

The background of the slide features a photograph of a group of people in a meeting room. They are seated around a long wooden table, looking towards the left. In the foreground, a large, semi-transparent blue letter 'C' is overlaid on the image. The overall color scheme is dark blue and white.

emperion

JUNE 18, 2025

Concussion Management

Our Presenter

- Elizabeth M. Pieroth, PsyD, ABPP, MPH
- Director of the Concussion Program at Midwest Orthopaedics at Rush and Rush University Medical Center.
- Board-Certified Clinical Neuropsychologist with over 20 years of experience in concussion assessment and management.
- Serves as the concussion specialist for the Chicago Bears, Blackhawks, White Sox, and Fire, among other professional and collegiate teams.
- Co-Director of the NFL Neuropsychology Consulting Program, Director of The Concussion Program for the National Women's Soccer League and The Professional Women's Hockey League.
- Active member of several national concussion-related committees, including the NFL Head, Neck and Spine Committee and the USA Football Heads Up Advisory Committee.
- Recipient of multiple awards, including the 2018 Chicago Illini of the Year Award and the 2016 USA Hockey Excellence in Safety Award.
- Recently completed a Master of Public Health through the Medical College of Wisconsin.
- Frequent speaker and educator and TEDxChicago Presenter on concussion management.



MIDWEST
ORTHOPAEDICS
AT RUSH



RUSH UNIVERSITY
MEDICAL CENTER

The Management of Concussions in Workers' Compensation Claims

Elizabeth M. Pieroth, PsyD, ABPP, MPH

Director of the Concussion Program

Midwest Orthopaedics at Rush & Rush University Medical Center

Disclosures:

Consult to (no personal income derived):

Chicago Bears

Chicago Blackhawks

Rockford IceHogs

Chicago White Sox

Chicago Red Stars

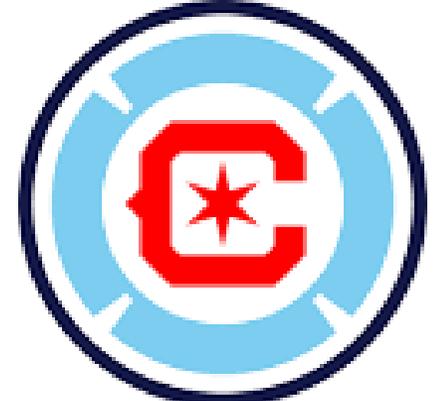
Chicago Fire

Chicago Steel

Chicago Hounds

Indy Fuel

MLB Umpires Association



MLBUA
MAJOR LEAGUE BASEBALL UMPIRES ASSOCIATION

Disclosures:

Volunteer consultation to:

Brain Injury Association of Illinois Board of Directors

National Advisory Board, US Football Heads Up Football Committee

US Soccer Sports Medicine Research, Education & Advisory Panel

Amateur Hockey Association of IL Safety Committee

Stipends received for:

Member, NFL Head, Neck and Spine Committee

Co-Director NFL Neuropsychology Consultant Program

Director Concussion Program ,National Women's Soccer League

Director Concussion Program, Professional Women's Hockey League

Consultant, Sway Medical Inc.



NATIONAL WOMEN'S SOCCER LEAGUE



BRAIN INJURY
ASSOCIATION
OF ILLINOIS



What are the basics to consider?

1. Is it a concussion?
2. Are the treatment recommendations appropriate for that individual?
3. What is the expected recovery time?
4. What treatments/evaluations are appropriate for persistent symptoms?
5. When can this individual return to work after a concussion?

1. Is it a concussion?

A. Is there contact/movement of the head significant to cause a concussion?

B. Are the symptoms experienced consistent with a concussion and not something else?

C. When did the symptoms start?



Why look at mechanism of injury?

The diagnosis of concussion requires contact to the head or forceful movement of the head significant enough to cause injury.

But...

- We don't have a threshold for the force required
- We don't have a clear understanding of what contributes to injury

Why look at initial symptoms?

1. Helps with differential diagnosis.

2. Helps us determine which patients may have a prolonged recovery.

(Martinez et al, 2020)



What else can cause concussion-like symptoms?

- Dehydration
- Cervical strain
- Chest/abdominal trauma
- Weight cutting
- Anxiety/psychological reaction to stressors or to the trauma itself
- Migraine (exercise-induced or traumatically-induced)
- Sinus infections/colds
- Life!



Concussion signs/symptoms are common in the general public

Visual problems	40%	Balance	14%	Temper Outbursts	30%
Headaches	58%	Dizziness/vertigo	22%	Anxiety	60%
Light sensitivity	30%	Word Finding	47%	Depression	33%
Poor Concentration	35%	Forgetful	47%		

(Paniak et al, 2002)

Common signs of concussion:



Dizziness



Nausea



Headaches



Light
Sensitivity



Confusion

Concussion signs/symptoms are common in certain populations

- 31,958 high school athletes
- 19% of boys and 28% of girls reported a symptom burden consistent with an ICD-10 diagnosis of Post-concussion syndrome
- Students with preexisting conditions even more likely:
 - 21-47% boys
 - 33-72% girls
- Prior psychiatric condition was the strongest predictor followed by history of migraine and ADHD

(Iverson, 2015)



Why look at time of symptom onset?

