Concussion

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Objectives

- **Define and discuss various types of head injuries in sport**
- **Review initial evaluation of an athlete with a head injury**
- **Review concussion evaluation and treatment**
- **Discuss return to play guidelines for an athlete with a head injury**

Head Injuries in Sport

- **Actual number of injuries unknown because many are not reported by the athlete**
- **Most head injuries in sport are minor:**
  - **Sports are third behind MVA and falls as cause of minor head injuries**
  - **Most common head injury in sports is a concussion**

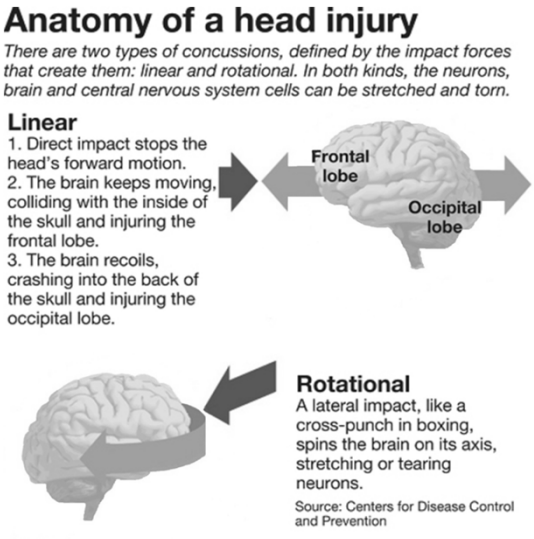
Concussion

- **Definition:**
  - ***Concussion is defined as a complex physiological process affecting the brain, induced by traumatic biomechanical forces.***
    - **Caused by a direct blow to the head, face, neck, or elsewhere on the body with an impulsive force transmitted to the head**

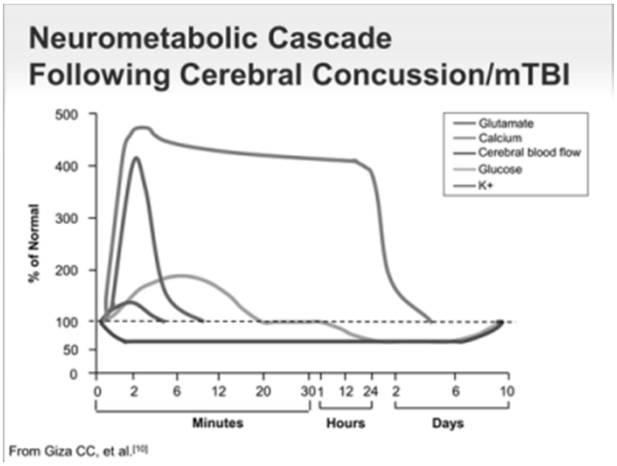
Concussion

- **Typically results in the rapid onset of short-lived impairment of neurological function that resolves spontaneously**
- **May result in neuropathological changes reflecting a functional disturbance rather than a structural injury**
- **Graded set of clinical syndromes that may or may not involve LOC**
- **Associated with grossly normal neuroimaging studies**

Concussion



Concussion



Sideline Assessment of Concussion

Table 1 Selected acute and delayed signs and symptoms suggestive of concussion

Cognitive	Somatic	Affective	Sleep disturbances
Confusion	Headache	Emotional lability	Trouble falling asleep
Anterograde amnesia	Dizziness	Irritability	Sleeping more than usual
Retrograde amnesia	Balance disruption	Fatigue	Sleeping less than usual
Loss of consciousness	Nausea/vomiting	Anxiety	
Disorientation	Visual disturbances (photophobia, blurry/double vision)	Sadness	
Feeling 'in a fog,' 'zoned out'	Phonophobia		
Vacant stare Inability to focus			
Delayed verbal and motor responses Slurred/incoherent speech			
Excessive drowsiness			

Putukian M, *et al. Br J Sports Med* 2013;**47**:285–288.

Sideline Assessment of Concussion

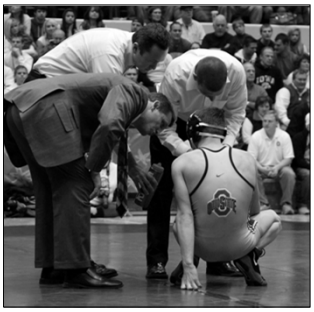
When to transport to an emergency facility:

- Worsening headache
- Very drowsy or cannot be easily awakened
- Cannot recognise people or places
- Develops significant nausea or vomiting
- Behaves unusually, more confused or irritable
- Develops seizures
- Weakness or numbness in the arms or legs
- Slurred speech or unsteadiness of gait

Putukian M, *et al. Br J Sports Med* 2013;**47**:285–288.

