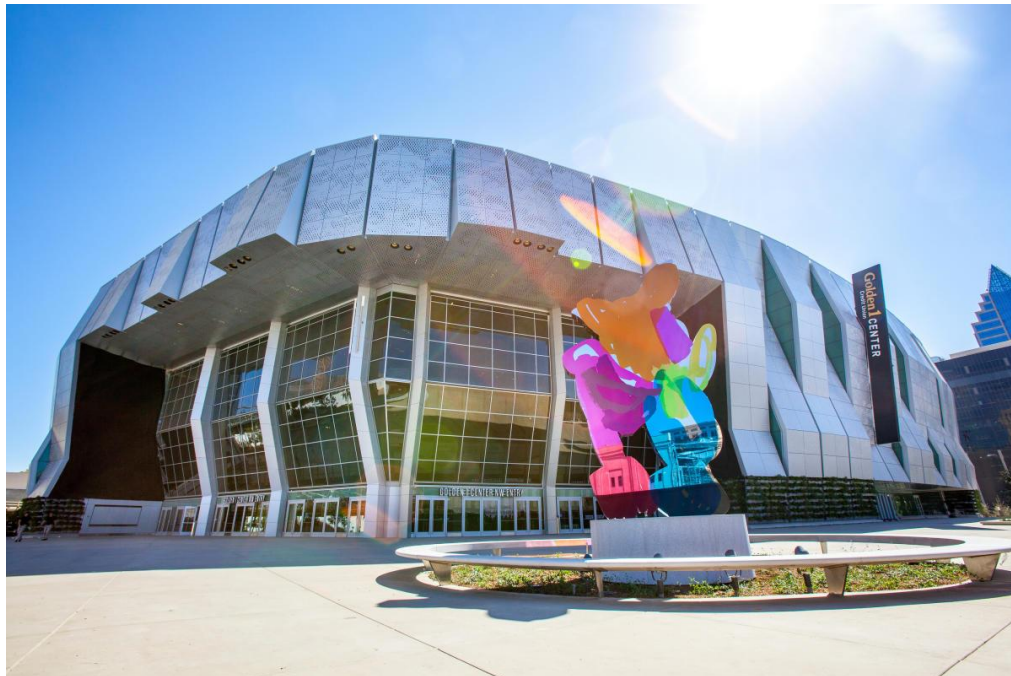


2024 Primary Care Hawaii Conference Update on Concussion Management

April 5, 2024
Jason D. Brayley, MD



History of Sport Related Concussion/Concussion in Sport Group (CISG)

- Vienna, Austria – 2001
- Initiated by International Ice Hockey Federation (IIHF)
- Held in conjunction with the IOC and FIFA
- Prague – 2004
- Zurich – 2008
- Zurich – 2012
- Berlin – 2016
- Amsterdam - 2022

The 6th International Conference on Concussion in Sport – Amsterdam, Oct. 2022

- Patricios et al., BJSM 2023;57-695-711 (June)
- 31 international expert panelists
- Consensus statement updated
- Methodology paper
- 10 systematic reviews*
- “Consensus agreement” defined a priori as 80% majority



The 6th International Conference on Concussion in Sport – Amsterdam, Oct. 2022

- 10 systematic reviews*
 - Acute screening
 - Follow-up/post injury evaluation
 - Rest and exercise
 - Treatment/rehabilitation
 - Persistent symptoms
 - Recovery
 - Return to Sport
 - Residual/long-term effects
 - Retirement
 - Risk reduction/prevention



“Conceptual Definition” of Sport-Related Concussion

- Majority decision but not reaching an 80% consensus
- 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
- Initiates a neurotransmitter and metabolic cascade, with possible axonal injury, blood flow changes 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 seen on standard neuroimaging studies but in the research setting, abnormalities may be present on functional, blood flow or metabolic imaging studies
- Range of clinical symptoms and signs +/- loss of consciousness
- Cannot be explained solely by drug, alcohol or medication use, other injuries (cervical, peripheral vestibular dysfunction) or other comorbidities (psychological factors, coexisting medical conditions)

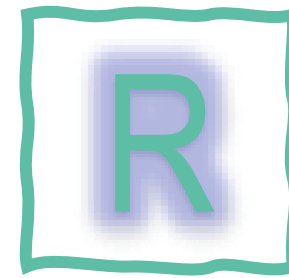


Keep in Mind...

- Deliberation over definition of concussion continues
- Very influential group but research is on SPORTS and that makes it difficult to generalize to other populations
- Only 1% of scientific literature on concussion involves children 5-12 years old
- 31 panelists represented multiple disciplines from nine different countries, six women, two identified as non-white, one was former Paralympian
- Recognized need for greater geographical and demographic diversity

The 6th International Conference on Concussion in Sport – Amsterdam, Oct. 2022

- Recognize: Definition of sport-related concussion
- Reduce: Prevention of concussion
- Remove: Sideline evaluation
- Refer
- Re-evaluate: The office assessment
- Rest and exercise
- Rehabilitation
- Recovery: Assessment of clinical recovery
- Return-to-learn and return-to-sport
- Reconsider: Potential long-term effects
- Retire
- Refine



The 6th International Conference on Concussion in Sport – Amsterdam, Oct. 2022

Concussion Recognition Tool-6 (CRT-6)/Sport Concussion Assessment Tool 6 (SCAT6)/Sport Concussion Office Assessment Tool 6 (SCOAT6)

Generalized recognition of concussion (non-medical personnel): CRT-6

Acute (first 72 hours up to 1 week):

- Sport Concussion Assessment Tool-6 (SCAT-6)
- Child SCAT-6 (ages 8-12)

>72 hours post-injury and for serial evaluations (“weeks”):

- Sport Concussion Office Assessment Tool-6 (SCOAT-6)
- Child SCOAT-6



The 6th International Conference on Concussion in Sport – Amsterdam, Oct. 2022

SCAT-6 link:

<https://bjsm.bmj.com/content/bjsports/57/11/622.full.pdf>

SCOAT-6 link:

<https://completeconcussions.com/wp-content/uploads/2023/06/SCOAT6.pdf>

CRT-6

- Intended for non-medically trained individuals for identification and immediate management of suspected concussion
- Not diagnostic
- Red flags: Call an ambulance
- If no red flags, identification of possible concussion recommendations
- Visible clues of suspected concussion
 - Physical symptoms
 - Changes in emotions
 - Changes in thinking
 - Awareness



Concussion Signs and Symptoms

| Physical symptoms | Cognitive symptoms | Sleep symptoms | Emotional symptoms |
|------------------------|---------------------------------------|--------------------------|--------------------------------------|
| Dizziness | Difficulty remembering | Sleeping more than usual | Easily angered or upset |
| Balance problems | Confusion | Unable to fall asleep | Feeling nervous or anxious |
| Nausea and/or vomiting | Inability to concentrate | Sleeping less than usual | Feelings of sadness |
| Sensitivity to light | Inability to think clearly | Mid-sleep awakenings | Crying more than usual |
| Sensitivity to noise | Mental fogginess | | Lack of interest in usual activities |
| Headache | Inability to remember new information | | Depression |
| Blurred vision | Trouble paying attention | | |
| Fatigue/low energy | Loss of focus | | |
| Flashing lights | | | |
| | | | |
| | | | |