Could the symptoms be caused by something else?

** If the symptoms start days later, it is likely not a concussion.*



Concussion in Sport Group

Patricios et al, 2023

British Journal of
Sports Medicine

Video Abstract

Consensus Statement on **Concussion in Sport**

The 6th International Conference on Concussion in Sport
Held in Amsterdam, October 2022

Jon S. Patricios, Kathryn J. Schneider, Jiří Dvorák, Osman H. Ahmed, Cheri A. Blauwet, Robert Cantu, Gavin A. Davis, Ruben J. Echemendia, Michael Makdissi, Mike McNamee, Steven P. Broglio, Carolyn Emery, Nina Feddermann-Demont, Gordon Fuller, Chris Giza, Kevin M. Guskiewicz, Brian Hainline, Grant Iverson, Jeffrey Kutcher, John Leddy, David Maddocks, Geoffrey T. Manley, Michael A. McCrea, Laura Purcell, Margot Putukian, Haruhiko Sato, Markku Tuominen, Michael Turner, Keith Owen Yeates, Stanley A. Herring, Willem Meeuwisse



Recognize

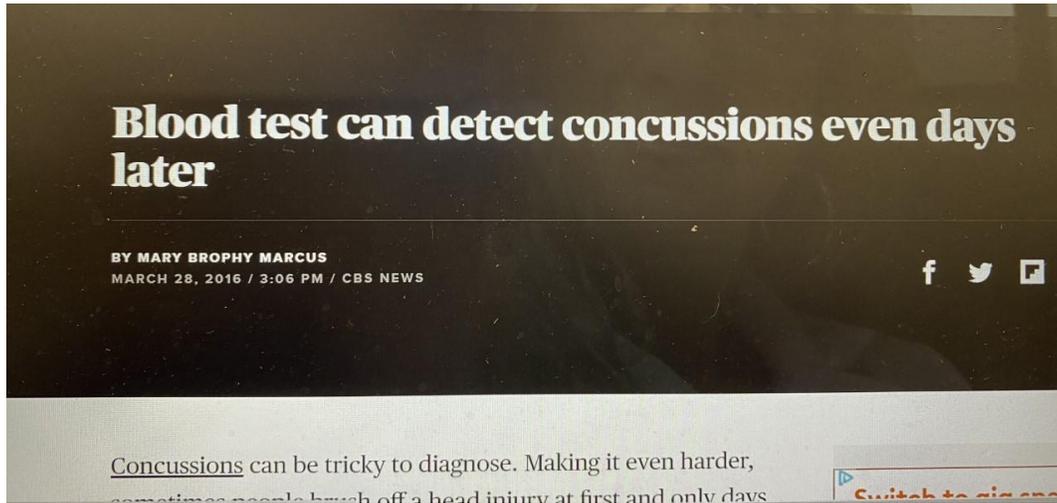
Sport-related concussion is a traumatic brain injury caused by a **direct blow to the head, neck or body resulting in impulsive force being transmitted to the brain** that occurs in sports and exercise related activities. This initiates a neurotransmitter and metabolic cascade, with possible axonal injury,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

Searching for the “Holy Grail” of Concussion Assessment

1. Blood
2. Saliva
3. Balance
4. Ocular



Searching for the “Holy Grail” of Concussion Assessment

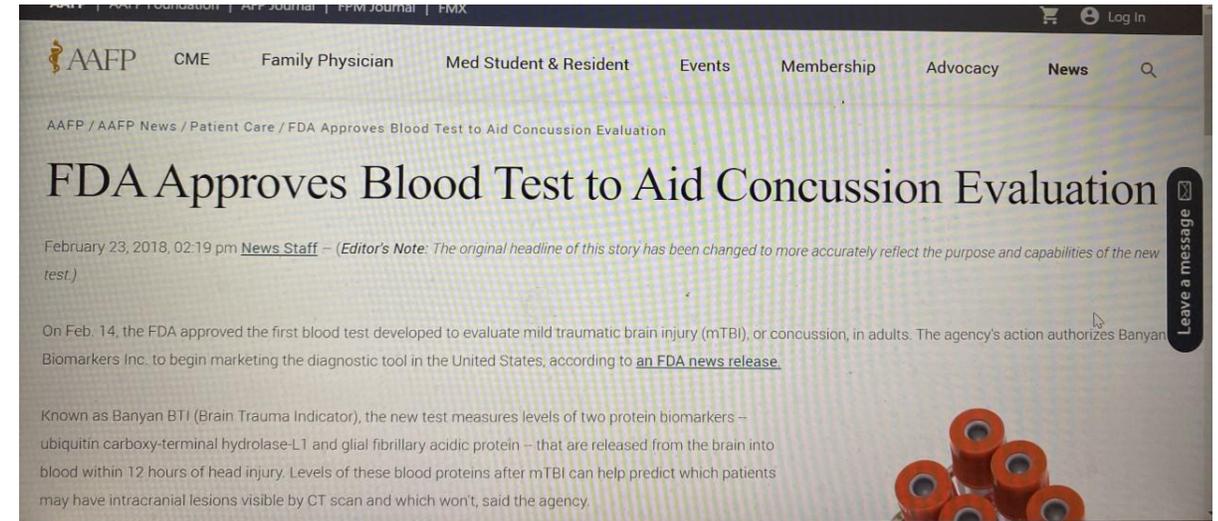


Blood test can detect concussions even days later

BY MARY BROPHY MARCUS
MARCH 28, 2016 / 3:06 PM / CBS NEWS

Concussions can be tricky to diagnose. Making it even harder, sometimes people brush off a head injury at first and only days