Sideline Assessment of Concussion

- **Working within a medical team for evaluation**
  - **Athletic trainers, team physicians, specialists**
- **Do you know the athlete?**
  - **Personality**
  - **Normal vs abnormal**
  - **Clinical judgment**
- **Standardized assessment**
  - **Symptom scale**
  - **Cognitive evaluation**
  - **Balance evaluation**



Sideline Assessment of Concussion

STEP 2: OBSERVABLE SIGNS

Witnessed ☐ Observed on Video ☐

Lying motionless on the playing surface	Y	N
Balance / gait difficulties / motor incoordination: stumbling, slow / laboured movements	Y	N
Disorientation or confusion, or an inability to respond appropriately to questions	Y	N
Blank or vacant look	Y	N
Facial injury after head trauma	Y	N

SCAT5. SPORT CONCUSSION ASSESSMENT TOOL – 5TH EDITION
DEVELOPED BY THE CONCUSSION IN SPORT GROUP
FOR USE BY MEDICAL PROFESSIONALS ONLY
supported by FIFA

STEP 3: MEMORY ASSESSMENT MADDOCKS QUESTIONS[2]

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

Mark Y for correct answer / N for incorrect

What venue are we at today?	Y	N
Which half is it now?	Y	N
Who scored last in this match?	Y	N
What team did you play last week / game?	Y	N
Did your team win the last game?	Y	N

Sideline Assessment of Concussion

STEP 4: EXAMINATION
GLASGOW COMA SCALE (GCS)[3]

Time of assessment			
Date of assessment			
Best eye response (E)			
No eye opening	1	1	1
Eye opening in response 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
Localizes to pain	5	5	5
Obeys commands	6	6	6
Glasgow Coma score (E + V + M)			

CERVICAL SPINE ASSESSMENT

Does the athlete report that their neck is pain free at rest?	Y	N
If there is NO neck pain at rest, does the athlete have a full range of ACTIVE pain free movement?	Y	N
Is the limb strength and sensation normal?	Y	N

Sideline Assessment of Concussion

STEP 2: SYMPTOM EVALUATION

The athlete should be given the symptom form and asked to read this instruction paragraph out loud then complete the symptom scale. For the baseline assessment, the athlete should rate his/her symptoms based on how he/she typically feels and for the post injury assessment the athlete should rate their symptoms at this point in time.

Please Check: ☐ **Baseline** ☐ **Post-Injury**

Please hand the form to the athlete

	none	mild		moderate		severe	
Headache	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
Total number of symptoms:							of 22
Symptom severity score:							of 132
Do your symptoms get worse with physical activity?						Y	N
Do your symptoms get worse with mental activity?						Y	N

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

Sideline Assessment of Concussion

IMMEDIATE MEMORY

List	Alternate 5 word lists					Score (of 5) Trial 1	Trial 2	Trial 3
A	Finger	Penny	Blanket	Lemon	Insect			
B	Candle	Paper	Sugar	Sandwich	Wagon			
C	Baby	Monkey	Perfume	Sunset	Iron			
D	Elbow	Apple	Carpet	Saddle	Bubble			
E	Jacket	Arrow	Pepper	Cotton	Movie			
F	Dollar	Honey	Mirror	Saddle	Anchor			
					Immediate Memory Score			of 15
					Time that last trial was completed			

List	Alternate 10 word lists					Score (of 10) Trial 1	Trial 2	Trial 3
G	Finger	Penny	Blanket	Lemon	Insect			
	Candle	Paper	Sugar	Sandwich	Wagon			
H	Baby	Monkey	Perfume	Sunset	Iron			
	Elbow	Apple	Carpet	Saddle	Bubble			
I	Jacket	Arrow	Pepper	Cotton	Movie			
	Dollar	Honey	Mirror	Saddle	Anchor			
					Immediate Memory Score			of 30
					Time that last trial was completed			

