
Head in the Game: Pediatric Concussion from Sidelines to Recovery

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Learning Objectives

1. Define concussion and understand its neurometabolic mechanisms
 2. Be informed on the tools to assess concussion on the sideline and in the clinical setting
 3. Understand pediatric concussion outcomes and persistent symptoms
 4. Understand second impact syndrome and that laws exist to help prevent it from occurring
 5. Be informed on the CDC HEADS UP concussion campaign and the return to play/school guidelines
 6. Understand how to treat recurrent concussions and clearance for patients with a history of a structural TBI
 7. Current resources available for healthcare providers for pediatric concussion management
-

Disclosures

- No relevant disclosures
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"But we don't operate on it?"



Introduction

- We see TONS of it and talk to families about it
- We help guide and counsel families of children who have it and provide referral to the appropriate resources and assist with return to activities
- Understanding concussion is essential as a pediatric neurosurgeon

History



- The recognition of concussion as a clinical syndrome separate from structural TBI is not new:
 - The Arabic physician Rhazes (10th Century) described the entity of concussion, and first used the term



- The Italian physician Lanfrancus (1306 AD) discussed "commotion cerebri" as a separate entity from structural brain injury

History: Concussion 2011

Impact

- Traumatic brain injury (TBI) is a serious public health concern
- 1-2 million sport-related concussions each year in children



Brain Protection 2016

Pediatric Concussion

- Most TBI (70-90%) are mild in severity (i.e. concussion)
- Estimated cost to society in the United States from concussion (medical and loss of work): \$17 billion

Crosby, J. Retired Med 2004

National Center for Injury Prevention and Control Report on Concussions in Child Traumatic Brain Injury in the United States: Steps to prevent a catastrophic health problem. Centers for Disease Control and Prevention, Atlanta, 2002.

What is a concussion?

Concussion in Sport Group (CISG) had its 6th meeting in Amsterdam in 2022:

- A traumatic brain injury caused by a direct blow to the head, neck, or body
- Results in an impulsive force being transmitted to the brain
- This initiates a neurotransmitter and metabolic cascade, with possible axonal injury, blood flow change and inflammation affecting the brain
- Symptoms/signs may be immediate or evolve over minutes or hours, and commonly resolve within days or may be prolonged



Periodics, British Journal of Sports Medicine 2023

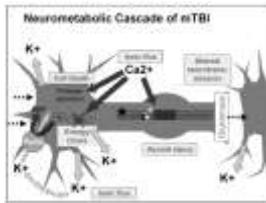
What is a concussion?



- No abnormalities seen on structural neuroimaging (CT/MRI)
 - But may be seen in the research setting on advanced neuroimaging
- May or may not involve the loss of consciousness
- The symptoms or signs not explained solely by drug, alcohol, medication use, other injuries (cervical injuries, peripheral vestibular dysfunction) or other comorbidities (psychological factors or coexisting medical conditions)
- Concussion does not have severity levels

Parkinson, British Journal of Sports Medicine 2023

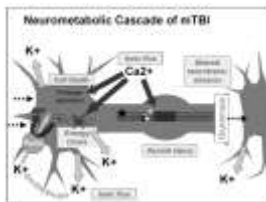
Neurometabolic Cascade



- Force to brain induces mechanoporation of lipid membranes

Giza, Neurosurgery 2014

Neurometabolic Cascade

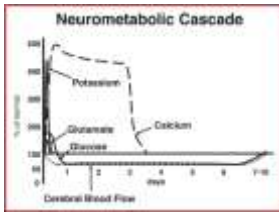


- Ion flux that trigger gated channels

Giza, Neurosurgery 2014

[illegible][illegible]

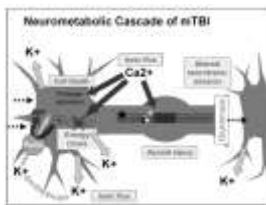
Neurometabolic Cascade



- Calcium influx into cell
- Sequestered by mitochondria
- Oxidative metabolism impaired and further worsens the energy crisis

Gov. Neurosurgery 2014

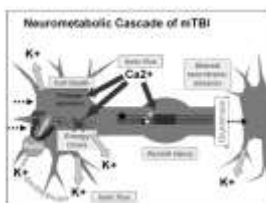
Neurometabolic Cascade



- After initial period of hyperglycolysis, glycolysis is impaired for 7-10 days
- Thought to correlate to greatest vulnerability to second impact

