Sport Related Concussion

Matthew Negaard, MD, CAQ-SM

Sports Medicine Physician, Forte Sports Medicine and Orthopedics

Clinical Assistant Professor of Emergency Medicine, University of Iowa

Team Physician, Indianapolis Colts

August 22, 2023

Forté SPORTS MEDICINE AND ORTHOPEDICS

No Disclosures

Forté SPORTS MEDICINE AND ORTHOPEDICS

Outline

- New Consensus Statement in June 2023
- Defining Concussion
- Recognizing Concussion
- Indications for Emergent Imaging
- Management of Concussion
  - In office assessment
  - Rest and Exercise
  - Screen Time
- Return to Learn
- Return to Sport
- Prevention of Concussion

Forté SPORTS MEDICINE AND ORTHOPEDICS

New Consensus Statement 2023

- Consensus Statement
- 10 Systematic Reviews
  - Prevention and Modifiable Risk Factors
  - Rest and Exercise after SRC
  - Targeted Interventions
  - Diagnosing Post-Concussive Syndrome
  - Biomarkers and Emerging technologies
  - Return to School and Sport
  - Later in Life Health Risks
  - Retire from Sport
- Sport Concussion Assessment Tool (SCAT6)
- Sport Concussion Office Assessment Tool (SCOAT6)

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

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

Forté SPORTS MEDICINE AND ORTHOPEDICS

Patricios JS, Schneider KJ, Dvorak J, et al. Consensus statement on concussion in sport: the 6th International Conference on Concussion in Sport-Amsterdam, October 2022. *Br J Sports Med*. 2023;57(11):695-711

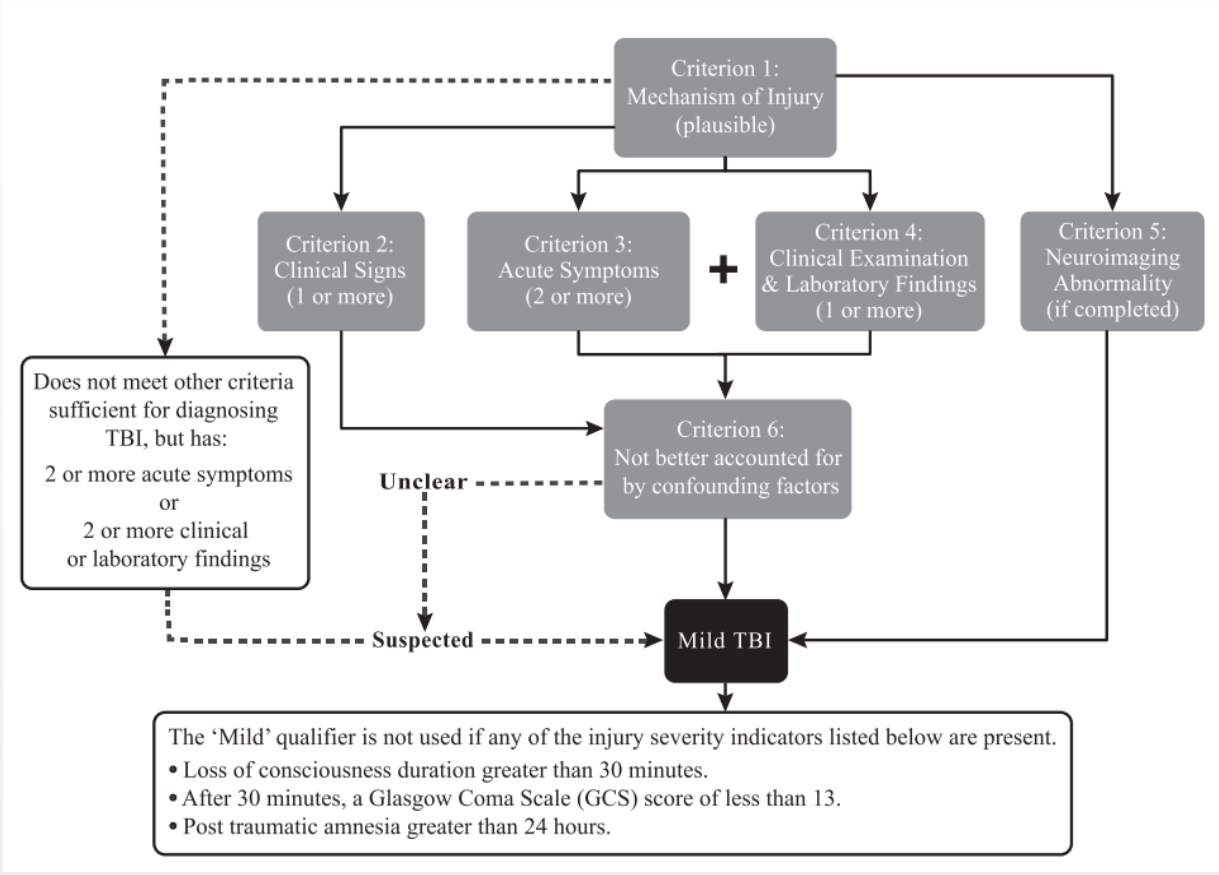
Sport Related Concussion

What is a concussion?