DIGITS BACKWARDS

Concentration Number Lists (circle one)					
List A	List B	List C			
4-9-3	5-2-6	1-4-2	Y	N	0
6-2-9	4-1-5	6-5-8	Y	N	1
3-8-1-4	1-7-9-5	6-8-3-1	Y	N	0
3-2-7-9	4-9-6-8	3-4-8-1	Y	N	1
6-2-9-7-1	4-8-5-2-7	4-9-1-5-3	Y	N	0
1-5-2-8-6	6-1-8-4-3	6-8-2-5-1	Y	N	1
7-1-8-4-6-2	8-3-1-9-6-4	3-7-6-5-1-9	Y	N	0
5-3-9-1-4-8	7-2-4-8-5-6	9-2-6-5-1-4	Y	N	1
List D	List E	List F			
7-8-2	3-8-2	2-7-1	Y	N	0
9-2-6	5-1-8	4-7-9	Y	N	1
4-1-8-3	2-7-9-3	1-6-8-3	Y	N	0
9-7-2-3	2-1-6-9	3-9-2-4	Y	N	1
1-7-9-2-6	4-1-8-6-9	2-4-7-5-8	Y	N	0
4-1-7-5-2	9-4-1-7-5	8-3-9-6-4	Y	N	1
2-6-4-8-1-7	6-9-7-3-8-2	5-8-6-2-4-9	Y	N	0
8-4-1-9-3-5	4-2-7-9-3-8	3-1-7-8-2-6	Y	N	1
		Digits Score:			of 4

Sideline Assessment of Concussion

MONTHS IN REVERSE ORDER

Now tell me the months of the year in reverse order. Start with the last month and go backward. So you'll say December, November. Go ahead.

Dec - Nov - Oct - Sept - Aug - Jul - Jun - May - Apr - Mar - Feb - Jan	0 1
Months Score	of 1
Concentration Total Score (Digits + Months)	of 5

STEP 5: DELAYED RECALL:

The delayed recall should be performed after 5 minutes have elapsed since the end of the Immediate Recall section. Score 1 pt. for each correct response.

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

Please record each word correctly recalled. Total score equals number of words recalled.

Total number of words recalled accurately: of 5 or of 10

STEP 4: NEUROLOGICAL SCREEN

See the instruction sheet (page 7) for details of test administration and scoring of the tests.

Can the patient read aloud (e.g. symptom check-list) and follow instructions without difficulty?	Y	N
Does the patient have a full range of pain-free PASSIVE cervical spine movement?	Y	N
Without moving their head or neck, can the patient look side-to-side and up-and-down without double vision?	Y	N
Can the patient perform the finger nose coordination test normally?	Y	N
Can the patient perform tandem gait normally?	Y	N

BALANCE EXAMINATION

Modified Balance Error Scoring System (mBESS) testing[5]

Which foot was tested (i.e. which is the non-dominant foot) ☐ Left ☐ Right

Testing surface (hard floor, field, etc.) _____

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

Condition	Errors
Double leg stance	of 10
Single leg stance (non-dominant foot)	of 10
Tandem stance (non-dominant foot at the back)	of 10
Total Errors	of 30

The Ohio State University Wexner Medical Center

Sideline Assessment of Concussion

STEP 6: DECISION

Domain	Date & time of assessment:		
Symptom number (of 22)			
Symptom severity score (of 132)			
Orientation (of 5)			
Immediate memory	of 15 of 30	of 15 of 30	of 15 of 30
Concentration (of 5)			
Neuro exam	Normal Abnormal	Normal Abnormal	Normal Abnormal
Balance errors (of 30)			
Delayed Recall	of 5 of 10	of 5 of 10	of 5 of 10

Date and time of injury: _____

If the athlete is known to you prior to their injury, are they different from their usual self?
☐ Yes ☐ No ☐ Unsure ☐ Not Applicable
(If different, describe why in the clinical notes section)

Concussion Diagnosed?
☐ Yes ☐ No ☐ Unsure ☐ Not Applicable

If re-testing, has the athlete improved?
☐ Yes ☐ No ☐ Unsure ☐ Not Applicable

I am a physician or licensed healthcare professional and I have personally administered or supervised the administration of this SCAT5.