Gov. Neurosurgery 2014

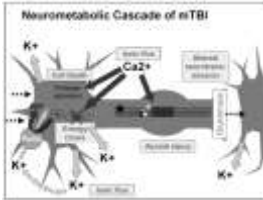
Neurometabolic Cascade



- Microtubules and cytoskeleton become injured

Gov. Neurosurgery 2014

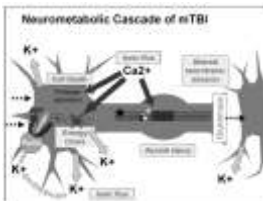
Neurometabolic Cascade



- Altered Neurotransmission
- GABAergic neurons become dysfunctional

Gov. Neurosurgery 2014

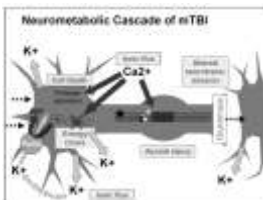
Neurometabolic Cascade



- NMDA receptors become dysfunctional

Gov. Neurosurgery 2014

Neurometabolic Cascade



- Inflammatory factors and abnormal protein aggregation within cells

Gov. Neurosurgery 2014

Connection with signs/symptoms?

Physiological perturbations after concussion and proposed clinical correlates.

| Post-TBI pathophysiology | Acute symptoms / clinical correlates |
|---|---|
| Ionic flux | Migraine headache, photophobia, phonophobia |
| Energy crisis | Vulnerability to second injury |
| Axonal injury | Impaired cognition, slowed processing, slowed reaction time |
| Impaired neurotransmission | Impaired cognition, slowed processing, slowed reaction time |
| Protein activation, altered cytoskeletal proteins, cell death | Chronic atrophy, development of persistent impairment |

From: Neurotrauma 2017

Diagnosing a Concussion

- The diagnosis of a concussion is a clinical judgement (history and exam)
- A diagnosis can be made even if the screening tests are negative
- Some common symptoms include:
 - Confusion
 - Headache
 - Vision disturbances (double/blurred)
 - Photophobia
 - Dizziness or imbalance
 - Nausea or vomiting
 - Memory loss
 - ringing ears
 - Difficulty concentrating
 - Sleep disturbances

Red Flags/Warning Signs

- Any period of loss of consciousness or Glasgow Coma Scale (GCS <15) require more careful evaluation
 - Neurologic deficits
 - Altered mental status
 - Seizures
 - Weakness or numbness
 - Worsening headache
 - Intractable vomiting
 - Deteriorating status
- The presence of any of these red flags necessitates removal from play, appropriate on-site treatment and immediate transport to a hospital for further evaluation

Diagnosis/Care

Child Sport Concussion Assessment Tool - 6 (SCAT6)



8-page series of questions meant to be used by healthcare professionals

- Supports the clinical diagnosis of concussion
- Ideally within 72hrs (up to 7 days)
- Ages 8 to 12

ChildSCAT6
British Journal of Sports Medicine 2023

Diagnosis/Care

Child Sport Concussion Office Assessment Tool - 6 (SCOA6)



- 14-page series of questions
- healthcare professionals in office setting
 - Supports the clinical diagnosis of concussion
 - After 72 hrs
 - Ages 8 to 12

Sport Concussion Office Assessment Tool 6 (SCOA6)
British Journal of Sports Medicine 2023

Diagnosis/Care

Acute Concussion Evaluation (ACE)



- 1 page series of questions
- healthcare professionals in office setting
- Can be used for diagnosis but also tracking symptom domains
- Important for track and proper referral

Diagnosis/Care

Concussion Recognition Tool 6 (CRT6)



- 2-page screening tool
- Non medically trained to help identify concussion and aid in the immediate management

The Concussion Recognition Tool 6 (CRT6)
British Journal of Sports Medicine 2021



<https://www.swaymedical.com>

Outcomes

- 25-30% experience persistent symptoms
- Symptoms continuing beyond 28 days are termed:
 - Persistent postconcussion symptoms (PPCS)
- Children's learning, social development, and mental health
- Physician's poor at predicting