Forté SPORTS MEDICINE AND ORTHOPEDICS

Defining Concussion

- "Traumatic brain injury caused by direct blow to head, neck or body resulting in an impulsive force being transmitted to the brain…"
  - Neurotransmitter and metabolic cascaded → blood flow change, inflammatory change, axonal injury
  - Symptoms occur within hours
  - No abnormalities on structural imaging
  - Spectrum of clinical symptoms
- American Congress of Rehabilitation Medicine Diagnostic Criteria for mTBI
  - Diagnostic vs conceptual definition



Forté SPORTS MEDICINE AND ORTHOPEDICS

Patricios JS, Schneider KJ, Dvorak J, et al. Consensus statement on concussion in sport: the 6th International Conference on Concussion in Sport-Amsterdam, October 2022. *Br J Sports Med*. 2023;57(11):695-711

Silverberg ND, Iverson GL; ACRM Brain Injury Special Interest Group Mild TBI Task Force members:, et al. The American Congress of Rehabilitation Medicine Diagnostic Criteria for Mild Traumatic Brain Injury. *Arch Phys Med Rehabil*. 2023;104(8):1343-1355

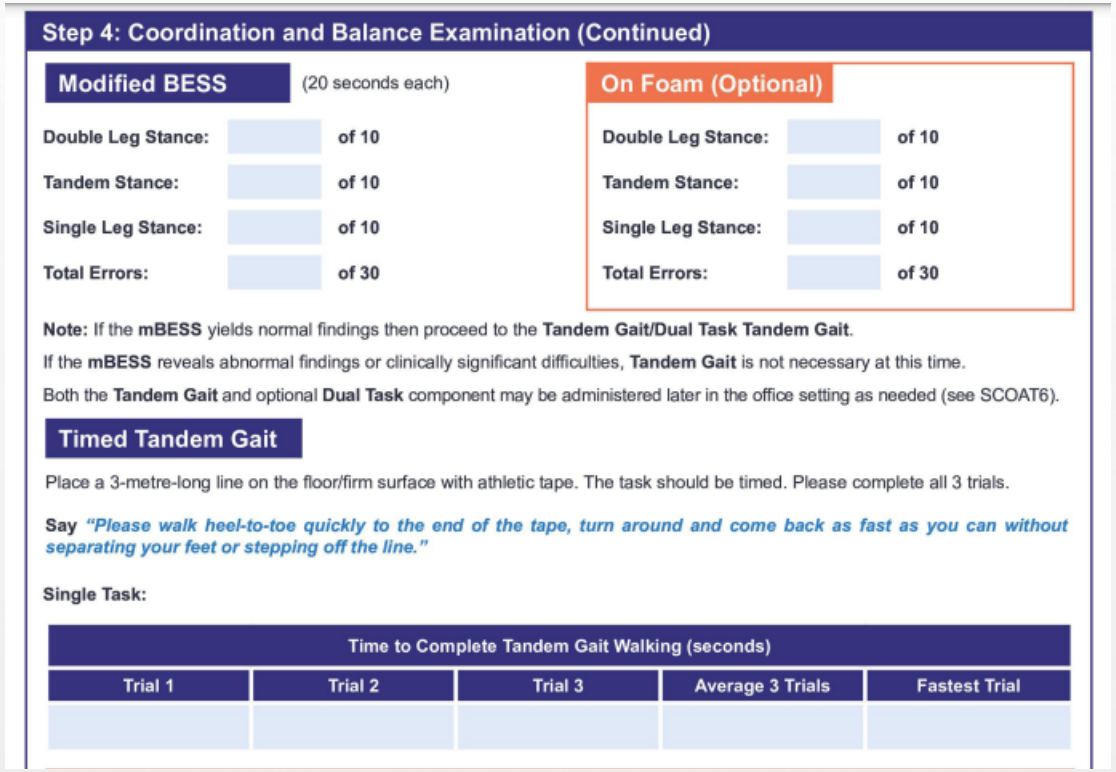
Sport Related Concussion

How do you recognize a concussion?

Forté SPORTS MEDICINE AND ORTHOPEDICS

Recognizing Concussion

- Signs for Immediate Removal
  - LOC, Seizure, posturing, ataxia, poor balance, confusion, changes in behavior, amnesia
- Maddocks Questions
  - What venue are we at?
  - What half is it?
  - Who scored last?
  - Who did you play last week?
  - Did you win last week?
- Sport Concussion Assessment Tool 6
  - Within 72 hours, Serial Evaluations
  - S/S, Cognitive, Memory, Balance and Coordination, Delayed Recall
  - SCAT6
    - >12 years old
  - Child SCAT6
    - 8 – 12 years old



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 SCOAT6).

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

Forté SPORTS MEDICINE AND ORTHOPEDICS

Patricios JS, Schneider KJ, Dvorak J, et al. Consensus statement on concussion in sport: the 6th International Conference on Concussion in Sport-Amsterdam, October 2022. *Br J Sports Med*. 2023;57(11):695-711