Signature: _____

Name: _____

Title: _____

Registration number (if applicable): _____

Date: _____

Sideline Assessment of Concussion

Table 3 Sideline concussion evaluation tests

Test	Time to administer	Sensitivity	Specificity	False positives	False negatives
Symptom scores	2–3 min				
Broglio (2007) 9-item		68%			32%
McCrea (2005) 17-item		89%	100%	0%	11%
Maddocks	<1 min				
(CJSM 1995)		32–75%	86–100%	29–68%	0–11%
SAC	5 min				
Barr (2001)		94%	76%	24%	6%
McCrea (2005)		80%	91%	9%	20%
BESS	5 min				
(McCrea 2005)		34%	91%	66%	9%
Modified BESS	2–3 min	Unknown	Unknown	Unknown	Unknown
SAC + BESS	10 min	Unknown	Unknown	Unknown	Unknown
NFL Sideline Concussion Assessment Tool (SAC+modified BESS+Symptoms score)	8–10 min	Unknown	Unknown	Unknown	Unknown
SCAT2 (SAC+modified BESS+Glasgow coma scale+physical signs score+Maddock's score+coordination exam	8–10 min	Unknown	Unknown	Unknown	Unknown

Harmon KG, *et al*. *Br J Sports Med* 2013;**47**:15–26.

Sideline Assessment of Concussion

- **SAC**
  - **Sensitive for 48 hours following SRC**
- **Maddock's**
  - **Useful for acute evaluation only**
- **Symptoms**
  - **Sensitive initially; approaching 0 at day 7**
- **Balance**
  - **Lower sensitivity (confounding variables)**
  - **Good specificity to day 7**

Sideline Assessment of Concussion

- **Combination evaluations**
  - **Include validated sub sections but are not validated in the evaluation of SRC**
- **Gold standard**

Clinical impression

A clinician's diagnostic impression should override a negative sideline assessment

Putukian M, *et al. Br J Sports Med* 2013;**47**:285–288.

Sideline Assessment of Concussion

- **King-Devick**
  - **Saccadic eye movements**
- **"Concussion bin"**
  - **Rest period for evaluation (15 min)**
  - **Move to a quiet environment for testing**
- **Serial evaluations**
  - **Monitor for neurologic deterioration**
  - **Clinical determination if a concussion occurred**

Return to Play Following Concussion

- No return to play on same day of concussion
  - US Team Physician Consensus Statement
  - NCAA (2010)
  - Legislation – "Lysert law"
- Duration of symptoms: 7-10 days
  - Multimodal assessment
  - Cognitive deficits

McCrea M, Guskiewicz KM, Marshall SW, *et al*. Acute effects and recovery time following concussion in collegiate football players: the NCAA Concussion Study. *JAMA* 2003;290:2556–63.

Belanger HG, Vanderploeg RD. The neuropsychological impact of sport-related concussion: a meta-analysis. *J Int Neuropsychol Soc* 2005;11:345–57.

Return to Play Following Concussion

- Normal testing ("at baseline") and clinical impression determine beginning of return to play progression
- No set time period for completion

Table 4 Graduated return-to-play protocol

Rehabilitation stage	Objective of stage
No activity	Recovery
Light aerobic exercise	Increase heart rate
Sport-specific exercise	Add movement
Non-contact training drills	Exercise, coordination and cognitive load
Full-contact practise	Restore athlete's confidence; coaching staff assesses functional skills
Return to play	

Harmon KG, *et al*. *Br J Sports Med* 2013;**47**:15–26.

Concussion Grading

- No consensus exists regarding the grading of concussions
- There is very little evidence to support any specific grading scheme
- Most have been based on expert opinion and limited data
- Glasgow Coma Scale is the only validated scale for use in head injury

Concussion Evaluation

- Neuropsychological testing has been shown to be of value when evaluating concussion
  - Baseline testing is needed for accurate results and periodic baseline updates are recommended
  - Players may return to baseline testing while still symptomatic
  - Aid to clinical decision making

Concussion Evaluation

- Neuroimaging is not usually necessary and is usually normal with a concussion injury
  - CT scan initial study of choice if concurrent focal injury is present
  - MRI better for anatomy and if imaging is needed 48 hours or more post injury
- Newer modalities (PET scan, functional MR modalities) promising but not established for use in concussion

Concussion evaluation myths

Making return to play after concussion objective

Recovery After Sports Concussion

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Disclosures

- None

Objectives

- Learn the latest recommendations from the International Berlin Conference on Sports Concussion?
- What is post-traumatic headache? What are the different populations that get them?
- What types of pharmacologic treatments are there for abortive treatment?
- What types of pharmacologic treatments are there for preventative treatment?
- How can you tell the difference between post-traumatic headache and migraine or other primary headache syndrome?