Switch to air mode



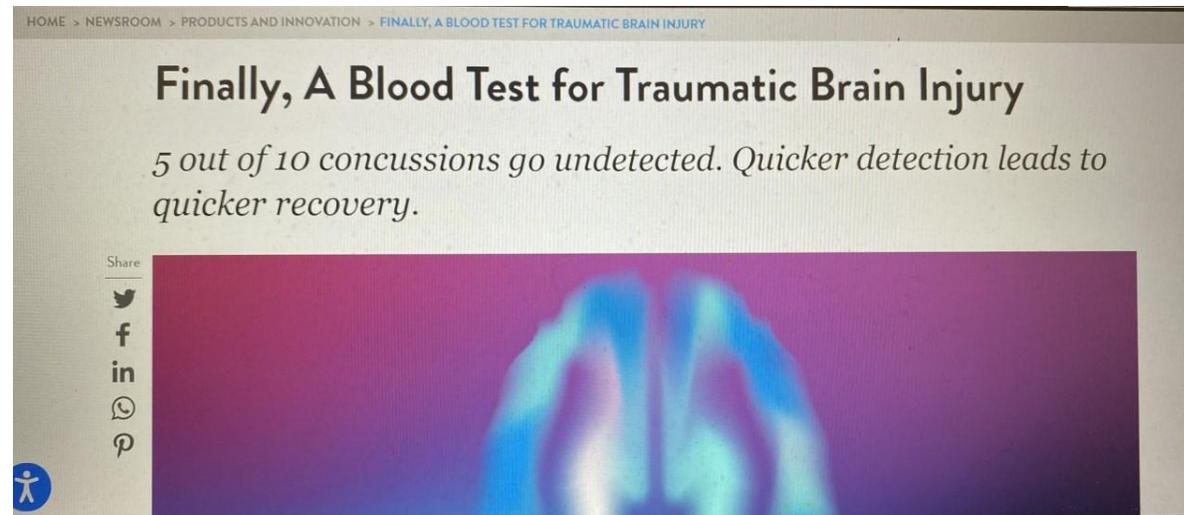
AAFP / AAFP News / Patient Care / FDA Approves Blood Test to Aid Concussion Evaluation

FDA Approves Blood Test to Aid Concussion Evaluation

February 23, 2018, 02:19 pm [News Staff](#) – (Editor's Note: The original headline of this story has been changed to more accurately reflect the purpose and capabilities of the new test.)

On Feb. 14, the FDA approved the first blood test developed to evaluate mild traumatic brain injury (mTBI), or concussion, in adults. The agency's action authorizes Banyan Biomarkers Inc. to begin marketing the diagnostic tool in the United States, according to [an FDA news release](#).

Known as Banyan BTI (Brain Trauma Indicator), the new test measures levels of two protein biomarkers – ubiquitin carboxy-terminal hydrolase-L1 and glial fibrillary acidic protein – that are released from the brain into blood within 12 hours of head injury. Levels of these blood proteins after mTBI can help predict which patients may have intracranial lesions visible by CT scan and which won't, said the agency.



HOME > NEWSROOM > PRODUCTS AND INNOVATION > FINALLY, A BLOOD TEST FOR TRAUMATIC BRAIN INJURY

Finally, A Blood Test for Traumatic Brain Injury

5 out of 10 concussions go undetected. Quicker detection leads to quicker recovery.

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Searching for the “Holy Grail” of Concussion Assessment

Brain & Nervous System > News

[WEBMD HEALTH NEWS]

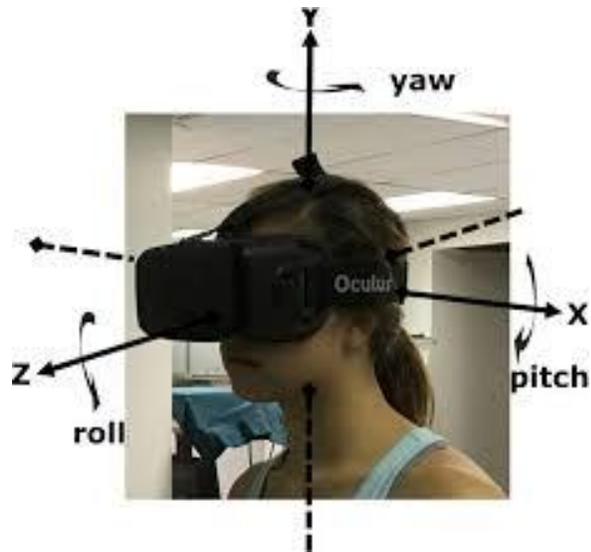
Saliva Test a Game Changer for Identifying Concussion?