Burton. JAMA 2010;303:1000-1001
Yoon. Arch Pediatr Adolesc Med 2012
Zemek. JAMA 2014

Centers for Disease Control and Prevention Report to Congress: The Management of Traumatic Brain Injury in Children Division of Unintentional Injury Prevention Atlanta, GA 2018



BMJ

Neurology, Neurosurgery,
Psychiatry

Original research

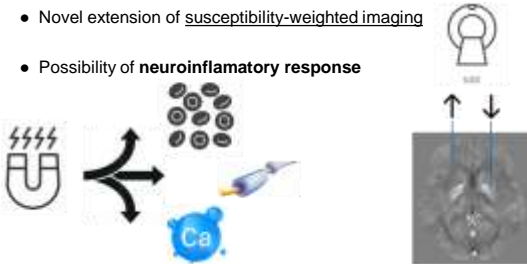
Neurosurgery

Can quantitative susceptibility mapping help diagnose and predict recovery of concussion in children? An A-CAP study

Nicholas Soder,¹ David Gold,^{1,2,3,4} Brad Goodstein,^{1,2,3,4} Richard Proyne,^{1,2,3,4,5} Ashley L. Ware,^{1,2,3,4} Adam H. Beauchamp,⁶ William R. Craig,^{1,2} Jayanth Dhan,^{1,2} Roger Zemek,^{1,2,3} Jay Khoo-Cambria,^{1,2} Keith Owen Yeates,^{1,2} On behalf of the Pediatric Emergency Research Canada A-CAP study team

Soder N. *J Neurol Neurosurg Psychiatry* 2023

- Novel extension of susceptibility-weighted imaging
- Possibility of **neuroinflammatory response**



Specific Aims

1. Assess post-acute differences in QSM between children with concussion and a comparison group of children with mild orthopaedic injury (OI)
2. Determine whether post-acute QSM makes an incremental contribution to the prediction of PPCS at 4 weeks post-injury, over and above the acute 5P risk score



• Children (N=967) aged 8-17 years with concussion or OI were recruited from 5 Canadian pediatric emergency departments

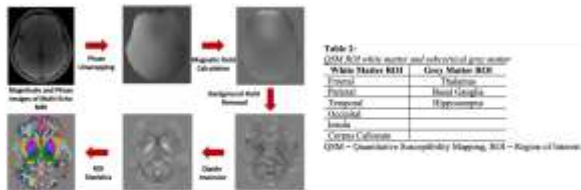
• Alberta Children's Hospital (Calgary)

• Children's Hospital of Eastern Ontario (Ottawa)

• Centre Hospitalier Universitaire Sainte-Justine (Montreal)

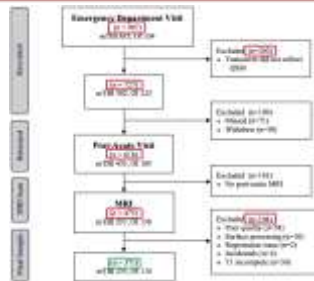
• Stollery Children's Hospital (Edmonton)

• British Columbia Children's Hospital (Vancouver)



- Individualized z-scores were calculated for each ROI for each participant

$$ZScore_i = \frac{(\bar{X}_i - \mu_i)}{\sigma_i}$$



Aim 1

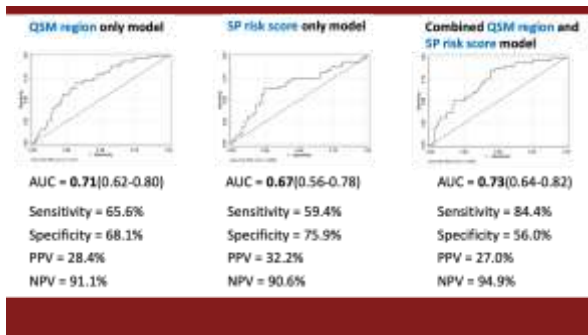
Multivariable Linear Regression Analyses





•Covariates: Age at injury, MRI Scanner, and Sex

•Did not reveal a statistically significant difference in any post-acute ROI QSM Z-score between concussion and OI children in any region