Berlin Guidelines

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 Makdissi,[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 Vos[46]

Symptoms after concussion

- **Headaches, fogginess, emotional lability**
- **Amnesia, focal deficits**
- **Unsteady gait**
- **Irritability or other behavior changes**
- **Cognitive changes (concentration deficit, slowed reaction times)**
- **Sleep/wake disturbance (trouble sleeping, drowsiness)**
- **Ocular symptoms (convergence insufficiency, trouble with saccades)**

Rest

Rest and treatment/rehabilitation following sport-related concussion: a systematic review

Kathryn J Schneider,[1] John J Leddy,[2] Kevin M Guskiewicz,[3] Tad Seifert,[4] Michael McCrea,[5] Noah D Silverberg,[6] Nina Feddermann-Demont,[7,8] Grant L Iverson,[9] Alix Hayden,[10] Michael Makdissi[11,12]

Rest

- **24-48 hours of cognitive and physical rest**
- **After that, a gradual return to activities is recommended**
- **No evidence that keeping an athlete in a dark room and out of school and all exercise until symptoms completely resolve is beneficial**
- **Many athletes recover within 10-14 days (adults) and 30 days (children)**

Return to School

- **Most important!**

Table 2 Graduated return-to-school strategy

Stage	Aim	Activity	Goal of each step
1	Daily activities at home that do not give the child symptoms	Typical activities of the child during the day as long as they do not increase symptoms (eg, reading, texting, screen time). Start with 5–15 min at a time and gradually build up	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 increased breaks during the day	Increase academic activities
4	Return to school full time	Gradually progress school activities until a full day can be tolerated	Return to full academic activities and catch up on missed work

McCrory P, Meeuwisse W, Dvořák J, *et al*
Consensus statement on concussion in sport—the 5th international conference on concussion in sport held in Berlin, October 2016
***Br J Sports Med* 2017;51:838-847.**

Return to School

ORIGINAL ARTICLES
www.jpeds.com • The Journal of Pediatrics

High School Principals' Resources, Knowledge, and Practices regarding the Returning Student with Concussion

Geoffrey L. Heyer, MD[1], Kevin D. Weber, MD, MHA[2], Sean C. Rose, MD[1], Sara Q. Perkins, BS[3], and Caitlin E. Schmittauer, RN[4]

- **In Ohio, schools without a designated case manager were smaller and less likely to have an athletic trainer**
- **Only 32% of respondents provided students with a written academic plan after a concussion.**

Return to Play

- **Once symptoms have completely resolved at rest, and the athlete is back to work/school, return to play progression may begin under the supervision of a health professional (preferably one with training in concussion)**

Table 1 Graduated return-to-sport (RTS) strategy

Stage	Aim	Activity	Goal of each step
1	Symptom-limited activity	Daily activities that do not provoke symptoms	Gradual reintroduction of work/school activities
2	Light aerobic exercise	Walking or stationary cycling at slow to medium pace. No resistance training	Increase heart rate
3	Sport-specific exercise	Running or skating drills. No head impact activities	Add movement
4	Non-contact training drills	Harder training drills, eg, passing drills. May start progressive resistance training	Exercise, coordination and increased thinking
5	Full contact practice	Following medical clearance, participate in normal training activities	Restore confidence and assess functional skills by coaching staff
6	Return to sport	Normal game play	

NOTE: An initial period of 24–48 hours of both relative physical rest and cognitive rest is recommended before beginning the RTS progression.
There should be at least 24 hours (or longer) for each step of the progression. If any symptoms worsen during exercise, the athlete should go back to the previous step.
Resistance training should be added only in the later stages (stage 3 or 4 at the earliest). If symptoms are persistent (eg, more than 10–14 days in adults or more than 1 month in children), the athlete should be referred to a healthcare professional who is an expert in the management of concussion.