Slide courtesy of Dawn Levine, PhD

SCAT-6 (sideline)

- Immediate assessment/neuro screen (red flags)
- Observable signs
- Glasgow Coma Scale
- C-spine assessment
- Coordination and ocular/motor screen
- Memory assessment (Maddocks questions)
- Symptom evaluation (graded symptom checklist)
- Cognitive screening: immediate memory, concentration, delayed recall
- Coordination and balance: mBESS, tandem gait, dual task gait
- Total cognitive score (50 points)

SCAT6™ Sport Concussion Assessment Tool

For Adolescents (13 years +) & Adults

Athlete Name: _____ ID Number: _____
 Date of Birth: _____ Date of Examination: _____ Date of Injury: _____
 Time of Injury: _____ Sex: Male Female Prefer Not To Say Other
 Dominant Hand: Left Right Ambidextrous Sport/Team/School: _____
 Current Year in School (if applicable): _____ Years of Education Completed (Total): _____
 First Language: _____ Preferred Language: _____
 Examiner: _____

Concussion History

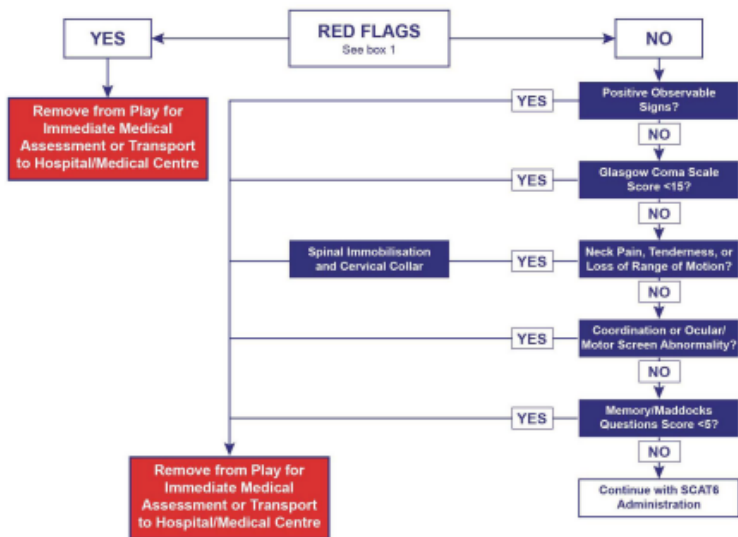
How many diagnosed concussions has the athlete had in the past?: _____
 When was the most recent concussion?: _____
 Primary Symptoms: _____
 How long was the recovery (time to being cleared to play) from the most recent concussion?: _____ (Days)

Immediate Assessment/Neuro Screen (Not Required at Baseline)

The following elements should be used in the evaluation of all athletes who are suspected of having a concussion prior to proceeding to the cognitive assessment, and ideally should be completed "on-field" after the first aid/emergency care priorities are completed.

If any of the observable signs of concussion are noted after a direct or indirect blow to the head, the athlete should be immediately and safely removed from participation and evaluated by an HCP.

The Glasgow Coma Scale is important as a standard measure for all patients and can be repeated over time to monitor deterioration of consciousness. The Maddocks questions and cervical spine exam are also critical steps of the immediate assessment.



Step 1: Observable Signs

Witnessed Observed on Video

| | | |
|---|---|---|
| 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 |

Step 2: Glasgow Coma Scale

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 |

| | | | |
|---------------------------------------|--|--|--|
| Glasgow Coma Score (E + V + M) | | | |
|---------------------------------------|--|--|--|

Box 1: Red Flags

- 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

Step 3: Cervical Spine Assessment

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

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

Step 4: Coordination & Ocular/Motor Screen

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

Step 5: Memory Assessment Maddocks Questions¹

Say "I am going to ask you a few questions, please listen carefully and give your best effort. First, tell me what happened?"

Modified Maddocks questions (Modified appropriately for each sport, 1 point for each correct answer)

| | | |
|--|-----------|---|
| What venue are we at today? | 0 | 1 |
| Which half is it now? | 0 | 1 |
| Who scored last in this match? | 0 | 1 |
| What team did you play last week/game? | 0 | 1 |
| Did your team win the last game? | 0 | 1 |
| Maddocks Score | /5 | |

Note: Appropriate sport-specific questions may be substituted

**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: _____ mins/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 typically feel with "1" representing a very mild symptom and "6" representing a severe symptom."

Suspected/Post-injury: Say "Please rate your symptoms below based on how you feel now with "1" representing a very mild symptom and "6" representing a severe symptom."

PLEASE HAND THE FORM TO THE ATHLETE

| 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 |

| | | |
|--|---|---|
| Do your symptoms get worse with physical activity? | Y | N |
| Do your symptoms get worse with mental activity? | Y | N |

If 100% is feeling perfectly normal, what percent of normal do you feel?

If not 100%, why?

PLEASE HAND THE FORM BACK TO THE EXAMINER

Once the athlete has completed answering all symptom items, it may be useful for the clinician to revisit items that were endorsed positively to gather more detail about each symptom.

Total number of symptoms: _____ of 22 Symptom severity score: _____ of 132

**Step 3: Cognitive Screening (Based on Standardized Assessment of Concussion; SAC)²****Orientation**

| | | |
|--|------|---|
| What month is it? | 0 | 1 |
| What is the date today? | 0 | 1 |
| What is the day of the week? | 0 | 1 |
| What year is it? | 0 | 1 |
| What time is it right now? (within 1 hour) | 0 | 1 |
| Orientation Score | of 5 | |

Immediate Memory

All 3 trials must be administered irrespective of the number correct on Trial 1. Administer at the rate of one word per second.

Trial 1: Say "I am going to test 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 in a previous trial."

| Word list used: A <input type="checkbox"/> B <input type="checkbox"/> C <input type="checkbox"/> | Alternate Lists | | | | | |
|--|-----------------|---------|---------|----------|---------|--|
| List A | Trial 1 | Trial 2 | Trial 3 | List B | List C | |
| Jacket | 0 1 | 0 1 | 0 1 | Finger | Baby | |
| Arrow | 0 1 | 0 1 | 0 1 | Penny | Monkey | |
| Pepper | 0 1 | 0 1 | 0 1 | Blanket | Perfume | |
| Cotton | 0 1 | 0 1 | 0 1 | Lemon | Sunset | |
| Movie | 0 1 | 0 1 | 0 1 | Insect | Iron | |
| Dollar | 0 1 | 0 1 | 0 1 | Candle | Elbow | |
| Honey | 0 1 | 0 1 | 0 1 | Paper | Apple | |
| Mirror | 0 1 | 0 1 | 0 1 | Sugar | Carpet | |
| Saddle | 0 1 | 0 1 | 0 1 | Sandwich | Saddle | |
| Anchor | 0 1 | 0 1 | 0 1 | Wagon | Bubble | |
| Trial Total | | | | | | |