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

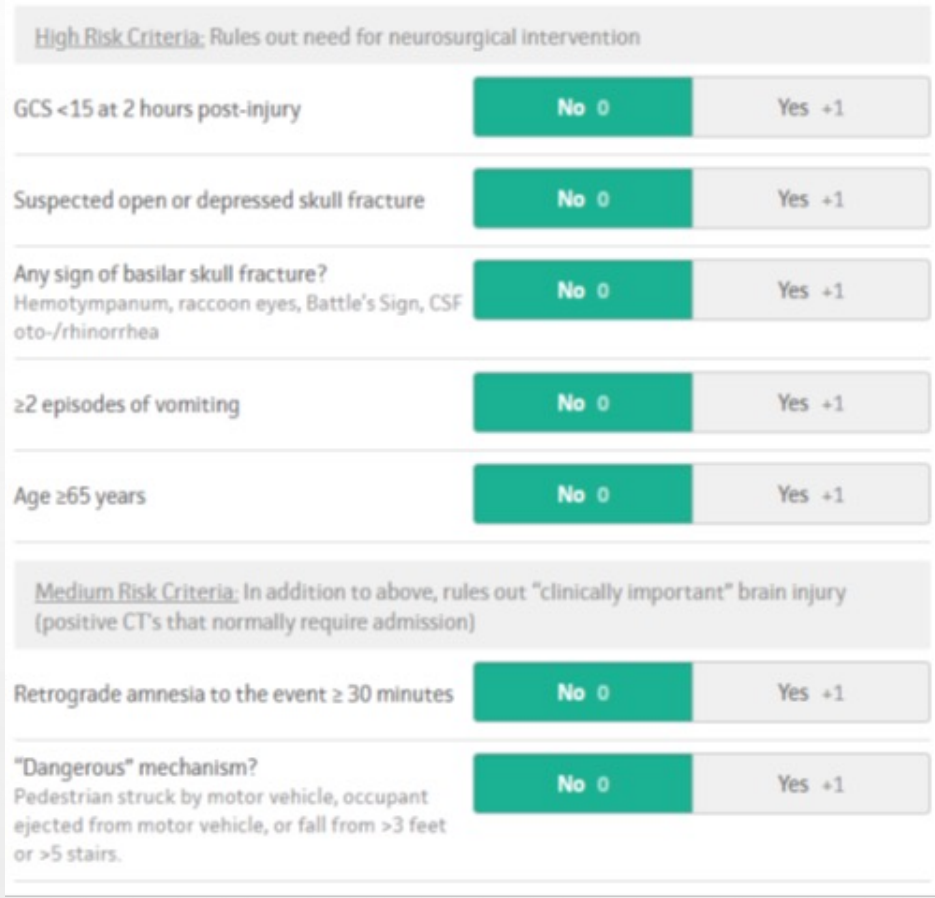
Sport Related Concussion

Who needs to go to the Emergency Department?

Forté SPORTS MEDICINE AND ORTHOPEDICS

Indications for Emergent Imaging

- **Canadian Head CT Rule**
  - Validation Study 2702 patients > 16 years old presenting to 9 Emergency Departments with Blunt Head Trauma
  - INCLUSION CRITERIA
    - Loss of Consciousness
    - Disorientation
    - Amnesia
    - GCS 13 – 15
  - 8.5% clinically important brain injury
    - 1.5% neurosurgical intervention
  - 100% sensitive for ciTBI and NSI
  - Subsequent studies reproduce 100% sensitivity for need for neurosurgical intervention
    - 87 – 100% sensitivity for clinically important injuries
- PECARN Pediatric Head Injury Algorithm
  - Children <18 years old
  - Validated in >2,500 children
  - 100% sensitive ruling out ciTBI



High Risk Criteria: Rules out need for neurosurgical intervention

GCS <15 at 2 hours post-injury	No 0	Yes +1
Suspected open or depressed skull fracture	No 0	Yes +1
Any sign of basilar skull fracture? Hemotympanum, raccoon eyes, Battle's Sign, CSF oto-/rhinorrhea	No 0	Yes +1
≥2 episodes of vomiting	No 0	Yes +1
Age ≥65 years	No 0	Yes +1

Medium Risk Criteria: In addition to above, rules out "clinically important" brain injury (positive CT's that normally require admission)

Retrograde amnesia to the event ≥ 30 minutes	No 0	Yes +1
"Dangerous" mechanism? Pedestrian struck by motor vehicle, occupant ejected from motor vehicle, or fall from >3 feet or >5 stairs.	No 0	Yes +1

Forté SPORTS MEDICINE AND ORTHOPEDICS

Stiell IG, Clement CM, Rowe BH, et al. Comparison of the Canadian CT Head Rule and the New Orleans Criteria in patients with minor head injury. *JAMA*. 2005;294(12):1511-1518
https://www.mdcalc.com/calc/608/canadian-ct-head-injury-trauma-rule
Schonfeld D, Bressan S, Da Dalt L, Henien MN, Winnett JA, Nigrovic LE. Pediatric Emergency Care Applied Research Network head injury clinical prediction rules are reliable in practice. *Arch Dis Child*. 2014;99(5):427-431

Sport Related Concussion

How do I evaluate a suspected concussion in clinic?

Forté SPORTS MEDICINE AND ORTHOPEDICS

In Office Concussion Assessment

- SCAT and Child SCAT 6
  - Use within first 72 hours, up to 7 days
- Sport Concussion Office Assessment Tool (SCOAT)
  - Athletes >12 years old
    - Child SCOAT6 8-12 years old
  - 72 hours – 30 days post injury
  - Review of 127 studies
    - Symptoms
    - Autonomic Nervous System
    - C-spine and Neuro Exam
    - Vestibular Ocular Assessment
    - Oculomotor Function
    - Balance and Gait
    - Cognitive Evaluation
    - Mental Health
- **Has NOT been studied**

SCOAT6:
⇒ A 10-word recall and digit backwards test.
⇒ Measurement of systolic and diastolic blood pressure as well as heart rate taken supine after 2 min rest and after standing for 1 min.
⇒ Evaluation of the cervical spine range of motion, muscle spasm, palpation for segmental tenderness and midline tenderness.
⇒ A neurological examination including assessment of cranial and spinal nerves, motor function, sensation and deep tendon reflexes.
⇒ Timed tandem gait as a single task and a more complex dual task with the addition of 3 cognitive tasks (such as serial 7's, months backwards or word recall backwards).
⇒ The modified vestibular ocular motor screening.
⇒ Delayed word recall, a minimum of 5 min after completion of the immediate word recall test.
⇒ A mental health and sleep screen.
For the Child SCOAT6 the following should be added:
⇒ Additional symptoms for child and parent report that capture additional subacute domains.
⇒ An age-appropriate measure of cognitive reaction time such as the Symbol Digit Modalities Test.
⇒ Validated paediatric measures for clinical domains, vestibular-ocular assessment and mental health and sleep questionnaires.

