**
  - neurologists, neurosurgeons, neuropsychologists
  - ophthalmologists, optometrists,
  - Psychiatrists
  - psychologists and psychiatrists



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## Sports Chiropractor's Role In Management

(Patricios et al, 2023)

Sports Chiropractors are now recognized as part of the SRC clinician network

- Multimodal assessment of athletes (e.g. SCAT6/SCOAT6)
- Dependent upon a Sports Chiropractors competency and expertise:
  - Cervicovestibular rehabilitation for dizziness, neck pain and/or headaches that have persisted for more than 10 days
  - Vestibular rehabilitation or cervicovestibular rehabilitation for dizziness/balance problems
  - Prescription of subsymptom threshold aerobic exercise in combination with other treatments
  - Implementation of Return-to-Learn and Return-to-Sport strategies



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## Rest and Exercise

(Patricious et al, 2023)

- Recommending strict rest until the complete resolution of concussion-related symptoms is not beneficial following SRC.
- **Relative (not strict) rest**, which includes activities of daily living and reduced screen time, **is indicated immediately and for up to the first 2 days after injury.**
- HCPs are encouraged to **recommend early (after 24–48 hours) return to PA as tolerated**
  - Individuals can systematically advance their exercise intensity based on the degree of symptom exacerbation experienced during the prior bout of aerobic exercise.
- HCPs can **prescribe subsymptom threshold aerobic exercise treatment within 2–10 days after SRC**, based on the individual's heart rate threshold (HRT) that does not elicit more than mild symptom exacerbation during the exercise test
  - Subsymptom threshold aerobic exercise treatment can be progressed systematically based on the determination of the new HRT on repeat exercise testing (every few days to every week).
  - Athletes may continue/advance the duration and intensity of PA or prescribed aerobic exercise provided there is no more than mild and brief exacerbation of their concussion-related symptoms



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1 Helps reduce chance of concussion

2 Protects jaw joints against injury

3 Protects soft tissues from impact

4 Cushions teeth against impact

5 Helps prevent injuries

Return-to-Learn and Return-to-Sport

Reduce, Reconsider, Retire

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## Return-to-Learn (RTL) Strategy

(Patricios et al, 2023)

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 (e.g., reading) while minimizing 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 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.

- Progression through the RTL strategy is symptom limited (no more than mild exacerbation of **current concussion symptoms**)
- Student-athletes **should complete full RTL before unrestricted RTS.**



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## Return-to-Sport (RTS) Strategy

(Patricios et al, 2023)

- Expect a **minimum of 1 week** to complete the full RTS strategy (24 hours for each step), but **typically unrestricted RTS can take up to 1 month**
- Athletes with difficulty progressing through RTS or with SSx that are not progressively recovering beyond the first 2-4 weeks may benefit from rehab / involvement of a team of HCPs experienced in managing SRC

Step	Exercise Strategy	Activity at Each Step	Goal
1	Symptom-limited activity.	Daily activities that do not exacerbate symptoms (e.g., walking).	Gradual reintroduction of work/school.
2	Aerobic exercise <b>2A – Light</b> (up to approx. 55% max HR) <b>then</b> <b>2B – Moderate</b> (up to approximately 70% max HR)	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 <b>NOTE:</b> if sport-specific exercise involves any risk of head impact, medical determination of readiness should occur prior to step 3.	Sport-specific training away from the team environment (e.g., 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 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 (e.g., passing drills, multiplayer training). Can integrate into 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.	

maxHR = predicted maximal Heart Rate according to age (i.e., 220-age)

Age Predicted Maximal HR= 220-age	Mild Aerobic Exercise	Moderate Aerobic Exercise
55%	220-age x 0.55 = training target HR	
70%		220-age x 0.70 = training target HR



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## REDUCE: PREVENTION OF CONCUSSION

(Patricios et al, 2023)

### Policy or rule changes

- Disallowing body checking in child or adolescent ice hockey reduced the rate of concussion in games by 58%
- Limiting the number and duration of contact practices, intensity of contact in practices and strategies restricting collision time in practices in American football across all age groups have led to an overall 64% reduction in practice-related concussions and to reduced head impact rates