Immediate Memory Score _____ of 30

Time Last Trial Completed: _____

**Step 3: Cognitive Screening (Continued)****Concentration****Digits Backward:**

Administer at the rate of one digit per second reading DOWN the selected column. If a string is completed correctly, move on to the string with next higher number of digits; if the string is completed incorrectly, use the alternate string with the same number of digits; if this is failed again, 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. For example, if I say 7-1-9, you would say 9-1-7. So, if I said 9-6-8 you would say? (8-6-9)"

Digit list used: A B C

| List A | List B | List C | | | | |
|---------------------|-------------|-------------|---|---|---|------|
| 4-9-3 | 5-2-6 | 1-4-2 | Y | N | 0 | 1 |
| 6-2-9 | 4-1-5 | 6-5-8 | Y | N | | |
| 3-8-1-4 | 1-7-9-5 | 6-8-3-1 | Y | N | 0 | 1 |
| 3-2-7-9 | 4-9-6-8 | 3-4-8-1 | Y | N | | |
| 6-2-9-7-1 | 4-8-5-2-7 | 4-9-1-5-3 | Y | N | 0 | 1 |
| 1-5-2-8-6 | 6-1-8-4-3 | 6-8-2-5-1 | Y | N | | |
| 7-1-8-4-6-2 | 8-3-1-9-6-4 | 3-7-6-5-1-9 | Y | N | 0 | 1 |
| 5-3-9-1-4-8 | 7-2-4-8-5-6 | 9-2-6-5-1-4 | Y | N | | |
| Digits Score | | | | | | of 4 |

Months in Reverse Order:

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

Start stopwatch and CIRCLE each correct response:

December November October September August July June May April March February January

Time Taken to Complete (secs): Number of Errors:

1 point if no errors and completion under 30 seconds

Months Score: of 1

Concentration Score (Digits + Months) of 5

Step 4: Coordination and Balance Examination**Modified Balance Error Scoring System (mBESS)³ testing**

(see detailed administration instructions)

Foot Tested: Left Right (i.e. test the non-dominant foot)

Testing Surface (hard floor, field, etc.):

Footwear (shoes, barefoot, braces, tape etc.):

OPTIONAL (depending on clinical presentation and setting resources): For further assessment, the same 3 stances can be performed on a surface of medium density foam (e.g., approximately 50cm x 40cm x 6cm) with the same instructions and scoring.

**Step 4: Coordination and Balance Examination (Continued)****Modified BESS** (20 seconds each)

Double Leg Stance: of 10

Tandem Stance: of 10

Single Leg Stance: of 10

Total Errors: of 30

On Foam (Optional)

Double Leg Stance: of 10

Tandem Stance: of 10

Single Leg Stance: 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 (see SCAT6).

Timed Tandem Gait

Place a 3-metre-long line on the floor/firm surface with athletic tape. The task should be timed. Please complete all 3 trials.

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

Single Task:

| Time to Complete Tandem Gait Walking (seconds) | | | | |
|--|----------------------|----------------------|----------------------|----------------------|
| Trial 1 | Trial 2 | Trial 3 | Average 3 Trials | Fastest Trial |
| <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |

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

Place a 3-metre-long line on the floor/firm surface with athletic tape. The task should be timed.

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 practise counting. Starting with 93, count backward by sevens until I say "stop". Note that this practice only involves counting backwards.

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

| Task | | | | | | | | | Errors | Time |
|----------|----|----|----|----|----|----|----|----|----------------------|----------------------|
| Practice | 93 | 86 | 72 | 65 | 58 | 51 | 44 | 37 | <input type="text"/> | <input type="text"/> |

Say "Good. Now I will ask you to walk heel-to-toe and count backwards out loud at the same time. Are you ready? The number to start with is 88. Go!"

Dual Task Cognitive Performance: Circle correct responses; record number of subtraction counting errors.

| Task | | | | | | | | | | | | | Errors | Time (circle fastest) | |
|---------|----|----|----|----|----|----|----|----|----|----|----|----|--------|-----------------------|----------------------|
| Trial 1 | 88 | 81 | 74 | 67 | 60 | 53 | 46 | 39 | 32 | 25 | 18 | 11 | 4 | <input type="text"/> | <input type="text"/> |
| Trial 2 | 90 | 83 | 76 | 69 | 62 | 55 | 48 | 41 | 34 | 27 | 20 | 13 | 6 | <input type="text"/> | <input type="text"/> |
| Trial 3 | 98 | 91 | 84 | 77 | 70 | 63 | 56 | 49 | 42 | 35 | 28 | 21 | 14 | <input type="text"/> | <input type="text"/> |

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

| | | | | | | | | | | | | | | | |
|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
| <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |
|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|

Starting Integer: Errors: Time:

**Step 4: Coordination and Balance Examination (Continued)**

Were any single- or dual-task, timed tandem gait trials not completed due to walking errors or other reasons?

Yes No

If yes, please explain why:

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 can remember in any order."

Time started: Word list used: A B C **Alternate Lists**

| List A | 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 |
| Delayed Recall Score | of 10 | | |

Total Cognitive ScoreOrientation: of 5Immediate Memory: of 30Concentration: of 5Delayed Recall: of 10Total: 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)

For use by Health Care Professionals only

**Step 6: Decision**

| Domain | Date: | Date: | Date: |
|--|-----------------|-----------------|-----------------|
| Neurological Exam (Acute Injury evaluation only) | Normal/Abnormal | Normal/Abnormal | Normal/Abnormal |
| 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 SCAT6.

Name: Signature: Title/Specialty: Registration/License number (if applicable): Date: **Additional Clinical Notes****Note:** Scoring on the SCAT6 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 SCAT6 and still have a concussion.

For use by Health Care Professionals only

SCOAT-6 (office)

- History of head injuries
- History of neurological, psychological, psychiatric or learning disorders
- Family history
- Symptom evaluation (GSC)
- Verbal cognitive tests
- Orthostatic vital signs
- C-spine assessment
- Neurological examination
- Balance, tandem gait, complex tandem gait, dual task gait
- Modified vestibular/ocular-motor screening
- Anxiety screen
- Depression screen
- Sleep screen
- Computerized cognitive test results (if used)
- Graded aerobic exercise test
- Overall assessment
- Management and follow-up
- Referral
- RTL/RTS strategies

Blue – 1st evaluation Green – Recommended Orange - Optional



Trusted Team Physicians for the Sacramento Kings

SCOAT-6

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 (3 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 determination made by an HCP. The various components of the SCOAT6 may 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, groups, and organisations. Any alteration (including translations and digital re-formatting), re-branding, or sale for commercial gain is not permissible without the expressed written consent of BMJ and the Concussion in Sport Group (CISG).

Completion Guide

Blue: Complete only at first assessment

Green: Recommended part of assessment

Orange: Optional part 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: _____

Examiner: _____ Date of Examination: _____

Referring Physician's Name: _____

Referring Physician's Contact Details: _____

* In reviewing studies informing the SCOAT6 and Child SCOAT6, the period defined for the included papers was 3–30 days. HCPs may choose to use the SCOAT6 beyond this timeframe but should be aware of the parameters of the review.