Forté SPORTS MEDICINE AND ORTHOPEDICS

Patricios JS, Schneider GM, van Ierssel J, et al. 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. *Br J Sports Med*. 2023;57(11):737-748
https://bjsm.bmj.com/content/57/11/651

Sport Related Concussion

I have diagnosed the patient with a concussion, now what?

Forté SPORTS MEDICINE AND ORTHOPEDICS

Rest after Concussion

- First 4 consensus statements recommended strict cognitive and physical rest until symptom resolution
  - **Expert opinion and animal models**
- "The best available evidence shows that recommendation strict rest until the complete resolution of concussion-related symptoms is **not** beneficial following SRC."
- Recommendations are now "relative rest" for first 24 – 48 hours
  - ADLs, reduced screen time, light physical activity

WHAT THIS STUDY ADDS

⇒ Strict rest until symptom resolution is not effective for SRC.

⇒ Light-intensity physical activity (eg, walking that does not more than mildly exacerbate symptoms) during the 48 hours after SRC facilitates recovery.

⇒ Prescribed subsymptom threshold aerobic exercise treatment, based on systematic exercise testing that identifies the individual's mild symptom exacerbation heart rate threshold, can safely be started within 2–14 days of SRC, facilitates recovery and reduces the incidence of postconcussive symptoms persisting beyond 1 month from injury.

⇒ Sleep disturbance appears to impair SRC recovery.

⇒ Reducing time spent viewing screens (eg, phones, computers) during the first 48 hours after injury appears to facilitate recovery.

Forté SPORTS MEDICINE AND ORTHOPEDICS

Leddy JJ, Burma JS, Toomey CM, et al. Rest and exercise early after sport-related concussion: a systematic review and meta-analysis. *Br J Sports Med*. 2023;57(12):762-770

Patricios JS, Schneider KJ, Dvorak J, et al. Consensus statement on concussion in sport: the 6th International Conference on Concussion in Sport-Amsterdam, October 2022. *Br J Sports Med*. 2023;57(11):695-711

Benefits of Strict Rest After Acute Concussion: A Randomized Controlled Trial

Danny George Thomas, MD ✉; Jennifer N. Apps, PhD; Raymond G. Hoffmann, PhD; Michael McCrea, PhD; Thomas Hammeke, PhD

- 98 patients ages 11 -22 who presented to Emergency Department within 24 hours of Concussion
- Strict Rest for 5 days vs Usual Care
  - Usual Care: 1-2 days rest, stepwise return to activity
- Strict Rest Group
  - More school absences
  - More symptoms > 10 days
  - Slower symptoms resolution

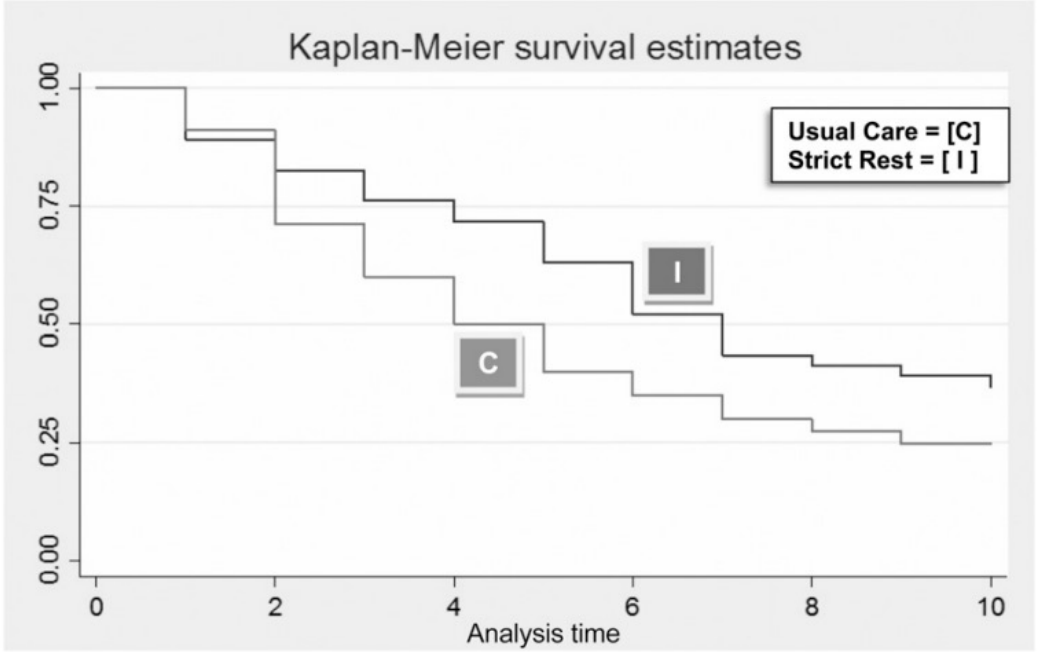


FIGURE 4
Proportion of patients reporting symptom resolution (PCSS ≤7) over time. It took longer for 50% the intervention group to report symptom resolution. However, the difference in overall proportion of patient reporting symptom resolution did not meet statistical significance (P = .08).