Aim 2

- Increased [frontal white matter susceptibility](#) was significantly associated with predicting parent-rated reliable change in cognitive symptoms ($p=0.001$)
- Model with frontal white matter and the 5P risk score performed [better](#) at predicting parent-rated reliable change in cognitive symptoms than the model with the 5P risk score alone ($p=0.0021$)
- No statistically significant association between QSM regions and other three PPCS outcomes (Parent Somatic, Child Cognitive + Somatic)



-  No significant group difference in post acute QSM ROI between concussion and OI children
 -  Susceptibility within the frontal white matter as a potential MRI biomarker that predicts persistent symptoms in children with concussion compared to the current clinical benchmark
 - Suggest a potential pathophysiological substrate associated with persistent symptoms
 -  Potential for using QSM to assist in the clinical management of concussion in children
 -  Currently looking at follow up 3- and 6-month MRI scans
- Future: Test a-priori in different population + improvement in QSM reconstruction and analysis

| Collaborating Authors | | Funding and Support |
|---|---|---|
|  |  |  |
| Dr. Jay Wu-Cambria MSc, MEd, FRSC | Dr. Keith Yeates PhD, FRPSC, ASPPE, FRCPC |  |
|  |  |  |
| Dr. Brad Goodfellow PhD | Dr. David Gobbi PhD |  |
| Dr. Richard Frayne PhD – University of Calgary | |  |
| Dr. Aubrey L. Ware PhD – University of Calgary | |  |
| Dr. Miriam Szeleschewski PhD – Centre Hospitalier Universitaire Sainte Justine | | |
| Dr. William R. Craig MD – University of Alberta | | |
| Dr. Gayle Dineen MD PhD – University of British Columbia | | |
| Dr. Roger Zemek MD – University of Ottawa | | |

Second Impact Syndrome

- Diffuse cerebral edema thought to result from impaired autoregulation that occurs with subsequent concussive injury

Second Impact Syndrome

- Varying degrees of rest have been recommended in the past and when to return to activities

Zackery Lystedt Law (House Bill 1824)

- May 2009
 - Washington state was the first to pass actual law requiring removal of youth from play after concussion on the day of injury, with required clearance from a licensed health provider prior to RTP
 - Every state followed adopting similar law



<https://www.dg.gov/heads-up/media/pdf/states/03210-zack-story.pdf>

Zackery Lystedt Law (House Bill 1824)

"There is no one tougher than my son. Sometimes players and parents wrongly believe that it shows strength and courage to play injured. Battling pain is glamorized. Zack couldn't swallow or hold his head up. Strength is seeing Zack stand up out of his wheelchair and learning to talk again."

- Victor Lystedt, Zack's Dad.



<https://www.cbc.ca/headlines/updates/2013/09/2013-09-20-zack-story.pdf>

Rowan's Law

- June 2016
 - Ontario, Canada was the first province to pass a law similar to previous
 - All other provinces in Canada have adopted something similar
 - Rowans Law Day last Wednesday in September



<https://www.ontario.ca/page/rowans-law-day>

Recovery

- Current guidelines recommend rest for the first 24 to 48 hours
- Avoiding physical and cognitive activities that worsen symptoms
- Must be restricted from physical activity, sports, and playground activity until cleared by a healthcare professional



Recovery

- Allows symptom burden to decrease
- Followed by the gradual return to cognitive and physical activities as tolerated
- This approach minimizes both the risk of secondary injury and the potential social isolation and academic consequences of prolonged removal.



HEADS UP Concussion (CDC)

- It is a campaign initiative to help coaches, parents, patients, and medical professions with the diagnosis, prevention, treatment and return to play surrounding concussions



<https://www.cdc.gov/heads-up/index.html>

6 Step Return to Play

- Remove from sport if sustained concussion
- Take at least 24h off from sports: get medical clearance.
- After that, do these 6 steps, with a minimum of 1 day between
- If symptoms come back or new symptoms, contact medical professional



Return to School

- Most kids can return to school 1 to 2 days after concussion
- Can shorten their recovery and reduce likelihood of mental health symptoms
- Letter for schools to be filled out by medical professional
 - Help school provide strategies for support and recovery



Return to School

- Ongoing multi-source assessment is crucial as students reintegrate into school environment
- Evaluations from teachers, caregivers, parents ect. must be combined to develop an overall impression of the child's recovery and integration into school



Oklahoma State Department of Health

- Excellent resources on concussion for:



<https://oklahoma.gov/health/health-education/prevention-service/concussions.html>

Parents and Guardians

Concussion Facts
Parents & Guardians

What is a concussion?
A concussion is a mild form of traumatic brain injury (TBI) caused by a bump, blow, or jolt to the head or body that causes the brain and the chemicals in the brain to move around and act differently. Concussions can happen to anyone, at any age, and in any situation. Concussions can be caused by sports, falls, car accidents, or other types of trauma.