McCrory P, Meeuwisse W, Dvořák J, *et al*
Consensus statement on concussion in sport—the 5th international conference on concussion in sport held in Berlin, October 2016
***Br J Sports Med* 2017;51:838-847.**

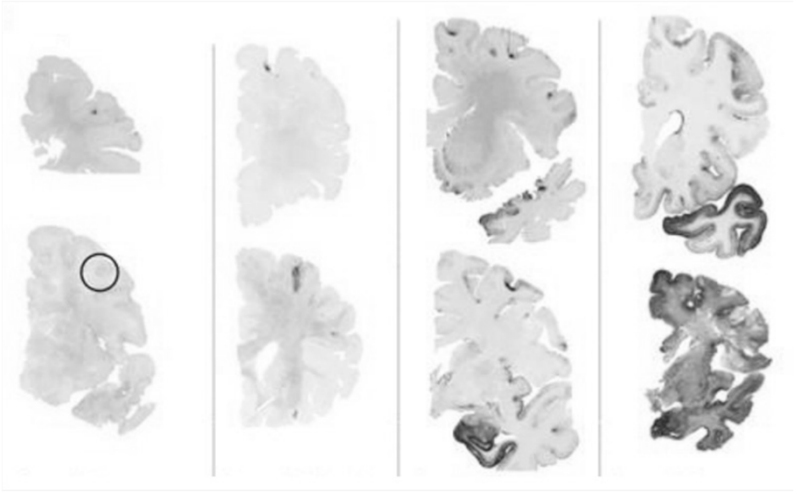
Rehabilitation

- **I use a multidisciplinary approach with our therapists at Ohio State for patients with prolonged symptoms**
- **Speech/cognitive therapy for cognitive symptoms**
- **Physical therapy for "symptom-limited" aerobic exercise program, cervical and vestibular therapy**
- **Ocular rehabilitation for athletes with difficulty with convergence or saccades**
- **Psychological therapy for persistent mood symptoms**
- **Pharmacologic therapy (usually for headaches or mood)**

Long-Term Effects

- There is no absolute number of concussion threshold where retirement is recommended. This is a decision involving athlete, parents (if under 18), and their physicians
- There has not yet been a cause and effect relationship established between concussions and chronic traumatic encephalopathy (CTE)
- Do a certain number of concussions cause CTE? Or many sub-concussive repetitive blows?

CTE



Source: Concussion Legacy Foundation

Concussion and Migraine

- Personal or family history of migraine observed in 80+% of symptomatic mild TBI
- Why is there so much comorbidity?
  - Thought that hyperexcitability of the brain in migraineurs can lead to increased risk of sustaining concussion
  - We know a pre-existing headache disorder like migraine is associated with an increased risk of worsened and prolonged symptoms after a concussion.
  - Peripheral activation of the trigeminocervical complex?

Source: Kuczynski A et al (2013). "Characteristics of post-traumatic headaches in children following mild traumatic brain injury and their response to treatment: a prospective cohort." *Dev Med Child Neurol*;55(7): 636-41.
Source: Gordon et al (2006). "Is migraine a risk factor for the development of concussion?" *Br J Sports Med*; 40(2): 184–185.
Source: Piovesan EJ, Kowacs PA, Oshinsky ML. (2003). "Convergence of cervical and trigeminal sensory afferents." *Curr Pain Headache Rep*;7(5): 377–83.

Acute Post-traumatic headache

- Most common symptom after minor head injury
- 94% of athletes with sports-related concussion have headache

Source: Marar M et al. (2012). "Epidemiology of concussions among United States high school athletes in 20 sports." *Am J Sports Med*; 40: 747–755.

Acute Post-traumatic headache

- A. Any headache fulfilling criteria C and D
- B. Traumatic injury to the head has occurred
- C. Headache is reported to have developed within 7 days of one of the following:
    1. the injury to the head
    2. regaining consciousness following injury to the head
    3. Discontinuation of medication (s) that impair the ability to sense or report headache following the injury to the head
- D. Either of the following:
    1. headache has resolved within 3 months after the injury to the head
    2. headache has not yet resolved but 3 months have not yet passed since the injury to the head

- Persistent post-traumatic headache = the above criteria but greater than 3 months.
- Similar criteria for "whiplash" headaches

Source: ichd-3.org

Populations

- Secondary gain is an important factor to account for when evaluating concussion patients
- Some VERY different populations:
    - Military
    - Athletes
    - Accident victims
    - Assault victims
    - Workplace injury
- Ask about pending litigation, worker's compensation claims, and of course future plans in sport with athletes.

Taking a Headache History

- Family history of migraine?
- Personal history of migraine?
- Detailed previous concussion history. Did they have headaches afterwards? How long? Were they like these?
- Location, length, character (Dull? Throbbing?), radiation, severity, time to build up, time of day when pain is worst or when headache starts, onset
- Associated symptoms: dizzy, nausea, vomiting, aura, photophobia, phonophobia, neck pain
- What is the patient taking for the pain?
- Triggers?
- Missing school/work due to headaches?
- Worsening with activity?