By Alicia Ault



March 26, 2021 | Research in the United Kingdom suggests

Searching for the “Holy Grail” of Concussion Assessment



Searching for the “Holy Grail” of Concussion Assessment



Summary





2. Are the treatment recommendations appropriate for that individual?



1. Acute injuries

2. Prolonged symptoms

What are the recommendations for an acute injury?



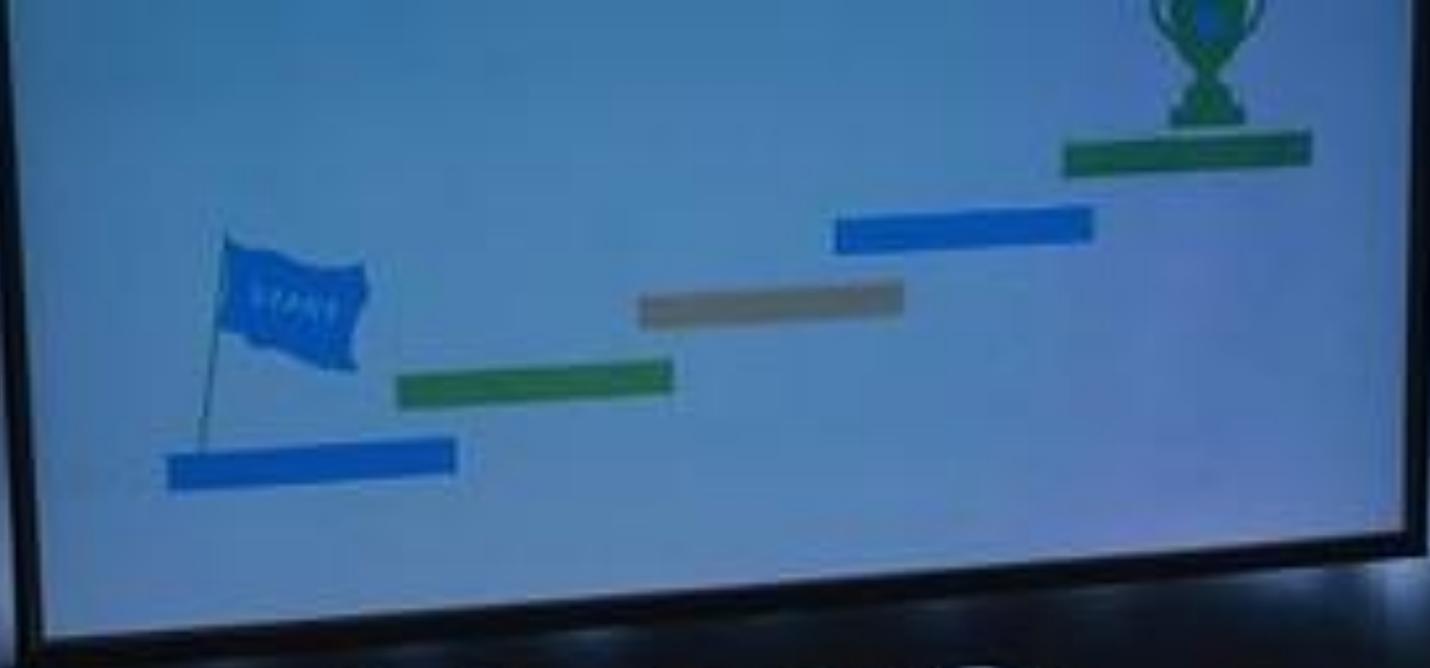
Symptom-Management

(Did you notice I didn't say rest?!?!)

What is the evidence to support recommendations for rest?



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Consensus statement on concussion in sport: the 3rd International Conference on Concussion in Sport held in Zurich, November 2005
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1718644/pdf/hms418694.pdf>

Concussion is Treatable: Statements of Agreement from the Targeted Evaluation and Active Management (TEAM) Approaches to Treating Concussion Meeting held in Pittsburgh, October 15–16, 2015

Michael W. Collins, PhD¹, Anthony P. Kontos, PhD¹, David O. Okonkwo, MD, PhD², Jon Almquist, ATC, VATL, ITAT³, Julian Bailes, MD⁴, Mark Barisa, PhD⁵, Jeffrey Bazarian, MD, MPH⁶, O. Josh Bloom, MD, MPH⁷, David Brody, MD, PhD⁸, Robert Cantu, MD⁹, Javier Cardenas, MD¹⁰, Jay Clugston, MD¹¹, Randall Cohen, DPT, ATC¹², Ruben Echemendia, PhD¹³, R.J. Elbin, PhD¹⁴, Richard Ellenbogen, MD¹⁵, Janna Fonseca, ATC⁷, Gerard Gioia, PhD¹⁶, Kevin Guskiewicz, PhD, ATC¹⁷, Robert Heyer, MD¹⁸, Gillian Hotz, PhD¹⁹, Grant L. Iverson, PhD²⁰, Barry Jordan, MD, MPH²¹, Geoffrey Manley, MD²², Joseph Maroon, MD², Thomas McAllister, MD²³, Michael McCrea, PhD²⁴, Anne Mucha, DPT²⁵, Elizabeth Pieroth, PsyD²⁶, Kenneth Podell, PhD²⁷, Matthew Pombo, MD²⁸, Teena Shetty, MD²⁹, Allen Sills, MD³⁰, Gary Solomon, PhD³⁰, Danny G. Thomas, MD, MPH^{24,31}, Tamara C. Valovich McLeod, PhD, ATC, FNATA³², Tony Yates, MD³³, and Ross Zafonte, DO³⁰