How do concussions happen?
Concussions can happen in many ways, including:
• Sports injuries (e.g., football, soccer, basketball, baseball, softball, hockey, volleyball, gymnastics, etc.)
• Falls (e.g., from a height, down stairs, etc.)
• Car accidents (e.g., motor vehicle accidents, etc.)
• Other types of trauma (e.g., assault, etc.)

Can concussion risk be reduced?
Yes, there are several ways to reduce the risk of a concussion:
• Wear your seat belt in the car.
• Use proper technique when playing sports.
• Avoid alcohol and drugs.
• Avoid risky behavior (e.g., drinking and driving, etc.).

Can my child keep playing after a concussion?
No, your child should not keep playing after a concussion. It is important to rest and recover from a concussion. If your child has a concussion, they should be taken out of play and not return to play until they are fully recovered and cleared by a healthcare provider.

SIGNS AND SYMPTOMS

Concussions can cause a variety of signs and symptoms. These can be physical, behavioral, or cognitive. If you notice any of these signs or symptoms in your child, it is important to seek medical attention.

| Physical | Behavioral | Cognitive |
|----------------------------|---------------------------------|----------------------------|
| Headache | Changes in mood | Changes in thinking |
| Nausea | Changes in personality | Changes in memory |
| Vomiting | Changes in behavior | Changes in attention |
| Blurred vision | Changes in social skills | Changes in decision-making |
| Loss of consciousness | Changes in communication | Changes in judgment |
| Slurred speech | Changes in self-control | Changes in impulse control |
| Balance problems | Changes in self-esteem | Changes in self-awareness |
| Sensitivity to light | Changes in self-image | Changes in self-respect |
| Sensitivity to noise | Changes in self-worth | Changes in self-confidence |
| Changes in sleep patterns | Changes in self-identity | Changes in self-perception |
| Changes in appetite | Changes in self-expression | Changes in self-assertion |
| Changes in energy levels | Changes in self-motivation | Changes in self-direction |
| Changes in concentration | Changes in self-discipline | Changes in self-control |
| Changes in focus | Changes in self-regulation | Changes in self-management |
| Changes in organization | Changes in self-organization | Changes in self-structure |
| Changes in planning | Changes in self-planning | Changes in self-structure |
| Changes in problem-solving | Changes in self-problem-solving | Changes in self-structure |
| Changes in decision-making | Changes in self-decision-making | Changes in self-structure |
| Changes in judgment | Changes in self-judgment | Changes in self-structure |
| Changes in impulse control | Changes in self-impulse control | Changes in self-structure |
| Changes in self-control | Changes in self-control | Changes in self-structure |
| Changes in self-esteem | Changes in self-esteem | Changes in self-structure |
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| Changes in self-control | Changes in self-control | Changes in self-structure |
| Changes in self-management | Changes in self-management | Changes in self-structure |
| Changes in self-structure | Changes in self-structure | Changes in self-structure |

DANGER SIGNS

There are several signs and symptoms that indicate a serious injury. If you notice any of these signs or symptoms, it is important to seek medical attention immediately.

- Repeated vomiting or nausea
- Seizures
- Loss of consciousness
- Slurred speech
- Unusual behavior
- Changes in vision
- Changes in hearing
- Changes in taste
- Changes in smell
- Changes in touch
- Changes in pain
- Changes in temperature
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- Changes in skin pain
- Changes in skin temperature
- Changes in skin blood pressure
- Changes in skin heart

[illegible]

Coaches



OKLAHOMA
State Department
of Health

Concussion Facts

COACHES

What is a concussion?

A traumatic brain injury (TBI) caused by a bump, blow, or jolt to the head or by a force to the body that causes the head and brain to move violently and suddenly. It can be caused by a fall, being struck by an object, or being in a motor vehicle crash. It can also be caused by a violent shaking of the head and/or body without direct contact to the head.