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## REDUCE: PREVENTION OF CONCUSSION

(Patricios et al, 2023)

### Mouth Guards

- Mouthguards were associated with a 28% reduced concussion rate in ice hockey across all age groups



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## REDUCE: PREVENTION OF CONCUSSION

(Patricios et al, 2023)

### NMT Warm-up Programmes

- On-field neuromuscular training (NMT) warm-up programmes completed at least three times per week has been associated with a lower rate of concussion in Rugby Union (rugby) across all age groups



Image taken from: <https://www.mdpi.com/2079-7737/11/7/1062>

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## REDUCE: PREVENTION OF CONCUSSION

(Patricios et al, 2023)

### Concussion Management Strategies

- Optimal concussion management strategies including implementing laws and protocols (eg, mandatory removal from play; requirements to receive clearance to RTP from an HCP; and education of coaches, parents and athletes regarding concussion signs and symptoms) are **associated with a reduction in recurrent concussion rates**



Image taken from [https://www.espn.in/nfl/story/\\_/id/35311635/review-finds-spotters-miss-devante-parker-head-injury](https://www.espn.in/nfl/story/_/id/35311635/review-finds-spotters-miss-devante-parker-head-injury)



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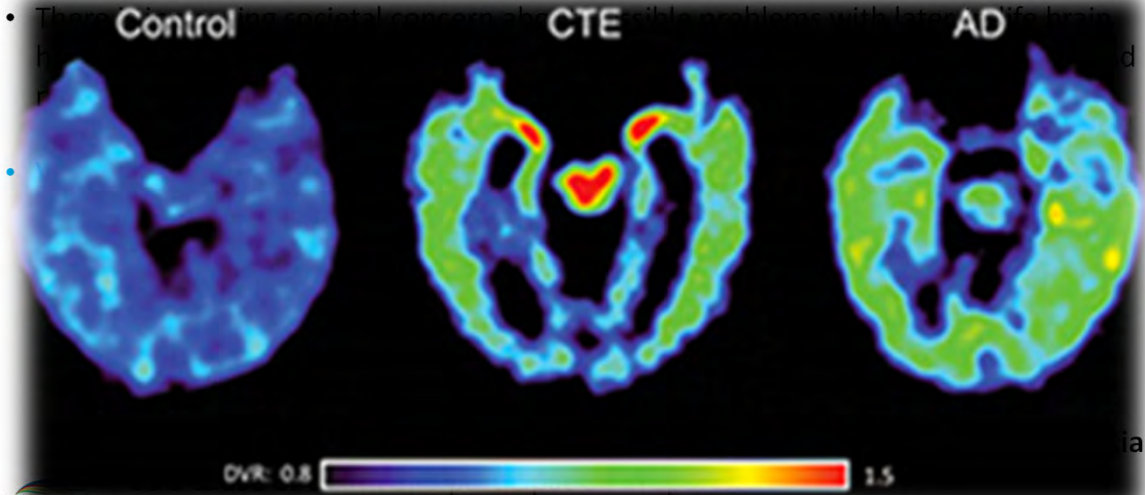
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## Reconsider: Potential Long-Term Effects

(Iverson et al, 2023; Patricious et al, 2023)