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► Additional material is published online only. To view please visit the journal online (<http://dx.doi.org/10.1136>)

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Consensus statement on concussion in sport: the 3rd International Conference on Concussion in Sport held in Zurich, November 2005
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2006878/pdf/hms-1058986.pdf>

Published in final edited form as:
JAMA Pediatr. 2018 November 01; 172(11): e182853. doi:10.1001/jamapediatrics.2018.2853.

Centers for Disease Control and Prevention Guideline on the Diagnosis and Management of Mild Traumatic Brain Injury Among Children

Angela Lumba-Brown, MD, Keith Owen Yeates, PhD, Kelly Sarmiento, MPH, Matthew J. Breiding, PhD, Tamara M. Haegerich, PhD, Gerard A. Gioia, PhD, Michael Turner, MD, Edward C. Benzel, MD, Stacy J. Suskauer, MD, Christopher C. Giza, MD, Madeline Joseph, MD, Catherine Broomand, PhD, Barbara Weissman, MD, Wayne Gordon, PhD, David W. Wright, MD, Rosemarie Scolaro Moser, PhD, Karen McAvoy, PhD, Linda Ewing-Cobbs, PhD, Ann-Christine Duhaime, MD, Margot Putukian, MD, Barbara Holshouser, PhD, David Paulk, EdD, Shari L. Wade, PhD, Stanley A. Herring, MD, Mark Halstead, MD, Heather T. Keenan, MD, PhD, Meeryo Choe, MD, Cindy W. Christian, MD, Kevin Guskiewicz, PhD, ATC, P. B. Raksin, MD, Andrew Gregory, MD, Anne Mucha, PT, DPT, H. Gerry Taylor, PhD, James M. Callahan, MD, John DeWitt, PT, DPT, ATC, Michael W. Collins, PhD, Michael W. Kirkwood, PhD, John Ragheb, MD, Richard G. Ellenbogen, MD, Theodore J. Spinks, MD, Theodore G. Ganiats, MD, Linda J. Sabelhaus, MLS, Katrina Altenhofen, MPH, Rosanne Hoffman, MPH, Tom Getchius, BA, Gary Gronseth, MD, Zoe Donnell, MA, Robert E. O'Connor, MD, MPH, Shelly D. Timmons, MD, PhD

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Consensus statement on concussion in sport: the 3rd International Conference on Concussion in Sport held in Zurich, November 2005
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1718644/pdf/hms418694.pdf>

BJSM Online First, published on April 26, 2017 as 10.1136/bjsports-2017-097699

Consensus statement on concussion in sport—the 5th international conference on concussion in sport held in Berlin, October 2016

Paul McCrory,¹ Willem Meeuwisse,² Jiří Dvorak,^{3,4} Mark Aubry,⁵ Julian Bailes,⁶ Steven Broglio,⁷ Robert C Cantu,⁸ David Cassidy,⁹ Ruben J Echemendia,^{10,11} Rudy J Castellani,¹² Gavin A Davis,^{13,14} Richard Ellenbogen,¹⁵ Carolyn Emery,¹⁶ Lars Engebretsen,¹⁷ Nina Feddermann-Demont,^{18,19} Christopher C Giza,^{20,21} Kevin M Guskiewicz,²² Stanley Herring,²³ Grant L Iverson,²⁴ Karen M Johnston,²⁵ James Kissick,²⁶ Jeffrey Kutcher,²⁷ John J Leddy,²⁸ David Maddocks,²⁹ Michael Maddessi,^{30,31} Geoff Manley,³² Michael McCrea,³³ William P Meehan,^{34,35} Sinji Nagahiro,³⁶ Jon Patricios,^{37,38} Margot Putukian,³⁹ Kathryn J Schneider,⁴⁰ Allen Sills,^{41,42} Charles H Tator,^{43,44} Michael Turner,⁴⁵ Pieter E Vos⁴⁶

► Additional material is published online only. To view please visit the journal online (<http://dx.doi.org/10.1136>)

PREAMBLE
 The 2017 Concussion in Sport Group (CISG) consensus statement is designed to build on the

articles were screened by the expert panels for the Berlin meeting. The details of the search strategies and findings are included in each of the systematic

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Consensus statement on concussion in sport: the 3rd International Conference on Concussion in Sport held in Zurich, November 2005
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2006878/pdf/hms-1058986.pdf>

Harmon KD - PMC - NCBI
 American Medical Society for Sports Medicine position statement
<https://bjsm.bmj.com/content/bjsports/534/213/full.pdf>

American Medical Society for Sports Medicine position statement on concussion in sport

Kimberly G Harmon,¹ James R Clugston,² Katherine Dec,³ Brian Hainline,⁴ Stanley Herring,⁵ Shawn F Kane,⁶ Anthony P Kontos,⁷ John J Leddy,⁸ Michael McCrea,⁹ Sourav K Poddar,¹⁰ Margot Putukian,^{11,12} Julie C Wilson,¹³ William O Roberts¹⁴

For numbered affiliations see end of article.