When an athlete takes a hit

A concussion can occur after a blow to the head or body, or a sudden jolt to the head or body. The brain can move back and forth inside the skull, causing it to collide with the skull's inner lining. This can cause brain cells to be injured and even die. A concussion can also cause chemical changes in the brain.

WHEN IN DOUBT, SIT THEM OUT

It is important to get a medical professional to evaluate the athlete. If the athlete is having any of the following symptoms, they should be removed from play and not allowed to return to play until they have been evaluated by a medical professional.

MYTH: A concussion is just a "bad bump on the head."

FACT: A concussion is a traumatic brain injury that can be life-threatening.

SIGNS AND SYMPTOMS

Signs and symptoms of a concussion can be divided into three categories: physical, emotional/behavioral, and cognitive. Not all athletes will experience all of these symptoms, and some may experience symptoms that are not listed here.

| Physical | Emotional/Behavioral | Cognitive |
|--|--|--|
| <ul style="list-style-type: none"> • Headaches • Nausea or vomiting • Balance problems • Dizziness • Blurred vision • Sensitivity to light or noise • Fatigue or tiredness • Loss of consciousness • Slurred speech • Ringing in the ears • Changes in heart rate or blood pressure | <ul style="list-style-type: none"> • Irritability • Depression • Anxiety • Changes in behavior • Changes in personality • Changes in social interactions • Changes in academic performance • Changes in sleep patterns • Changes in appetite • Changes in energy levels • Changes in motivation • Changes in focus • Changes in memory • Changes in judgment • Changes in decision-making • Changes in risk-taking behavior • Changes in impulse control • Changes in emotional stability • Changes in mood • Changes in self-esteem • Changes in self-image • Changes in self-perception • Changes in self-awareness • Changes in self-regulation • Changes in self-control • Changes in self-discipline • Changes in self-motivation • Changes in self-efficacy • Changes in self-confidence • Changes in self-respect • Changes in self-worth • Changes in self-esteem • Changes in self-image • Changes in self-perception • Changes in self-awareness • Changes in self-regulation • Changes in self-control • Changes in self-discipline • Changes in self-motivation • Changes in self-efficacy • Changes in self-confidence • Changes in self-respect • Changes in self-worth | <ul style="list-style-type: none"> • Confusion • Disorientation • Memory loss • Difficulty concentrating • Difficulty following instructions • Difficulty understanding questions • Difficulty making decisions • Difficulty solving problems • Difficulty completing tasks • Difficulty staying on task • Difficulty staying focused • Difficulty staying alert • Difficulty staying motivated • Difficulty staying engaged • Difficulty staying interested • Difficulty staying involved • Difficulty staying committed • Difficulty staying dedicated • Difficulty staying loyal • Difficulty staying faithful • Difficulty staying honest • Difficulty staying truthful • Difficulty staying open • Difficulty staying flexible • Difficulty staying adaptable • Difficulty staying resilient • Difficulty staying strong • Difficulty staying brave • Difficulty staying confident • Difficulty staying self-assured • Difficulty staying self-reliant • Difficulty staying self-sufficient • Difficulty staying self-starter • Difficulty staying self-motivated • Difficulty staying self-driven • Difficulty staying self-directed • Difficulty staying self-managing • Difficulty staying self-organizing • Difficulty staying self-disciplined • Difficulty staying self-controlled • Difficulty staying self-regulated • Difficulty staying self-monitored • Difficulty staying self-evaluated • Difficulty staying self-improved • Difficulty staying self-updated • Difficulty staying self-renewed • Difficulty staying self-rejuvenated • Difficulty staying self-restored • Difficulty staying self-revived • Difficulty staying self-resurrected • Difficulty staying self-reborn • Difficulty staying self-recreated • Difficulty staying self-reinvented • Difficulty staying self-renewed • Difficulty staying self-rejuvenated • Difficulty staying self-restored • Difficulty staying self-revived • Difficulty staying self-reurrected • Difficulty staying self-reborn • Difficulty staying self-recreated • Difficulty staying self-reinvented |

DANGER SIGNS

Some athletes may experience more serious symptoms that require immediate medical attention. If an athlete experiences any of the following symptoms, they should be removed from play and not allowed to return to play until they have been evaluated by a medical professional.