For use by Health Care Professionals Only

SCOAT6™

Developed by: The Concussion in Sport Group (CISG)

Supported by:



Sport Concussion Office Assessment Tool 6 - SCOAT6™

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 Including 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 _____ | | |

For use by Health Care Professionals only

British Journal of Sports Medicine



List All Current Medications - including over-the-counter, naturopathic and supplements

| Item | Dose | Frequency | Reason Taken |
|------|------|-----------|--------------|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

Family History of Any Diagnosed Neurological, Psychological, Psychiatric, Cognitive or Developmental Disorders

| Family Member | Diagnosis | Management Including Medication |
|---------------|---|---------------------------------|
| | <input type="checkbox"/> Depression | |
| | <input type="checkbox"/> Anxiety | |
| | <input type="checkbox"/> Attention deficit hyper-activity disorder (ADHD) | |
| | <input type="checkbox"/> Learning disorder/ dyslexia | |
| | <input type="checkbox"/> Migraine | |
| | <input type="checkbox"/> Other _____ | |

Additional Notes:



Symptom Evaluation

Please rate your symptoms below based on how you feel now with "1" representing a very mild symptom and "6" representing a severe symptom.

| | | | | | | |
|------|------|---|----------|---|--------|---|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| None | Mild | | Moderate | | Severe | |

| Symptom | Date of Assessment | | | | |
|--------------------------|--------------------|--------------------|-----------|-----------|-----------|
| | Pre-injury | Day injured (date) | Consult 1 | Consult 2 | Consult 3 |
| | Rating | Rating | Rating | Rating | Rating |
| Headaches | | | | | |
| Pressure in head | | | | | |
| Neck pain | | | | | |
| Nausea or vomiting | | | | | |
| Dizziness | | | | | |
| Blurred vision | | | | | |
| Balance problems | | | | | |
| Sensitivity to light | | | | | |
| Sensitivity to noise | | | | | |
| Feeling slowed down | | | | | |
| Feeling like "in a fog" | | | | | |
| Difficulty concentrating | | | | | |
| Difficulty remembering | | | | | |
| Fatigue or low energy | | | | | |
| Confusion | | | | | |
| Drowsiness | | | | | |
| More emotional | | | | | |
| Irritability | | | | | |
| Sadness | | | | | |
| Nervous or anxious | | | | | |
| Sleep disturbance | | | | | |
| Abnormal heart rate | | | | | |
| Excessive sweating | | | | | |
| Other _____ | | | | | |



Symptom Evaluation (Continued)

| Symptom | Date of Assessment | | | | |
|--|--------------------|--------------------|-----------|-----------|-----------|
| | Pre-injury | Day injured (date) | Consult 1 | Consult 2 | Consult 3 |
| | Rating | Rating | Rating | Rating | Rating |
| Do symptoms worsen with physical activity? | | | | | |
| Do symptoms worsen with cognitive (thinking) activity? | | | | | |
| Symptom number | | | | | |
| Symptom severity score | | | | | |
| What percentage of normal do you feel? | | | | | |

Verbal Cognitive Tests

Immediate Memory

All 3 trials must be administered irrespective of the number correct on Trial 1. Administer at the rate of one word per second in a monotone voice.

Trial 1: Say "I am going to test 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 in a previous trial."

Word list used: A B C

| List A | Alternate Lists | | | | | | | |
|--------------------|-----------------|---------|---------|--------|--------|---|----------|---------|
| | Trial 1 | Trial 2 | Trial 3 | List B | List C | | | |
| Jacket | 0 | 1 | 0 | 1 | 0 | 1 | Finger | Baby |
| Arrow | 0 | 1 | 0 | 1 | 0 | 1 | Penny | Monkey |
| Pepper | 0 | 1 | 0 | 1 | 0 | 1 | Blanket | Perfume |
| Cotton | 0 | 1 | 0 | 1 | 0 | 1 | Lemon | Sunset |
| Movie | 0 | 1 | 0 | 1 | 0 | 1 | Insect | Iron |
| Dollar | 0 | 1 | 0 | 1 | 0 | 1 | Candle | Elbow |
| Honey | 0 | 1 | 0 | 1 | 0 | 1 | Paper | Apple |
| Mirror | 0 | 1 | 0 | 1 | 0 | 1 | Sugar | Carpet |
| Saddle | 0 | 1 | 0 | 1 | 0 | 1 | Sandwich | Saddle |
| Anchor | 0 | 1 | 0 | 1 | 0 | 1 | Wagon | Bubble |
| Trial Total | | | | | | | | |

Immediate Memory Total _____ of 30

Time last trial completed: _____



Verbal Cognitive Tests: Alternate 15-word lists

Alternate 15-word lists may be accessed by scanning or clicking the QR code.



Record the total below.

Total _____ of 45

Digits Backwards

Administer at the rate of one digit per second in a monotone voice reading DOWN the selected column. If a string is completed correctly, move on to the string with next higher number of digits; if the string is completed incorrectly, use the alternate string with the same number of digits; if this is failed again, 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. For example, if I say 7-1-9, you would say 9-1-7. So, if I said 9-6-8 you would say? 8-6-9"

Digit list used: A B C

| List A | List B | List C | | | | |
|-------------|-------------|-------------|--------------|---|------|---|
| 4-9-3 | 5-2-6 | 1-4-2 | Y | N | 0 | 1 |
| 6-2-9 | 4-1-5 | 6-5-8 | Y | N | | |
| 3-8-1-4 | 1-7-9-5 | 6-8-3-1 | Y | N | 0 | 1 |
| 3-2-7-9 | 4-9-6-8 | 3-4-8-1 | Y | N | | |
| 6-2-9-7-1 | 4-8-5-2-7 | 4-9-1-5-3 | Y | N | 0 | 1 |
| 1-5-2-8-6 | 6-1-8-4-3 | 6-8-2-5-1 | Y | N | | |
| 7-1-8-4-6-2 | 8-3-1-9-6-4 | 3-7-6-5-1-9 | Y | N | 0 | 1 |
| 5-3-9-1-4-8 | 7-2-4-8-5-6 | 9-2-6-5-1-4 | Y | N | | |
| | | | Digits score | | of 4 | |

Months in Reverse Order

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

Start stopwatch and CIRCLE each correct response:

December November October September August July June May April March February January

Time Taken to Complete (secs): _____ (N <30 sec) Number of Errors: _____



Examination

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 ¹ | No <input type="checkbox"/> Yes <input type="checkbox"/> If yes: Description | No <input type="checkbox"/> Yes <input type="checkbox"/> If yes: Description |
| <ul style="list-style-type: none"> Dizziness or light-headedness 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 ≥ 20 mmHg or (2) diastolic BP drop of ≥ 10 mmHg (3) HR decreases (4) HR increases by > 30 bpm