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 Dr Kimberly G Harmon, Departments of Family Medicine and Orthopaedics and Sports Medicine, University of Washington, Seattle WA 98195, USA; kharmon@uw.edu

This article has been co-published in the *Journal of Sports Medicine and Clinical Journal of Sports Medicine*.

ABSTRACT
 Sport-related concussion (SRC) is a common injury in recreational and organised sport. Over the past 30 years, there has been significant progress in our scientific understanding of SRC, which in turn has driven the development of clinical guidelines for diagnosis, assessment and management of SRC. In addition to a growing need for knowledgeable healthcare professionals to provide evidence-based care for athletes with SRC, media attention and legislation have created awareness and, in some cases, fear about many issues and unknowns surrounding SRC. The American Medical Society for Sports Medicine (AMSSM) formed a writing group to review the existing literature on SRC

position statement on SRC was published in 2013 and this is an update to that statement.¹

WRITING GROUP SELECTION AND PROCESS
 The AMSSM Board of Directors appointed the chair (KGH) to assemble a writing group that was carefully selected to include a balanced panel of sports medicine physicians experienced in sideline and office evaluation and management of SRC, actively engaged in SRC research, and with demonstrated leadership in the area of SRC. Select subspecialty experts were invited to provide diverse viewpoints. Select members of the board, the publications committee and writing group were surveyed

Concussion in Sport Group (2022)

“The best available evidence shows that **recommending strict rest until the complete resolution of concussion-related symptoms is not beneficial** following SRC. Relative (not strict) rest, which includes activities of daily living and reduced screen time, is indicated immediately and for up to the first 2 days after injury.

Individuals can return to light-intensity physical activity, such as walking that does not more than mildly exacerbate their symptoms, during the initial 24-48 hours following a concussion.”

(Patricios et al, 2023)

Physical Activity after Concussion is OK!

Higher levels of activity were associated with shorter symptom duration and may reduce cases of delayed recovery.

(Howell et al., 2016; Leddy et al, 2018; Baker et al, 2020)

It's safe and effective in pediatric patients as well.

(Del Rossi et al, 2020)

"Available evidence demonstrates the potential of exercise in improving cognitive impairment, mood disorders, and post-concussion syndrome following TBI."

(Zhang et al, 2021)

Why does physical exertion help?

1. Improves sleep
2. Improves mood
3. Treats autonomic nervous system dysfunction
4. Prevents deconditioning



Inactivity after concussion may make symptoms worse

Patients who did **not** engage in early physical activity had:

- longer symptom duration
- greater odds of post-injury headache
- greater symptoms at initial clinical evaluation

(Howell et al, 2020, Howell et al, 2022)

Patients placed on extended rest showed no benefit and reported more symptoms (Thomas et al, 2015)

Inactivity after concussion may make symptoms worse

“Results supported the growing belief that prolonged absences from school and other life activities after a concussion may be detrimental to recovery. An early return to school may be associated with a lower symptom burden and, ultimately, faster recovery.” (Vaughan, et al 2023)

3. What is the expected recovery time?

1-3 weeks for most people - can be up to 4 weeks in children



What is true recovery?

One study looked at a number of physiological measures:

- Functional MRI
- Diffusion Tension Imaging (DTI)
- Magnetic Resonance Spectroscopy (MRS)
- Cerebral blood flow
- Electrophysiology
- Heart rate
- Exercise tolerance
- Fluid biomarkers
- Transcranial Magnetic Stimulation



Post-Concussion Syndrome (PCS)



Persistent Post-Concussion Symptoms (PPCS)

The focus is on the symptoms, not the concussion.

Does it really make a difference what we call it?

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www.glasbergen.com



“More and more patients are going to the Internet for medical advice. To keep my practice going, I changed my name to Dr. Google.”

4. What treatments/evaluations are appropriate for persistent symptoms?



The broken arm analogy

What are the causes of persistent symptoms?

“The Big 6”