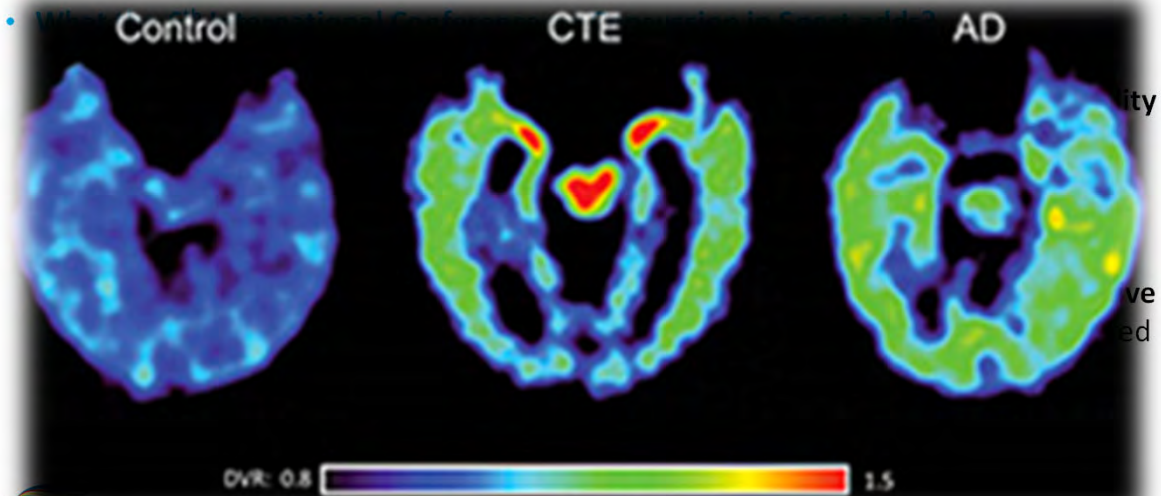
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## Reconsider: Potential Long-Term Effects

(Iverson et al, 2023; Patricious et al, 2023)



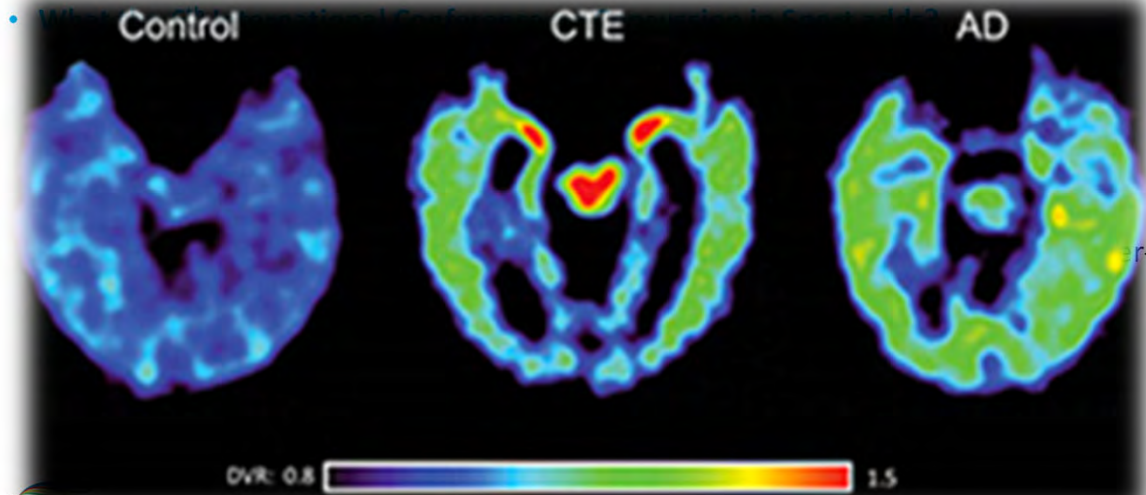
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## Reconsider: Potential Long-Term Effects

(Iverson et al, 2023; Patricious et al, 2023)



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## Retire

(Patricious et al, 2023)

- There is **no clear evidence of the factors that, if present, would unequivocally lead to retirement** or discontinued participation in contact or collision sports
- Decisions regarding retirement or discontinuation from contact or collision sports are complex and multifaceted and should involve clinicians with expertise in traumatic brain injury and sport and preferably a multidisciplinary team
- **Given the positive benefits of exercise on health**, care must be taken to avoid restricting all PA.
- **All athletes who ultimately retire from contact or collision sports should be encouraged to continue non-contact or low-contact PA**



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Questions?



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*Doctors working at international events need to update their head injury module every 2 years to remain current.*

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