Forté SPORTS MEDICINE AND ORTHOPEDICS

Thomas DG, Apps JN, Hoffmann RG, McCrea M, Hammeke T. Benefits of strict rest after acute concussion: a randomized controlled trial. *Pediatrics*. 2015;135(2):213-223

Physical Activity after Concussion

- Recommend early return to physical activity as tolerated
  - Avoid situations with risk of re-injury
  - Walking, cycling, etc
- Advance activity gradually as tolerated
- Tolerate Mild Symptom Exacerbation
  - 2 point increase on 10 point scale
  - "Brief" (< 1 hour) of exacerbation of symptoms
- Prescribing PA within 2- 10 days of injury reduces incidence of post concussive syndrome

Key recommendations

⇒ Meta-analysis reveals that subsymptom threshold aerobic exercise treatment (based on formal exercise testing) should be prescribed to adolescents as soon as 2 days after sport-related concussion (SRC), which facilitates recovery by a mean of −4.64 days (95% CI −6.69, −2.59). Grading of Recommendations, Assessment, Development and Evaluations recommendation is high.

⇒ Subsymptom threshold aerobic exercise treatment (based on formal exercise testing) should be prescribed to adolescents as soon as 2 days after SRC to significantly reduce their incidence of persisting postconcussive symptoms (PPCS) beyond 1 month. Aerobic exercise is also effective for reducing symptoms in athletes who suffer from PPCS.

⇒ Adolescents and young adults should return to light physical activity (eg, walking and easy activities of daily living) and limit their cognitive activity and screen use within the first 48 hours after injury to facilitate recovery.

⇒ Concussion symptom exacerbation is typically brief, does not delay recovery and should not prevent athletes with SRC from resuming activity/exercise after brief relative rest.

Forté SPORTS MEDICINE AND ORTHOPEDICS

Leddy JJ, Burma JS, Toomey CM, et al. Rest and exercise early after sport-related concussion: a systematic review and meta-analysis. *Br J Sports Med*. 2023;57(12):762-770

Patricios JS, Schneider KJ, Dvorak J, et al. Consensus statement on concussion in sport: the 6th International Conference on Concussion in Sport-Amsterdam, October 2022. *Br J Sports Med*. 2023;57(11):695-711

Aerobic Exercise vs Stretching

- 118 athletes 13 – 18 years old presented within 10 days of SRC
- Sub symptom threshold aerobic activity vs stretching at least 20 min daily
- Aerobic activity group more likely to recover within 4 weeks
- 48% reduced risk of persisting post-concussive symptoms in aerobic activity group

Early targeted heart rate aerobic exercise versus placebo stretching for sport-related concussion in adolescents: a randomised controlled trial

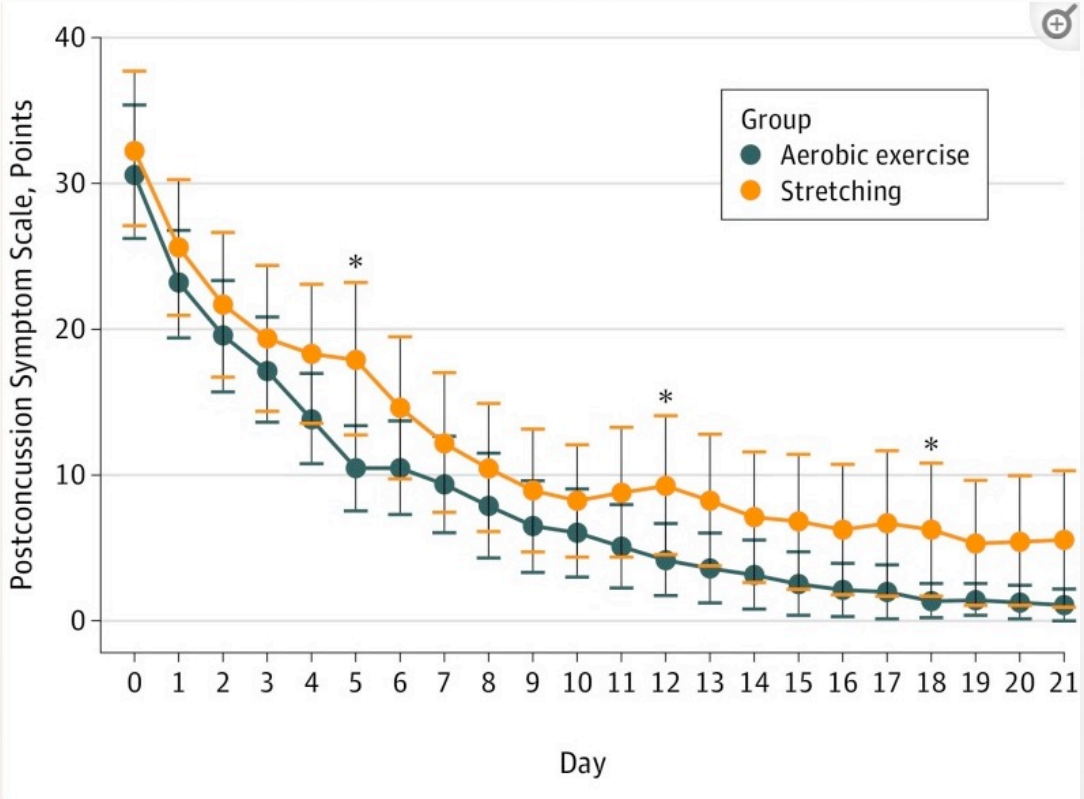
John J Leddy [1], Christina L Master [2], Rebekah Mannix [3], Douglas J Wiebe [4], Matthew F Grady [5], William P Meehan [6], Eileen P Storey [7], Brian T Vernau [8], Naomi J Brown [5], Danielle Hunt [9], Fairuz Mohammed [10], Andrea Mallon [8], Kate Rownd [10], Kristy B Arbogast [11], Adam Cunningham [12], Mohammad N Haider [12], Andrew R Mayer [13], Barry S Willer [14]