Cervical Spine Assessment

| Cervical Spine Palpation | Signs and Symptoms |
|--------------------------|---|
| Muscle Spasm | <input type="checkbox"/> Normal <input type="checkbox"/> Abnormal |
| Midline Tenderness | <input type="checkbox"/> Normal <input type="checkbox"/> Abnormal |
| Paravertebral Tenderness | <input type="checkbox"/> Normal <input type="checkbox"/> Abnormal |

| Cervical Active Range of Motion | Result |
|---------------------------------|---|
| Flexion (50-70°) | <input type="checkbox"/> Normal <input type="checkbox"/> Abnormal |
| Extension (60-85°) | <input type="checkbox"/> Normal <input type="checkbox"/> Abnormal |
| Right Lateral Flexion (40-50°) | <input type="checkbox"/> Normal <input type="checkbox"/> Abnormal |
| Left Lateral Flexion (40-50°) | <input type="checkbox"/> Normal <input type="checkbox"/> Abnormal |
| Right Rotation (60-75°) | <input type="checkbox"/> Normal <input type="checkbox"/> Abnormal |
| Left Rotation (60-75°) | <input type="checkbox"/> Normal <input type="checkbox"/> Abnormal |



Neurological Examination

Cranial Nerves

Normal Abnormal Not tested

Notes:

Other Neurological Findings

Limb Tone: Normal Abnormal Not tested

Strength: Normal Abnormal Not tested

Deep Tendon Reflexes: Normal Abnormal Not tested

Sensation: Normal Abnormal Not tested

Cerebellar Function: Normal Abnormal Not tested

Comments:

Balance

Barefoot on a firm surface with or without foam mat.

Foot Tested: Left Right (i.e. test the non-dominant foot)

Modified BESS

Double Leg Stance: of 10

Tandem Stance: of 10

Single Leg Stance: of 10

Total Errors: of 30

On Foam

Double Leg Stance: of 10

Tandem Stance: of 10

Single Leg Stance: of 10

Total Errors: of 30

Timed Tandem Gait

Place a 3-metre-long line on the floor/firm surface with athletic tape.

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

| Time to Complete Tandem Gait Walking (seconds) | | | | |
|--|----------------------|----------------------|----------------------|----------------------|
| Trial 1 | Trial 2 | Trial 3 | Average 3 Trials | Fastest Trial |
| <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> | <input type="text"/> |

Abnormal/failed to complete Unstable/sway Fall/over-step Dizzy/nauseous

**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):

Dual Task Gait

Say "Now, while you are walking heel-to-toe, I will ask you to recite the following words in reverse order / count backwards out loud by 7s (for instance starting at 100, then 93, 86 etc.) / recite the months of the year in reverse order"

(select one cognitive task). Allow for a verbal practice attempt of the cognitive task selected.

| Cognitive Tasks | | | | | | | | | | | | |
|--------------------------------------|----------|----------|---------|-----------|--------|-------|-------|-------|-------|-------|----------|---------|
| Trial 1 (Words - spell backwards) | VISIT | ALERT | FENCE | BRAVE | MOUSE | DANCE | CRAWL | LEARN | | | | |
| OR Trial 2 (Subtract serial 7s) | 95 | 88 | 81 | 74 | 67 | 60 | 53 | 46 | | | | |
| OR Trial 3 (Months backwards) | December | November | October | September | August | July | June | May | April | March | February | January |

Before attempting the dual task: "Good. Now I will ask you to walk heel-to-toe calling the answers out loud at the same time. Are you ready?"

Number of Trials Attempted: Number of Correct Trials: Average Time (s):

Cognitive Accuracy Score (Number Correct / Number Attempted):

Comments:

**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) | | | | | | |

Anxiety Screen

Not Done

Assign scores of 0, 1, 2, and 3 to the response categories, respectively, of "not at all," "several days," "more than half the days," and "nearly every day."

| Over the last 2 weeks, how often have you been bothered by any of the following problems? | Not at all | Several days | More than half the days | Nearly every day |
|---|------------|--------------|-------------------------|------------------|
| 1. Feeling nervous, anxious, or on edge | 0 | 1 | 2 | 3 |
| 2. Not being able to stop or control worrying | 0 | 1 | 2 | 3 |
| 3. Worrying too much about different things | 0 | 1 | 2 | 3 |
| 4. Trouble relaxing | 0 | 1 | 2 | 3 |
| 5. Being so restless that it's hard to sit still | 0 | 1 | 2 | 3 |
| 6. Becoming easily annoyed or irritable | 0 | 1 | 2 | 3 |
| 7. Feeling afraid as if something awful might happen | 0 | 1 | 2 | 3 |

Anxiety Screen Score: 0–4: minimal anxiety 5–9: mild anxiety
10–14: moderate anxiety 15–21: severe anxiety

Depression Screen

Not Done

The purpose is to screen for depression in a "first-step" approach. Patients who screen positive should be further evaluated with the PHQ-9 to determine whether they meet criteria for a depressive disorder.

| Over the last 2 weeks, how often have you been bothered by any of the following problems? | Not at all | Several days | More than half the days | Nearly every day |
|---|------------|--------------|-------------------------|------------------|
| 1. Little interest or pleasure in doing things | 0 | 1 | 2 | 3 |
| 2. Feeling down, depressed or hopeless | 0 | 1 | 2 | 3 |

Depression Screen Score: (Ranges from 0-6, 3 being the cutpoint to screen for depression)

**Sleep Screen**Not Done

| 1. During the past week how many hours of actual sleep did you get at night? (This may be different than the number of hours you spent in bed.) | |
|--|---|
| 5 to 6 hours | 4 |
| 6 to 7 hours | 3 |
| 7 to 8 hours | 2 |
| 8 to 9 hours | 1 |
| More than 9 hours | 0 |

| 2. How satisfied/dissatisfied were you with the quality of your sleep? | |
|--|---|
| Very dissatisfied | 4 |
| Somewhat dissatisfied | 3 |
| Somewhat satisfied | 2 |
| Satisfied | 1 |
| Very satisfied | 0 |

| 3. During the recent past, how long has it usually taken you to fall asleep each night? | |
|---|---|
| Longer than 60 minutes | 3 |
| 31-60 minutes | 2 |
| 16-30 minutes | 1 |
| 15 minutes or less | 0 |

| 4. How often do you have trouble staying asleep? | |
|--|---|
| Five to seven times a week | 3 |
| Three of four times a week | 2 |
| Once or twice a week | 1 |
| Never | 0 |

| 5. During the recent past, how often have you taken medicine to help you sleep? (prescribed or over-the-counter) | |
|---|---|
| Five to seven times a week | 3 |
| Three of four times a week | 2 |
| Once or twice a week | 1 |
| Never | 0 |

Sleep Screen Score:

A higher sleep disorder score (SDS) indicates a greater likelihood of a clinical sleep disorder:

- 0-4 (Normal)
- 5-7 (Mild)
- 8-10 (Moderate)
- 11-17 (Severe)