How to treat?

- No randomized controlled clinical trials in PTH treatment
- Standard of care is treating the headache like the primary headache type it most resembles (usually migraine)

IV Abortive Treatment

- Retrospective study by Chan et al showed that among patients with mild TBI treated with combinations of prochlorperazine, ketorolac, ondansetron, or metoclopramide, patients treated with highest rate of treatment success received either prochlorperazine or metoclopramide alone.
- An earlier 1994 study showed evidence for dihydroergotamine (DHE) and metoclopramide for headache after concussion.
- In our neurology infusion center we will use various combinations of ketorolac, prochlorperazine, IV fluids, DHE, metoclopramide, dexamethasone, valproic acid, magnesium, and diphenhydramine to break severe migraine attacks and cycles, including post-traumatic headache.

Source: Chan S, Burowski B, Byczkowski T, et al. (2015). "Intravenous migraine therapy in children with posttraumatic headache in the ED." *Am J Emerg Med.*;33:635–9
Source: McBeath JG, Nanda A. (1994), "Use of dihydroergotamine in patients with postconcussion syndrome. *Headache*;34(3):148–51.

Options for Home Abortive Therapy

- Acetaminophen
- NSAIDs, including prescription indomethacin, diclofenac, etodolac, etc.
- Combination analgesics (acetaminophen/caffeine/aspirin). Midrin (isometheptene/dichloralphenazone/acetaminophen). AVOID butalbital-containing compounds due to risk of medication overuse headaches
- Triptans
  - Longer-acting: frovatriptan, zolmitriptan (pill and nasal spray), naratriptan
  - Shorter-acting: sumatriptan (pill, nasal powder, injectable, nasal spray), almotriptan, rizatriptan, eletriptan
- Ergots
  - DHE (subcutaneous or nasal spray)
- Anti-emetics
  - Prochlorperazine (rectal, oral, injectable), metoclopramide (oral or injectable), promethazine (rectal, oral, injectable)

Source: Becker, W. J. (2015) "Acute Migraine Treatment." *Continuum*; 21 (4): 953-972.

Clinical Pearls for Abortive Treatment

- Avoid triptans, ergots, acetaminophen/dichloralphenazone/isometheptene in patients with coronary artery disease, peripheral vascular disease, hemiplegic migraine, or stroke.
- These are technically contraindicated in migraine with brainstem aura as well.
- Avoid medication overuse headaches. Limit all abortive use to 10 days/month or less. Exception is muscle relaxants and anti-emetics.
- Oral steroid tapers can break bad headache cycles. I usually use a three day course of dexamethasone (4 mg TID day 1, 4 mg BID day 2, 4 mg once day 3) or prednisone (60 mg daily for 5 days and then taper by 10 mg per day until off). Add PPI/H2 blocker if not already on one, and avoid this in patients with poorly controlled diabetes.
- Another option is chlorzoxazone 500 mg every 6 hours for 5 days
- Sometimes infusion therapy is warranted.

Preventative Treatments

- What evidence is there for treatments in post-traumatic headache?
- For now, we use migraine or tension-type headache treatments

Amitriptyline

- Weiss et al (propranolol and/or amitriptyline) and Tyler showed benefit of amitriptyline in post-traumatic headache.
- Saran found in 1988 that amitriptyline was Ineffective.
- Retrospective studies!
- Side effects: weight gain, dry mouth, constipation. Avoid in those with arrhythmias. Often will check EKG in children and younger adults before initiating this medication.

Valproic Acid

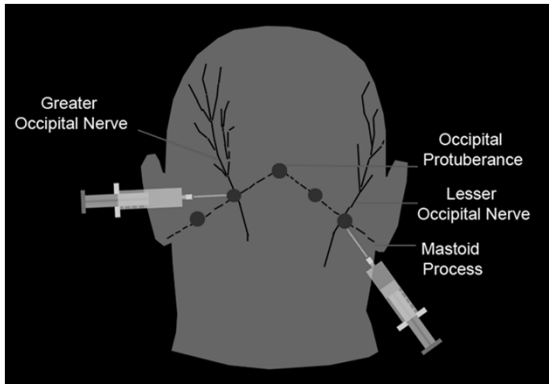
- Packard found that in 100 patients with chronic post-traumatic headache, 60% had mild to moderate improvement in headaches after one month
- Side effects: very toxic to fetus (generally don't have to child-bearing age females), blood count derangements, tremor, weight gain, alopecia. Contraindicated in liver failure.
- Retrospective!