Forté SPORTS MEDICINE AND ORTHOPEDICS

Leddy JJ, Master CL, Mannix R, et al. Early targeted heart rate aerobic exercise versus placebo stretching for sport-related concussion in adolescents: a randomised controlled trial. *Lancet Child Adolesc Health*. 2021;5(11):792-799

Early Subthreshold Aerobic Exercise for Sport-Related Concussion: A Randomized Clinical Trial

- 103 participants, aerobic exercise vs stretching
- Exercise group recovered median 13 days compared to 17 days in stretching group
- Higher incidence of recover > 30 days in stretching group



Forté SPORTS MEDICINE AND ORTHOPEDICS

Leddy JJ, Haider MN, Ellis MJ, et al. Early Subthreshold Aerobic Exercise for Sport-Related Concussion: A Randomized Clinical Trial. *JAMA Pediatr*. 2019;173(4):319-325

Rehabilitation

- "If dizziness, neck pain and/or headaches persist for more than 10 days, cervicovestibular rehabilitation is recommended"
- Refer and order placed at first visit
  - Physical Therapist with experience with concussion
- Buffalo Treadmill Test 24-48 hours post injury
  - Prescribed exercise program

Forté SPORTS MEDICINE AND ORTHOPEDICS

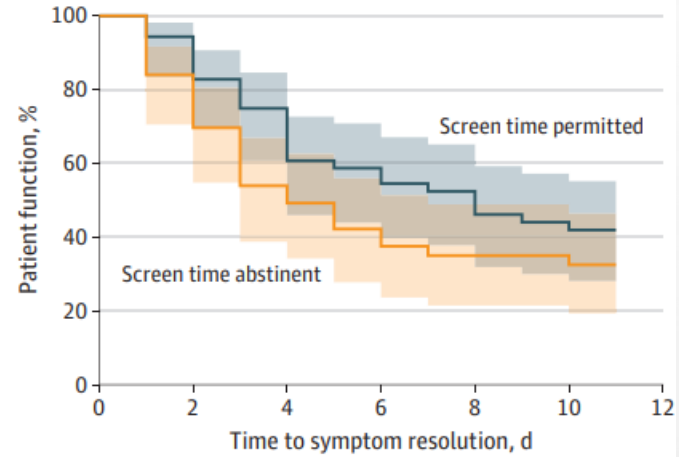
Patricios JS, Schneider KJ, Dvorak J, et al. Consensus statement on concussion in sport: the 6th International Conference on Concussion in Sport-Amsterdam, October 2022. *Br J Sports Med*. 2023;57(11):695-711

https://ubortho.com/services/concussion-management-center/research/exercise-is-medicine/

Limiting Screen Time

- "…reduced screen use in the fist 48 hours after injury is warranted but may not be effective beyond that."
- Patients 12 -25 years old in ED with Concussion
  - Screen time permitted vs restricted first 48 hours
  - Screen time median recovery 8 days s 3.5 days
- Study of Children in ED with Concussion or Orthopedic Injury with screen time measured
  - …"greater screen time was not consistently associated with more symptoms…"

Figure 2. Kaplan-Meier Survival Curve Comparing Days Until Concussion Recovery of Screen Time Abstinent vs Screen Time Permitted Groups



No. at risk						
Screen time permitted	53	49	37	28	25	21
Screen time abstinent	50	41	23	18	14	14

Forté SPORTS MEDICINE AND ORTHOPEDICS

Patricios JS, Schneider KJ, Dvorak J, et al. Consensus statement on concussion in sport: the 6th International Conference on Concussion in Sport-Amsterdam, October 2022. *Br J Sports Med*. 2023;57(11):695-711

Macnow T, Curran T, Tolliday C, et al. Effect of Screen Time on Recovery From Concussion: A Randomized Clinical Trial. *JAMA Pediatr*. 2021;175(11):1124-1131

Cairncross M, Yeates KO, Tang K, et al. Early Postinjury Screen Time and Concussion Recovery. *Pediatrics*. 2022;150(5):e2022056835.

Sport Related Concussion

I have diagnosed the patient with a concussion, when can they go back to school?

Forté SPORTS MEDICINE AND ORTHOPEDICS

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 Learn with accommodations 8.3 days
Return to Learn without academic support 10.0 days

Forté SPORTS MEDICINE AND ORTHOPEDICS

Patricios JS, Schneider KJ, Dvorak J, et al. Consensus statement on concussion in sport: the 6th International Conference on Concussion in Sport-Amsterdam, October 2022. *Br J Sports Med*. 2023;57(11):695-711

Putukian M, Purcell L, Schneider KJ, et al. Clinical recovery from concussion-return to school and sport: a systematic review and meta-analysis. *Br J Sports Med*. 2023;57(12):798-809

Sport Related Concussion

I have diagnosed the patient with a concussion, when can they go back to sport?

Forté SPORTS MEDICINE AND ORTHOPEDICS

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.	

Return to Sport 19.8 days (highly variable)

Initial symptom score strongest predictor of RTS

Forté SPORTS MEDICINE AND ORTHOPEDICS

Patricios JS, Schneider KJ, Dvorak J, et al. Consensus statement on concussion in sport: the 6th International Conference on Concussion in Sport-Amsterdam, October 2022. *Br J Sports Med*. 2023;57(11):695-711

Putukian M, Purcell L, Schneider KJ, et al. Clinical recovery from concussion-return to school and sport: a systematic review and meta-analysis. *Br J Sports Med*. 2023;57(12):798-809

Sport Related Concussion

What can we do to prevent concussion injuries?