**Delayed Word Recall**

Minimum of 5 minutes after immediate recall

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

| Word list used: | A <input type="checkbox"/> | B <input type="checkbox"/> | C <input type="checkbox"/> | Alternate Lists | |
|-----------------|----------------------------|----------------------------|----------------------------|-----------------|--|
| List A | 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 | | |

Score: of 10Record Actual Time (mins) Since Completing Immediate Recall: **Computerised Cognitive Test Results (if used)**Not Done Test Battery Used: Recent Baseline - if performed (Date): Post-Injury Result (Rest): Post-Injury Result (Post-Exercise Stress): **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: **Overall Assessment**

Summary:

**Management and Follow-up Plan**Cervical or brain imaging (X-rays/CT/MRI) Imaging Requested: Reason: Findings:

Recommendations regarding return to:

Class: Work: Driving: Sport: (See revised graduated [return-to-learn](#) and [return-to-sport](#) §**Referral**

Further assessment, intervention or management

Assessment by:

Name:

 Athletic Trainer/Therapist Exercise Physiologist Neurologist Neuropsychologist Neurosurgeon Ophthalmologist Optometrist Paediatrician Physiatrist/Rehab Phys Physiotherapist Psychologist Psychiatrist Sport and Exercise Medicine Phys Other

Pharmacotherapy Prescribed:

Date of Review: **Additional Clinical Notes****Return-to-Learn (RTL) Strategy**

Facilitating RTL is a vital part of the recovery process for student-athletes. Policies to facilitate academic support, including accommodations/learn support should address risk factors for greater RTL duration (e.g., social environmental, physical, curricular, and testing factors as needed). **Not** If symptom exacerbation occurs during cognitive activity or screen time aspects of learning are reported, clinicians should consider implement recovery process. When the RTL strategy is implemented, it can begin f an incremental increase in cognitive load (Steps 2 to 4). Progression th exacerbation of current symptoms related to the current concussion) and symptom resolution. Further, while the RTL and RTS strategies can occ unrestricted RTS.

| Step | Mental Activity | Activity |
|------|--|---|
| 1 | Daily activities that do not result in more than a mild exacerbation* of symptoms related to the current concussion. | Typical activities (e.g., reading) while mini Start with 5–15 min gradually |
| 2 | School activities. | Homework, reading activities outside of |
| 3 | Return to school part time. | Gradual introduction need to start with a with greater access the day. |
| 4 | Return to school full time. | Gradually progress full day can be tolerate mild* symptom exa |

NOTE: Following an initial period of relative rest (24–48 hours following increase in their cognitive load. Progression through the strategy for stud symptom exacerbation.

*Mild and brief exacerbation of symptoms is defined as an increase of n no symptoms and 10 the worst symptoms imaginable) for less than an cognitive activity.
For Use by Health Care Professionals only

Return-to-Sport (RTS) Strategy

Return to sport participation after an SRC follows a graduated stepwise strategy, an example of which is outlined in Table 2. RTS occurs in conjunction with return to learn (see RTL strategy) and under the supervision of a qualified HCP. Following an initial period of relative rest (Step 1: approximately 24–48 hours), clinicians can implement Step 2 (i.e., light (Step 2A) and then moderate (Step 2B) aerobic activity) of the RTS strategy as a treatment of acute concussion. The athlete may then advance to steps 3–6 on a time course dictated by symptoms, cognitive function, clinical findings, and clinical judgement. Differentiating early activity (step 1), aerobic exercise (Step 2), and individual sport-specific exercise (Step 3) as part of the treatment of SRC from the remainder of the RTS progression (Steps 4–6) can be useful for the athlete and their support network (e.g., parents, coaches, administrators, agents). Athletes may be moved into the later stages that involve risk of head impact (Steps 4–6 and Step 3 if there is any risk of head impact with sport-specific activity) of the RTS strategy following authorization by the HCP and after resolution of any new symptoms, abnormalities in cognitive function, and clinical findings related to the current concussion. Each step typically takes at least 24 hours. Clinicians and athletes can expect a minimum of 1 week to complete the full rehabilitation strategy, but typical unrestricted RTS can take up to one month post-SRC. The time frame for RTS may vary based on individual characteristics, necessitating an individualized approach to clinical management. Athletes having difficulty progressing through the RTS strategy or with symptoms and signs that are not progressively recovering beyond the first 2–4 weeks may benefit from rehabilitation and/or involvement of a multidisciplinary team of HCP experienced in managing SRC. Medical determination of readiness, including psychological readiness, to return to at-risk activities should occur prior to returning to any activities at risk of contact, collision or fall (e.g., multiplayer training drills), which may be required prior to any of steps 3–6, depending on the nature of the sport or activity that the athlete is returning to and in keeping with local laws/requirements.

| 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 2A – Light (up to approx. 55% max HR) then 2B – Moderate (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 NOTE: 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 |

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

Vestibular Screening

- Saccades horizontal
- Saccades vertical
- Smooth pursuit
- VOR horizontal
- VOR vertical
- Near point of convergence
- Balance

- Dizziness
- Headache
- Nausea
- Concentration
- Fatigue
- Blurry vision
- Difficulty focusing on moving targets
- Vertigo

Examples of Impact on Daily Functioning

| Visual activity | Function | Impact on school and learning |
|--------------------------------|--|---|
| Saccades | Critical for quickly shifting gaze from one point to another | Reading/tracking words |
| | | |
| Vestibular ocular reflex (VOR) | Keeps eye movements stable while head moves | Stay focused while looking back and forth (i.e. teacher to board to paper, computer to paper) |
| | | |

Concussion recovery trajectory

(McCroory et al., 2017; Halstead et al., 2018)

24-72 hours:

Large adverse effects on cognitive functioning, balance, and other symptoms

10 days to 2 weeks:

Rapid recovery within this time frame

1 month:

Majority recovered from a clinical perspective (*reported symptoms*)