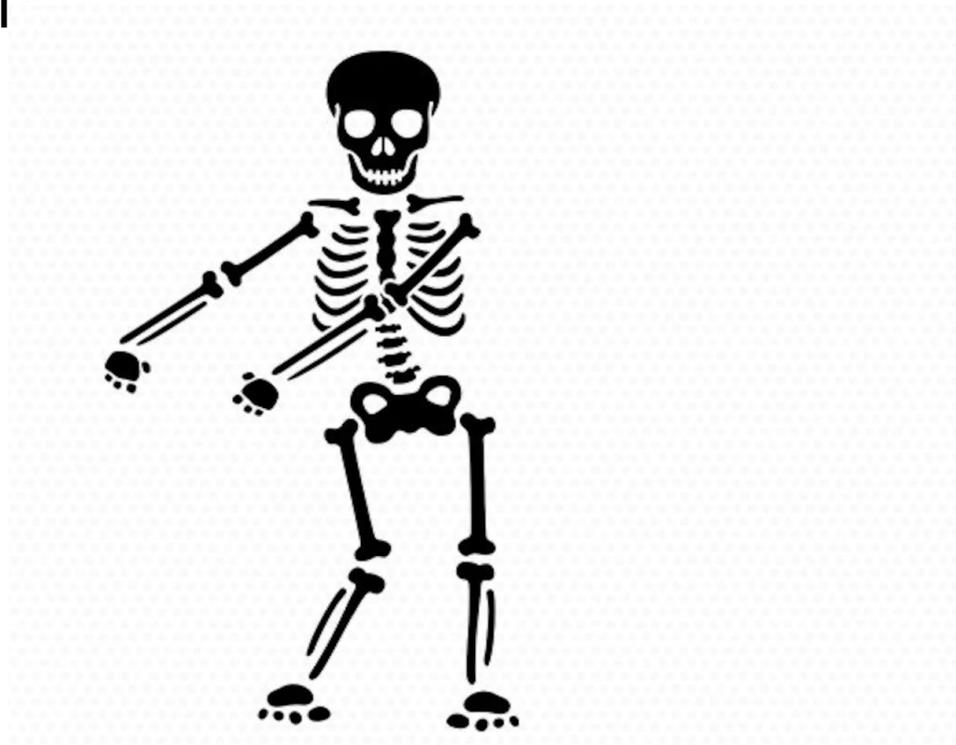
1. Cervical
2. Vestibular
3. Ocular-motor
4. Migraine
5. Autonomic Dysfunction
6. Psychological factors



What are the causes of persistent symptoms?

The **cervical spine** plays a role in symptoms of

- Headaches
- Dizziness
- Impaired balance
- Visual disturbance
- Altered eye and head movement



What are the causes of persistent symptoms?

A review study published September 2021 demonstrated that 90% of patients with PPCS had cervicogenic symptoms.

The lack of diagnosis of these symptoms significantly increased the chance of PPCS.

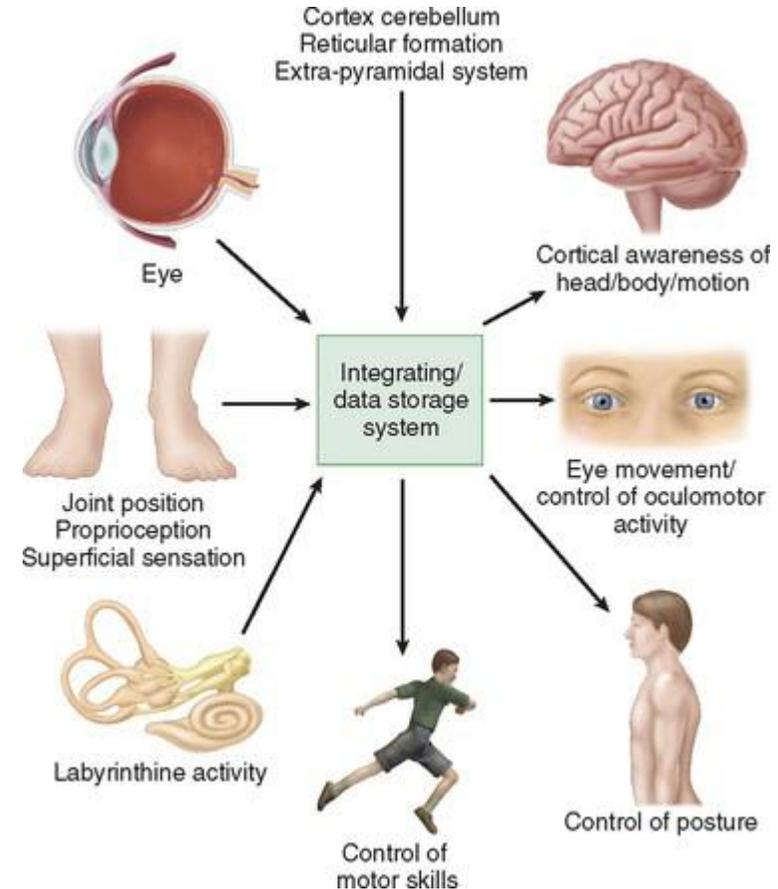
(Cheever et al, 2021)



What are the causes of persistent symptoms?

Vestibular dysfunction causes:

- Dizziness
- Unstable gait
- Nausea
- Mental fogginess
- Blurred Vision
- Impaired visual focus



What are the causes of persistent symptoms?