Forté SPORTS MEDICINE AND ORTHOPEDICS

Prevention of Sport Related Concussion

- Policy and Rule Changes have greatest impact
  - No checking in youth ice hockey reduced rate concussion in games by 58%
  - Reducing number and duration of contact practices in American Football reduced rate of practice related concussion by 64%
  - Rule changes mixed results across sports
- Neuromuscular warm up has been shown to reduce rates of concussion in Rugby
  - Shown to be beneficial to reduce other injuries

⇒ Policy disallowing bodychecking should be supported for all children and most levels of adolescent ice hockey (GRADE quality rating: high).
⇒ Strategies limiting contact practice in American football should inform related policy and recommendations for all levels (GRADE quality rating: low).
⇒ Neuromuscular training warm-up programmes are recommended, based on research in rugby, while more research is needed for females and other team sports. The focus should be on exercise components targeting concussion prevention (GRADE quality rating: moderate).

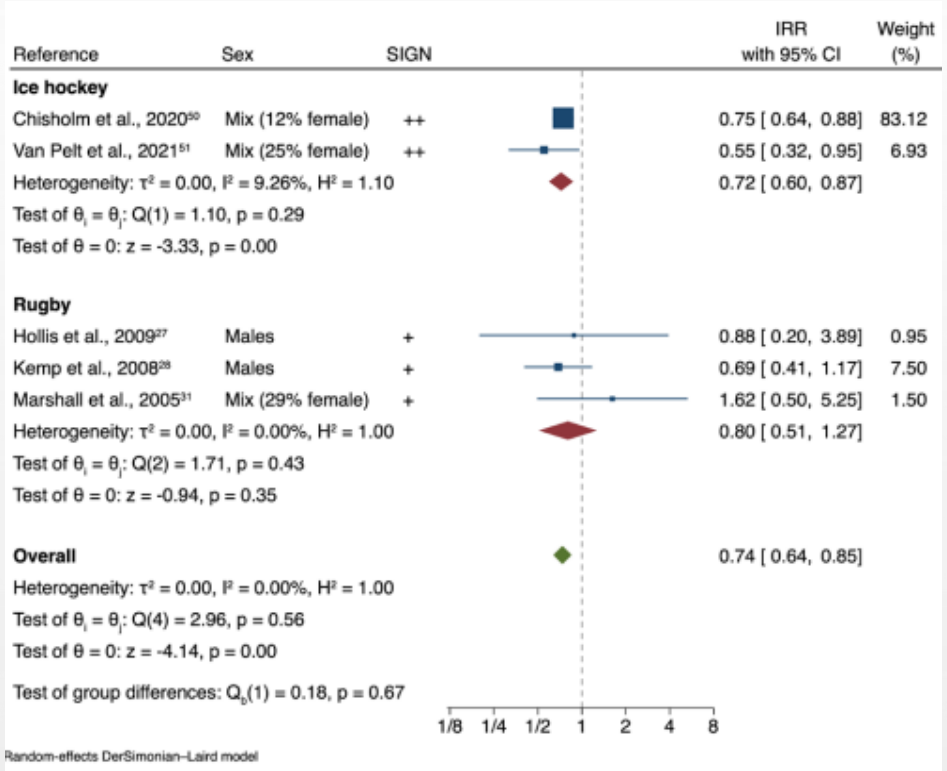
Forté SPORTS MEDICINE AND ORTHOPEDICS

Patricios JS, Schneider KJ, Dvorak J, et al. Consensus statement on concussion in sport: the 6th International Conference on Concussion in Sport-Amsterdam, October 2022. *Br J Sports Med*. 2023;57(11):695-711

Eliason PH, Galarneau JM, Kolstad AT, et al. Prevention strategies and modifiable risk factors for sport-related concussions and head impacts: a systematic review and meta-analysis. *Br J Sports Med*. 2023;57(12):749-761

Prevention of Sport Related Concussion

- Personal Protective Equipment
  - Mouthguards – reduced rate of concussion in ice hockey
  - Helmets – Mixed
    - Lacrosse lower SRC in males with mandated helmets than girls with headgear
    - Proper fit in American Football may reduce severity of symptoms
    - Different padding in American Football may reduce incidence
    - 19% lower SRC in NFL players with approved helmets compared to unapproved
  - Juglar Vein Compression – head impact severity not reduced in ice hockey and American Football



Forté SPORTS MEDICINE AND ORTHOPEDICS

Patricios JS, Schneider KJ, Dvorak J, et al. Consensus statement on concussion in sport: the 6th International Conference on Concussion in Sport-Amsterdam, October 2022. *Br J Sports Med*. 2023;57(11):695-711

Eliason PH, Galarneau JM, Kolstad AT, et al. Prevention strategies and modifiable risk factors for sport-related concussions and head impacts: a systematic review and meta-analysis. *Br J Sports Med*. 2023;57(12):749-761

Summary

- Familiarize yourself with the New Guidelines and Systematic Reviews
- Use Canadian HCT Rule and PEACARN Head Injury rule to help determine who needs emergent imaging
- Use SCAT6 for evaluations on the sideline and within 72 hours of injury
- Use SCOAT6 for evaluations >72 post injury
- Relative Rest for 24-48 hours is ok, but GET MOVING after that
- Early Aerobic Activity is beneficial and safe
- Refer to trained physical therapist early in course
- Follow Return to Learn and Sport Progressions
- Personal Protective Equipment effectiveness various depending on sport

Forté SPORTS MEDICINE AND ORTHOPEDICS

Thank you!