Topiramate

- **Erickson in 2011 found that there was a significant decline in headaches after TBI in soldiers when using topiramate.**
- **Side effects: nephrolithiasis, paresthesias, weight loss, cognitive dysfunction, word-finding difficulty, acute angle-closure glaucoma**
- **Retrospective! Look at the population as well.**

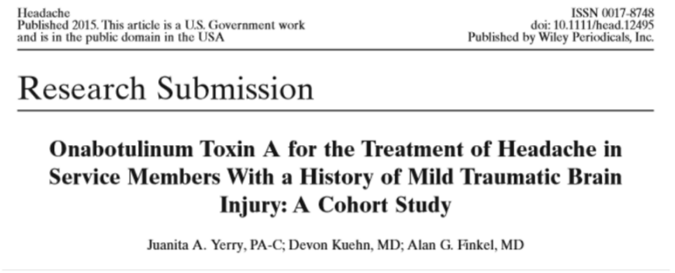
Interventional Treatment in PTH

- **Several retrospective studies show benefit for occipital nerve blocks**
- **A few small studies and lots of anecdotal evidence are promising for physical therapy of the neck in PTH**
- **Others: SPG block, transcranial magnetic stimulation have case reports in PTH**



Source: Conidi FX (2016). "Interventional Treatment for Post-traumatic Headache." *Curr Pain Headache Rep*; 20: 40.
Source: Seifert T (2016). "Post-Traumatic Headache Therapy in the Athlete." *Curr Pain Headache Rep;* 20: 41

Onabotulinumtoxin A



Headache
Published 2015. This article is a U.S. Government work and is in the public domain in the USA

ISSN 0017-8748
doi: 10.1111/head.12495
Published by Wiley Periodicals, Inc.

Research Submission

Onabotulinum Toxin A for the Treatment of Headache in Service Members With a History of Mild Traumatic Brain Injury: A Cohort Study

Juanita A. Yerry, PA-C; Devon Kuehn, MD; Alan G. Finkel, MD

- **64 (63 of them men) active duty military members underwent injections after mild TBI.**
- **Most received PREEMPT protocol**
- **64% felt better**
- **Retrospective!**

Opportunities for research in treatments for PTH?

- **More studies on medications in athletes**
- **Particularly onabotulinumtoxin A**
- **Venlafaxine/desvenlafaxine**
- **Gabapentin**
- **Memantine**
- **Physical therapy of the neck**
- **Melatonin**
- **Alternative treatments**

Alternative treatments in PTH?

Curr Pain Headache Rep (2017) 21:22
DOI 10.1007/s11916-017-0624-x

PSYCHOLOGICAL AND BEHAVIORAL ASPECTS OF HEADACHE AND PAIN (D BUSE, SECTION EDITOR)

Behavioral Treatments for Post-Traumatic Headache

Felicia Fraser[1] · Yuka Matsuzawa[1] · Yuen Shan Christine Lee[1] · Mia Minen[2]

- **CBT = mixed results**
- **Biofeedback studies in PTH promising, however many trials were combined with some other modalities. Also small N of patients**
- **One positive study in servicepeople for acupuncture**

The real reason you came…

- **How to tell the difference between post-traumatic headache and migraine?**
- **In a patient with a previous history of migraine or a young patient with a family history of migraine but no personal migraines, how in the world can you tell?**
- **Signs the post-traumatic headache may have reverted back to migraine:**
  - **All other concussion symptoms resolved**
  - **The headaches do not worsen with exercise**
  - **The headaches are random and do not correlate with increased mental or physical activity**
  - **The frequency and character are now similar to what they were prior to the injury**
- **What if the patient is on migraine/posttraumatic headache prophylaxis?**
  - **Controversial**
  - **Exercise caution**
  - **There is always concern that medications mask symptoms. That said, an underlying migraine disorder could worsen off the medication even though the concussion recovery itself has completed.**

General Pearls

- **Headache lifestyle is very important: keep caffeine intake steady, hydration, exercise, sleep, regular meals, mood.**
- **Avoid analgesic medication overuse**
- **Encourage a multidisciplinary approach with psychology, physical therapy (and occupational and/or speech therapy for other concussion symptoms).**
- **Refer if necessary. We have a Comprehensive Sports Concussion Clinic at Ohio State.**