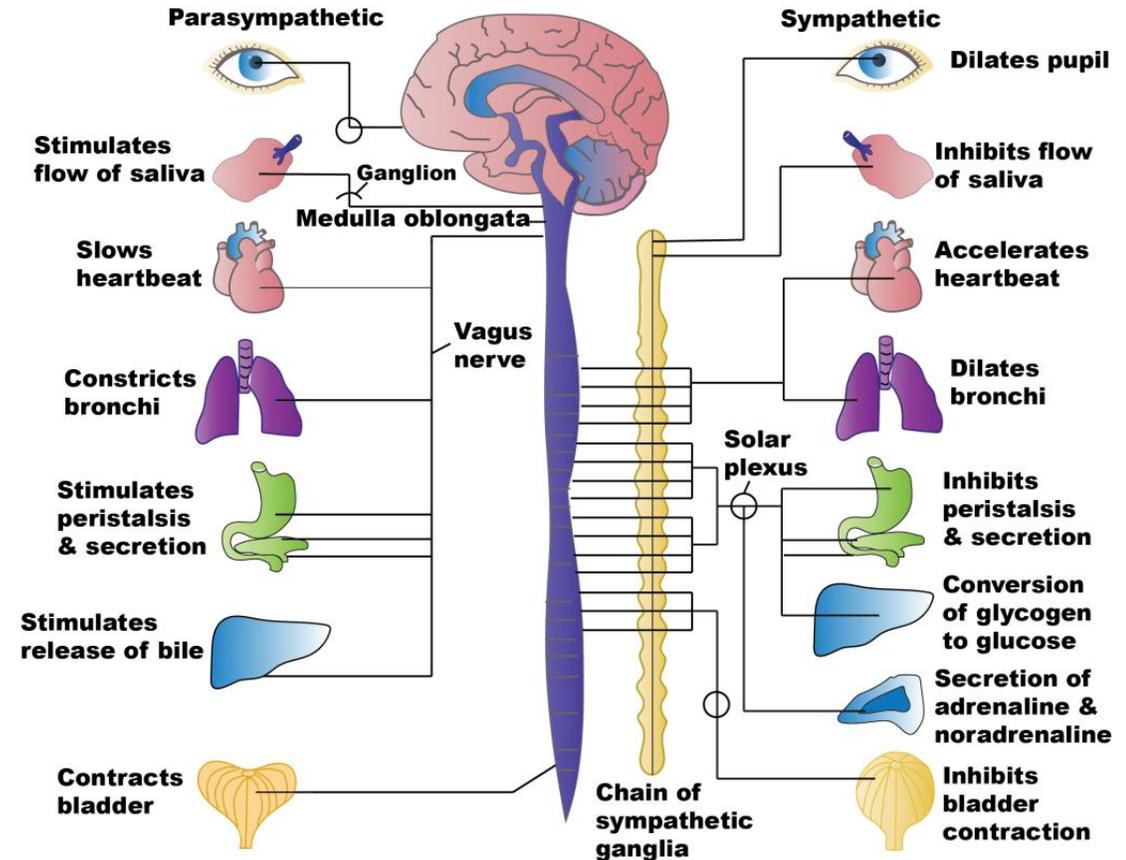
Vestibular rehabilitation has been shown to be effective with pediatric patients (Storey et al, 2018), adolescents (Park et al, 2018; Kontos et al, 2021) and adults. (Schneider et al, 2017)

Early intervention resulted in reduced time lost from sport and return to baseline functioning and was more effective than physical and cognitive rest alone. (Park et al, 2018)

What are the causes of persistent symptoms?

Autonomic Nervous System

In the acute state, heart rate variability (HRV) can be abnormal in concussion patients. This may also manifest as orthostatic hypotension with postural change and altered heart rate, and blood pressure at both rest and with exercise. (Coffman et al, 2021)



What are the causes of persistent symptoms?

Psychological Factors

It is estimated that between 12 - 44% of individuals experience depressive symptoms within the first 3 months after a concussion.

(Iverson et al, 2020)

Emotional distress after an injury, along with pre-injury mental health disorders, is a predictor for a longer recovery and higher symptom

ratings. (van der Naalt et al, 2017; Silverberg et al, 2015; Lange et al, 2011)

Mental health issues is the “*strongest predictor for persistent post-concussion symptoms.*” (Ponsford et al, 2020)

What are the causes of persistent symptoms?

Psychological Factors

There is evidence to support the use of CBT treatment for adults, as well as children and adolescents. (McCarty et al, 2021; McNally et al, 2017)

Other Factors to Consider:

- Pain
- Anxiety/depression*
- Sleep disturbances*
- Medication side effects
- Malingering
- Factitious Disorder
- Somatoform Disorder
- **Functional Neurologic Disorder**
- Attributional bias



The Role of the Concussion Specialist

There is consistent evidence that the earlier a concussion patient is evaluated by a concussion specialist, the sooner they recover.

(Desai et al, 2019; Kontos et al, 2020; French et al, 2020)



5. When can an individual return to work after a concussion?

Most individuals can safely return to work within a 1-2 days.*

*The critical factors are the individual's:

- job responsibilities
- symptom exacerbation
- severity of symptoms

When can this individual return to work after a concussion?

IMO, there are two general mistakes in return-to-work decisions:

1. Believing that any cognitive or physical activity is harmful after concussion and/or prolongs recovery.
2. Believing that any persistent symptoms are due to malingering/exaggeration so simply deciding the person can return to work after a period of time.



**Available to see patients
via telehealth in 41 states.**

Non-PsyPACT states:

**Alaska, California, Iowa, Hawaii,
Louisiana, Massachusetts, Montana,
New York and Oregon**

Thank you!

Elizabeth M. Pieroth, PsyD, ABPP, MPH

elizabeth.pieroth@rushortho.com

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 @MOR_Docs

 @MOR-Docs



Thank you!

Next CEU Webinar Topics:

***The 5 W's of Carpal Tunnel* coming this fall!**