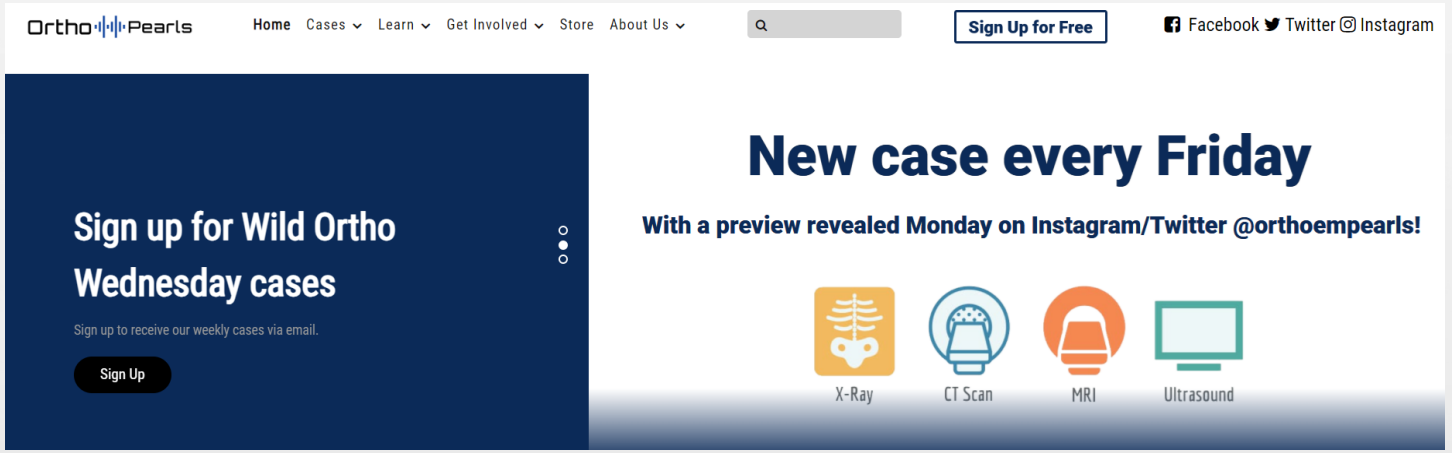
mnegaard@forteortho.com

LinkedIn – Matthew Negaard

Instagram - matthewnegaardmd

Twitter - @MattNegaard

https://www.orthoempearls.com/



References

- Patricios JS, Schneider KJ, Dvorak J, et al. Consensus statement on concussion in sport: the 6th International Conference on Concussion in Sport-Amsterdam, October 2022. *Br J Sports Med*. 2023;57(11):695-711
- Silverberg ND, Iverson GL; ACRM Brain Injury Special Interest Group Mild TBI Task Force members:, et al. The American Congress of Rehabilitation Medicine Diagnostic Criteria for Mild Traumatic Brain Injury. *Arch Phys Med Rehabil*. 2023;104(8):1343-1355
- https://bjsm.bmj.com/content/bjsports/57/11/622.full.pdf
- Stiell IG, Clement CM, Rowe BH, et al. Comparison of the Canadian CT Head Rule and the New Orleans Criteria in patients with minor head injury. *JAMA*. 2005;294(12):1511-1518
- https://www.mdcalc.com/calc/608/canadian-ct-head-injury-trauma-rule
- Schonfeld D, Bressan S, Da Dalt L, Henien MN, Winnett JA, Nigrovic LE. Pediatric Emergency Care Applied Research Network head injury clinical prediction rules are reliable in practice. *Arch Dis Child*. 2014;99(5):427-431
- Patricios JS, Schneider GM, van Ierssel J, et al. 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. *Br J Sports Med*. 2023;57(11):737-748
- https://bjsm.bmj.com/content/57/11/651 (SCOAT6 Form)
- Leddy JJ, Burma JS, Toomey CM, et al. Rest and exercise early after sport-related concussion: a systematic review and meta-analysis. *Br J Sports Med*. 2023;57(12):762-770
- Macnow T, Curran T, Tolliday C, et al. Effect of Screen Time on Recovery From Concussion: A Randomized Clinical Trial. *JAMA Pediatr*. 2021;175(11):1124-1131
- Cairncross M, Yeates KO, Tang K, et al. Early Postinjury Screen Time and Concussion Recovery. *Pediatrics*. 2022;150(5):e2022056835.
- Thomas DG, Apps JN, Hoffmann RG, McCrea M, Hammeke T. Benefits of strict rest after acute concussion: a randomized controlled trial. *Pediatrics*. 2015;135(2):213-223
- Leddy JJ, Master CL, Mannix R, et al. Early targeted heart rate aerobic exercise versus placebo stretching for sport-related concussion in adolescents: a randomised controlled trial. *Lancet Child Adolesc Health*. 2021;5(11):792-799
- Leddy JJ, Haider MN, Ellis MJ, et al. Early Subthreshold Aerobic Exercise for Sport-Related Concussion: A Randomized Clinical Trial. *JAMA Pediatr*. 2019;173(4):319-325
- Putukian M, Purcell L, Schneider KJ, et al. Clinical recovery from concussion-return to school and sport: a systematic review and meta-analysis. *Br J Sports Med*. 2023;57(12):798-809
- Eliason PH, Galarneau JM, Kolstad AT, et al. Prevention strategies and modifiable risk factors for sport-related concussions and head impacts: a systematic review and meta-analysis. *Br J Sports Med*. 2023;57(12):749-761

Forté SPORTS MEDICINE AND ORTHOPEDICS

Forté SPORTS MEDICINE AND ORTHOPEDICS

forteortho.com