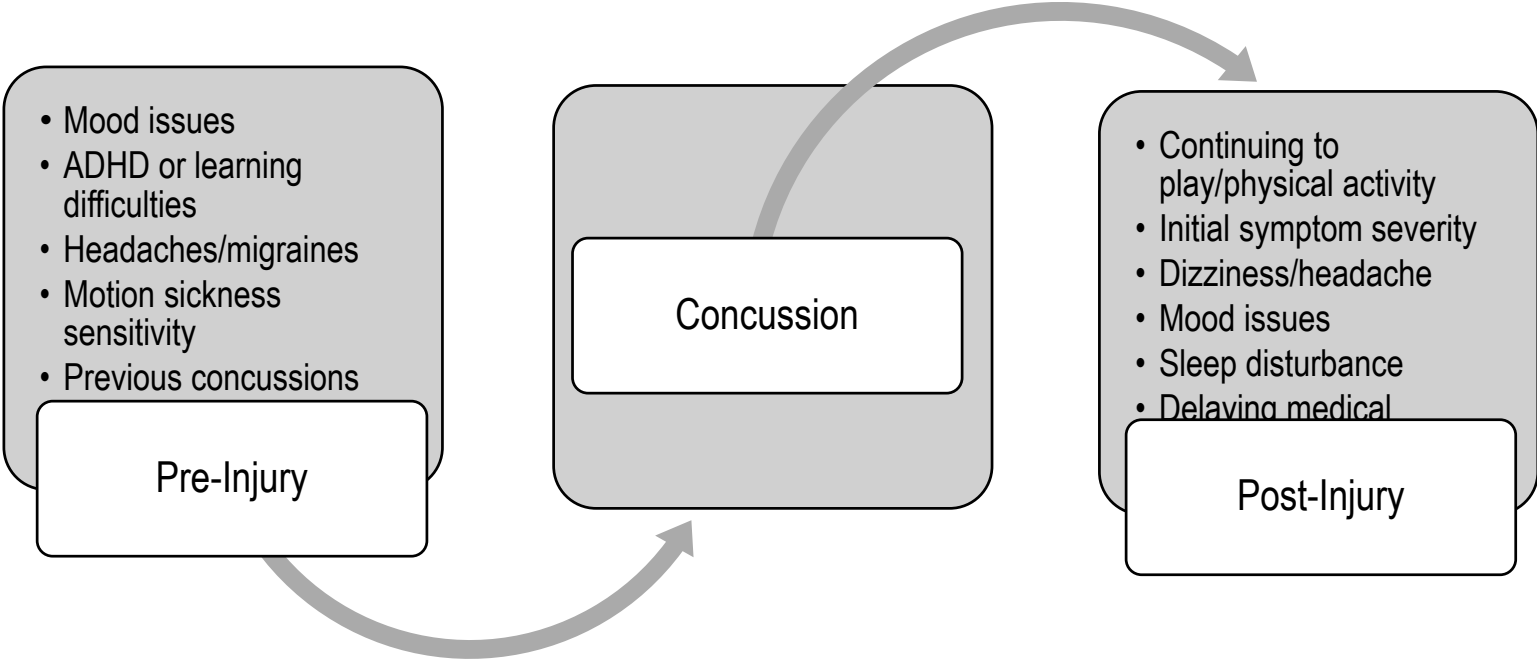
>1 month:

Can be expected and/or considered “persisting”

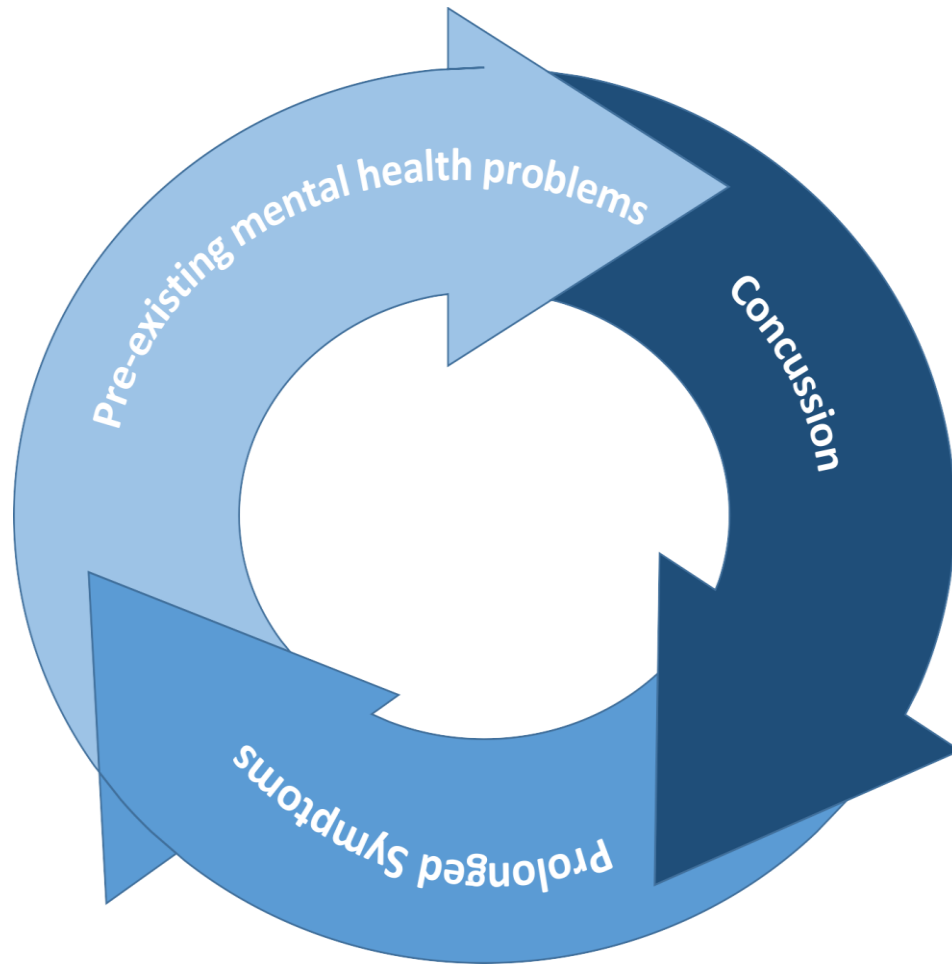
Recovery

- NCAA consortium athletes 2-4 weeks normal recovery
- Up to 30% report persistent symptoms beyond 4 weeks (Iverson et al., 2017)
- CDC suggests recovery **within 1-3 months** when considering parent education and outcomes are determined by a combination of tools (e.g. validated symptom scales, cognitive testing and balance)

Factors Contributing to Recovery



Slide courtesy of Dawn Levine, PhD



Biopsychosocial Model

Biological

- Physiologic considerations
- Neurometabolic cascade post-concussion
- Autonomic nervous system function
- Early exercise may provide physiologic adaptations to improve outcomes
- Clinical manifestations and considerations for evaluation
- Symptoms
- Cognitive function
- Motor/Balance
- Visual and Vestibular
- Medication/pharmacologic considerations
- Sex and age may influence outcomes and treatment considerations

Psychological

- Anxiety and depression should be considered in evaluation and treatment
- General mood considerations
- Integration back into social activities that do not exacerbate symptoms may improve athlete perceptions
- Exercise and rehabilitation effects on psychosocial outcomes (e.g., quality of life)
- Comprehensive approach/care team may improve outcomes
- Peer support and cognitive behavioral therapy, especially in those with persistent symptoms

Social

- Peer/teammate interaction
- Engagement in daily social activities without symptom exacerbation early in the process
- Rehabilitation as a means for social interaction
- Social support systems consideration
- Work and school interactions

Register-Mihalik, 2020



Trusted Team Physicians for the Sacramento Kings

Return-to-Learn

Table 1 Return-to-learn (RTL) strategy

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

Following an initial period of relative rest (24–48 hours following an injury at Step 1), athletes can begin a gradual and incremental increase in their cognitive load. Progression through the strategy for students should be slowed when there is more than a mild and brief symptom exacerbation.

*Mild and brief exacerbation of symptoms is defined as an increase of no more than 2 points on a 0–10 point scale (with 0 representing no symptoms and 10 the worst symptoms imaginable) for less than an hour when compared with the baseline value reported prior to cognitive activity.