- Loss of consciousness
- Seizures
- Repeated vomiting
- Increasing headache
- Increasing drowsiness
- Increasing confusion
- Increasing disorientation
- Increasing memory loss
- Increasing difficulty concentrating
- Increasing difficulty following instructions
- Increasing difficulty understanding questions
- Increasing difficulty making decisions
- Increasing difficulty solving problems
- Increasing difficulty completing tasks
- Increasing difficulty staying on task
- Increasing difficulty staying focused
- Increasing difficulty staying alert
- Increasing difficulty staying motivated
- Increasing difficulty staying engaged
- Increasing difficulty staying interested
- Increasing difficulty staying involved
- Increasing difficulty staying committed
- Increasing difficulty staying dedicated
- Increasing difficulty staying loyal
- Increasing difficulty staying faithful
- Increasing difficulty staying honest
- Increasing difficulty staying truthful
- Increasing difficulty staying open
- Increasing difficulty staying flexible
- Increasing difficulty staying adaptable
- Increasing difficulty staying resilient
- Increasing difficulty staying strong
- Increasing difficulty staying brave
- Increasing difficulty staying confident
- Increasing difficulty staying self-assured
- Increasing difficulty staying self-reliant
- Increasing difficulty staying self-sufficient
- Increasing difficulty staying self-starter
- Increasing difficulty staying self-motivated
- Increasing difficulty staying self-driven
- Increasing difficulty staying self-directed
- Increasing difficulty staying self-managing
- Increasing difficulty staying self-organizing
- Increasing difficulty staying self-disciplined
- Increasing difficulty staying self-controlled
- Increasing difficulty staying self-regulated
- Increasing difficulty staying self-monitored
- Increasing difficulty staying self-evaluated
- Increasing difficulty staying self-improved
- Increasing difficulty staying self-updated
- Increasing difficulty staying self-renewed
- Increasing difficulty staying self-rejuvenated
- Increasing difficulty staying self-restored
- Increasing difficulty staying self-revived
- Increasing difficulty staying self-reurrected
- Increasing difficulty staying self-reborn
- Increasing difficulty staying self-recreated
- Increasing difficulty staying self-reinvented

Learn more about concussion at oklahoma.gov/health/oklahoma-state-department-of-health

<https://oklahoma.gov/health/health-education/legislative-prevention-services/concussions.html>

Return to Learn



RETURN TO LEARN: CONCUSSION

WHAT IS A CONCUSSION AND HOW CAN I IDENTIFY ONE?

A concussion is a mild traumatic brain injury (MTBI) caused by a blow to the head or a jolt to the body. It can cause a temporary change in the way the brain works. Symptoms can include headache, dizziness, nausea, vomiting, confusion, and memory loss. If you or someone you know has these symptoms after a head injury, it's important to seek medical attention.

CONCUSSIONS LEAD TO MISSING SCHOOL OR CLASSROOM

Students who have a concussion may have difficulty concentrating, remembering information, and completing assignments. They may also have fatigue and irritability. It's important to communicate with school officials about the student's condition and the need for accommodations.

EXAMPLES OF SCHOOL SUPPORT

- Allow the student to rest and avoid activities that require concentration or physical exertion.
- Provide a quiet place for the student to rest.
- Allow the student to skip or shorten assignments.
- Allow the student to take breaks during class.
- Allow the student to use a calculator or other aids.
- Allow the student to use a computer or other technology.
- Allow the student to use a peer tutor or other support.
- Allow the student to use a modified schedule.
- Allow the student to use a modified assignment.
- Allow the student to use a modified classroom.
- Allow the student to use a modified teacher.
- Allow the student to use a modified parent.
- Allow the student to use a modified community.
- Allow the student to use a modified society.
- Allow the student to use a modified world.
- Allow the student to use a modified everything.

For more information, visit: <https://oklahoma.gov/health/education/injury-prevention-services/concussions.html>

RETURN TO LEARN PROTOCOL

RETURN TO LEARN PROTOCOL

PHASE 1

Rest and avoid activities that require concentration or physical exertion.

PHASE 2

Return to school or classroom with accommodations.

PHASE 3

Return to school or classroom with accommodations.

PHASE 4

Return to school or classroom with accommodations.

PHASE 5

Return to school or classroom with accommodations.