Return-to-Sport

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

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

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

HCP, healthcare professional; maxHR, predicted maximal heart rate according to age (ie, 220-age).

Tips from Neuropsychology

- Concussion evaluation is a dynamic process, often needs to be repeated periodically in the acute stages as the concussion evolves
- Concussion is a REHABILITATIVE INJURY – normal recovery 2-4 weeks
- “Cocoon therapy” is not helpful and may prolong symptoms in many cases
- Assessment is multifactorial – think holistically
- Use appropriate resources
- Psychiatric comorbidity must be addressed
- When cognitive, emotional and ocular-vestibular issues are part of the picture, school accommodations will be needed



Case 1

- 15 y/o male hit during flag football game kick off
- Seen in office 4 days after injury
- c/o HA, photophobia, decreased energy, inability to focus, balance “off”, sleeping more than usual
- No prior concussions
- No significant past medical history (no ADD/ADHD, no mental health issues)
- No medications
- Both parents physicians, highly concerned

Case 1



Trusted Team Physicians for the Sacramento Kings

Case 1 - continued

- Exam (4 days): No gross neuro findings, balance with inability to maintain single leg stance (multiple toe taps), increased dizziness/rapid “blinking”/mild HA with saccades.
- Recommendations at first visit? School, social, exercise...
- Follow up/visit 2 (11 days): Balance improved, saccades testing normal, tolerating full school day
- Recommendations at visit 2? School, social, exercise...



Case 2

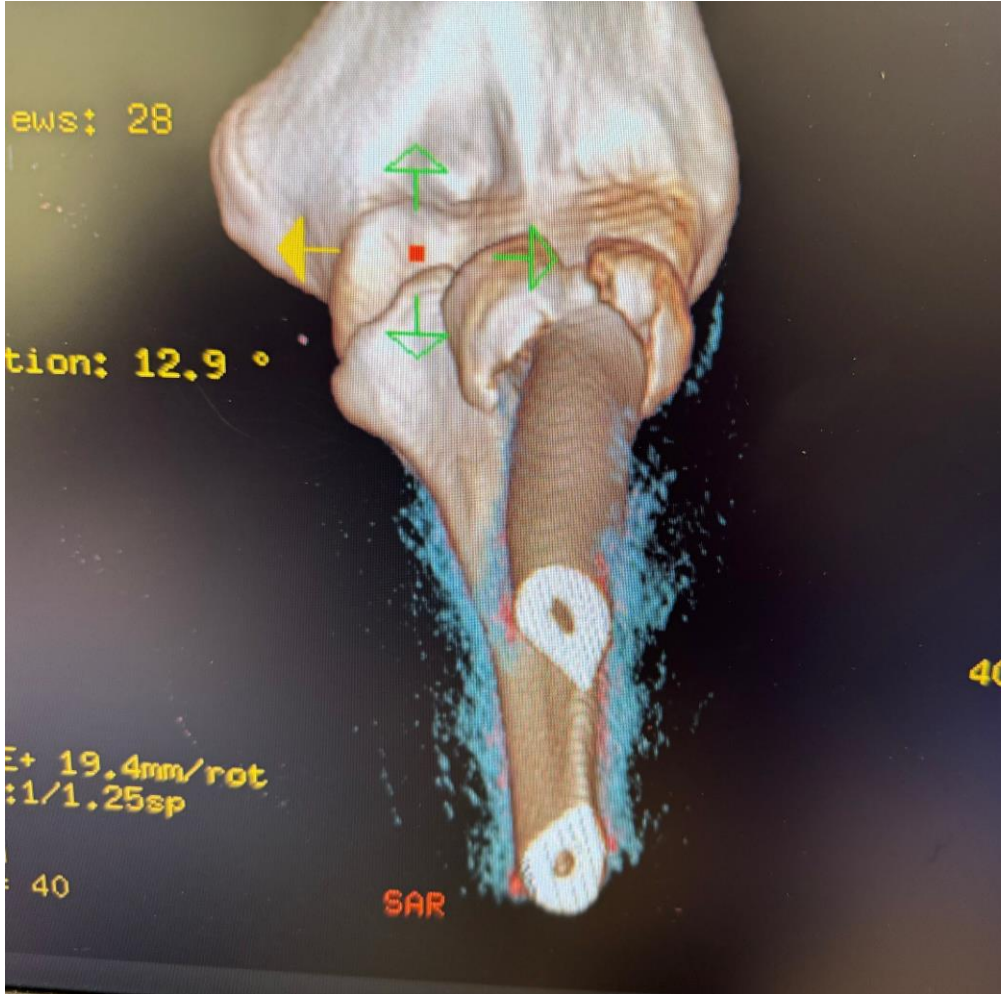
- 18 y/o crashes jumping mountain bike on free afternoon during 1st quarter of college in Washington state
- Roommate texts his father (physician) that he's been taken to ED
- Can't remember crash, doesn't remember being picked up at track, can't move elbow
- c/o HA, "feels out of it", photophobia, repeating things on way to ED
- No prior concussions
- No significant past medical history (no ADD/ADHD, no mental health issues)

- Diagnosed with displaced radial head fracture, discharged with splint
- Flown home, CT confirms nature of fracture, surgery performed 4 days later
- Concussion evaluation 6 days later

Case 2



Case 2



Case 2 - continued

- Point of case?
 - Don't forget concussion with distracting injuries
 - Academic accommodations are invaluable
 - your time will be greatly appreciated
- Early contact with school
- Early light exercise, socialization are vital
- Be encouraging, engage colleagues as needed
- Regular check in with teachers, academic advisors, etc
- Acute symptoms lasted 2 weeks
- Word finding challenges (compared to normal) still present 4 weeks later



Resources

- [The Concussion Recognition Tool 6 \(CRT6\) | British Journal of Sports Medicine \(bmj.com\)](#)
- [Sport Concussion Assessment Tool 6 \(SCAT6\) \(bmj.com\)](#)
- [Sport Concussion Office Assessment Tool 6 \(SCOAT6\) | British Journal of Sports Medicine \(bmj.com\)](#)
- [Child SCAT6 | British Journal of Sports Medicine \(bmj.com\)](#)
- [Child SCOAT6 | British Journal of Sports Medicine \(bmj.com\)](#)



Sport Related Concussion – Key Points

- Be aware of SRC/Consensus group publications approximately every 4 years
- If covering games, pull from play with any level of concern, be familiar with SCAT6 (completed in 10-15 minutes)
- Tailor focused evaluation to your clinical practice, with exam and further recommendations based on SCAT6/SCOAT6
- After brief period of full rest, encourage safe exercise and social engagement
- Don't forget cervical/muscular pain as a source of ongoing symptoms
- Be sure to assess vestibular/ocular function at each visit, and refer for appropriate therapy to reduce duration of symptoms
- Remember the impact of prior mental health issues in recovery
- Return to Learn must be completed before Return to Sport (which takes minimum of 1 week)
- Many concussions not resolved for up to 4 weeks



Thank you!



Trusted Team Physicians for the Sacramento Kings