For more information, visit: <https://oklahoma.gov/health/education/injury-prevention-services/concussions.html>

<https://oklahoma.gov/health/education/injury-prevention-services/concussions.html>

Return to Play



RETURN TO PLAY: BACK TO SPORTS AFTER A CONCUSSION

Before you begin

• An athlete's progression through the Return to Play Protocol should be supervised by a licensed healthcare provider who has experience with concussion management.

• The athlete should not return to play until they have been cleared by a healthcare provider.

• The athlete should not return to play until they have been cleared by a healthcare provider.

WHEN IN DOUBT, GET THEM OUT

• If an athlete has a concussion, they should be removed from play immediately.

• If an athlete has a concussion, they should be removed from play immediately.

• If an athlete has a concussion, they should be removed from play immediately.

For more information, visit: <https://oklahoma.gov/health/education/injury-prevention-services/concussions.html>

RETURN TO PLAY PROTOCOL

STEP 1: REST

• Rest and avoid activities that require concentration or physical exertion.

STEP 2: LIGHT EXERCISE

• Light aerobic exercise, such as walking or swimming.

STEP 3: MILD EXERCISE

• Moderate aerobic exercise, such as jogging or cycling.

STEP 4: HARD EXERCISE

• Hard aerobic exercise, such as running or swimming.

STEP 5: PROCEED WITH CAUTION

• Return to play with caution and avoid contact sports.

STEP 6: RETURN TO PLAY

• Return to play with caution and avoid contact sports.

For more information, visit: <https://oklahoma.gov/health/education/injury-prevention-services/concussions.html>

<https://oklahoma.gov/health/education/injury-prevention-services/concussions.html>



PedsConcussion

PELAGIC CONCUSSION

The Pelagic Concussion is a mild traumatic brain injury (MTBI) caused by a blow to the head or a jolt to the body. It can cause a temporary change in the way the brain works. Symptoms can include headache, dizziness, nausea, vomiting, confusion, and memory loss. If you or someone you know has these symptoms after a head injury, it's important to seek medical attention.

CONCUSSIONS LEAD TO MISSING SCHOOL OR CLASSROOM

Students who have a concussion may have difficulty concentrating, remembering information, and completing assignments. They may also have fatigue and irritability. It's important to communicate with school officials about the student's condition and the need for accommodations.

EXAMPLES OF SCHOOL SUPPORT

- Allow the student to rest and avoid activities that require concentration or physical exertion.
- Provide a quiet place for the student to rest.
- Allow the student to skip or shorten assignments.
- Allow the student to take breaks during class.
- Allow the student to use a calculator or other aids.
- Allow the student to use a computer or other technology.
- Allow the student to use a peer tutor or other support.
- Allow the student to use a modified schedule.
- Allow the student to use a modified assignment.
- Allow the student to use a modified classroom.
- Allow the student to use a modified teacher.
- Allow the student to use a modified parent.
- Allow the student to use a modified community.
- Allow the student to use a modified society.
- Allow the student to use a modified world.
- Allow the student to use a modified everything.

For more information, visit: <https://oklahoma.gov/health/education/injury-prevention-services/concussions.html>

Read N. Zemek R. Dawson J. Lehoucq AA, et al (2023) Living Guideline for Pediatric Concussion Care. www.pedsconcussion.com

<https://doi.org/10.1196/CSF.5033WVW>

Multiple Concussions

- Varies by institution/provider
- Persistent post-concussive symptoms:
 - consider taking season off
- Two concussions in one season:
 - consider taking season off
- Persistent cognitive deficits:
 - formal neuropsych testing, consider return to play when recovered

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Multiple Concussions

- 3 lifetime concussions
 - consider taking season off or retirement
- 4 concussions
 - strongly consider retirement

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Structural TBI (Skull Fracture/Blood in Head)

- Will be asked for clearance
- Controversial with no established guidelines:
 - Symptom free and negative follow up imaging (at 3-6 months)
 - No sports allowed for 1 year with follow up visit and scan at 1 year. Return to play pathway is considered.



Multidisciplinary Care is Essential

- Occupational Therapy
- Physical Therapy
- Neuropsychology
- Vestibular Therapy
- Neurology
- Sports Medicine
- Neurosurgery
- Psychiatry/psychology



QUESTIONS? Thank you!

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