Head Injuries in Football: It's Not Always a Concussion

Michael Moll MEd., LAT

GLATA Winter Meeting
March 9, 2017

University of Wisconsin
BADGER
Sports Medicine

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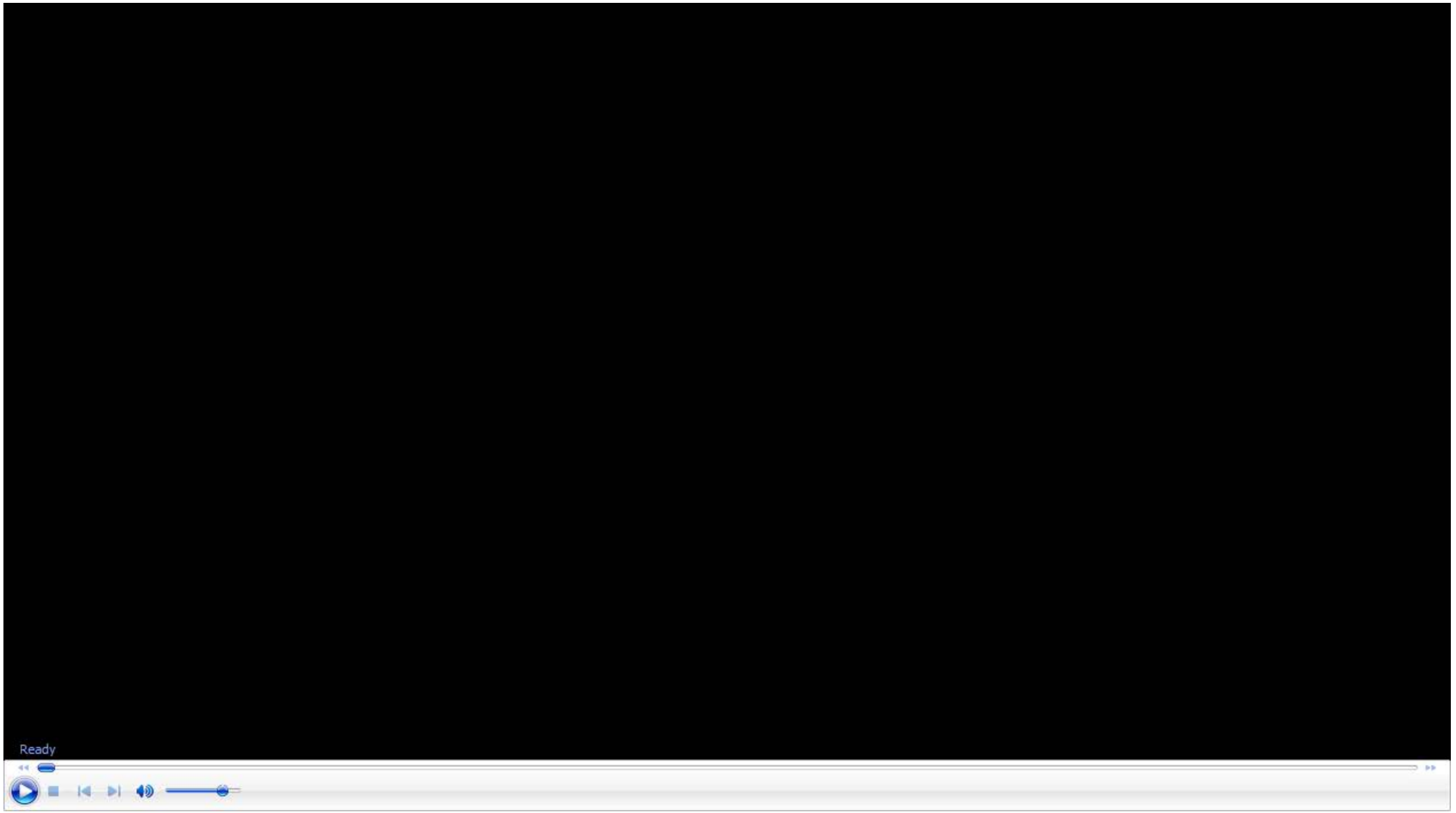
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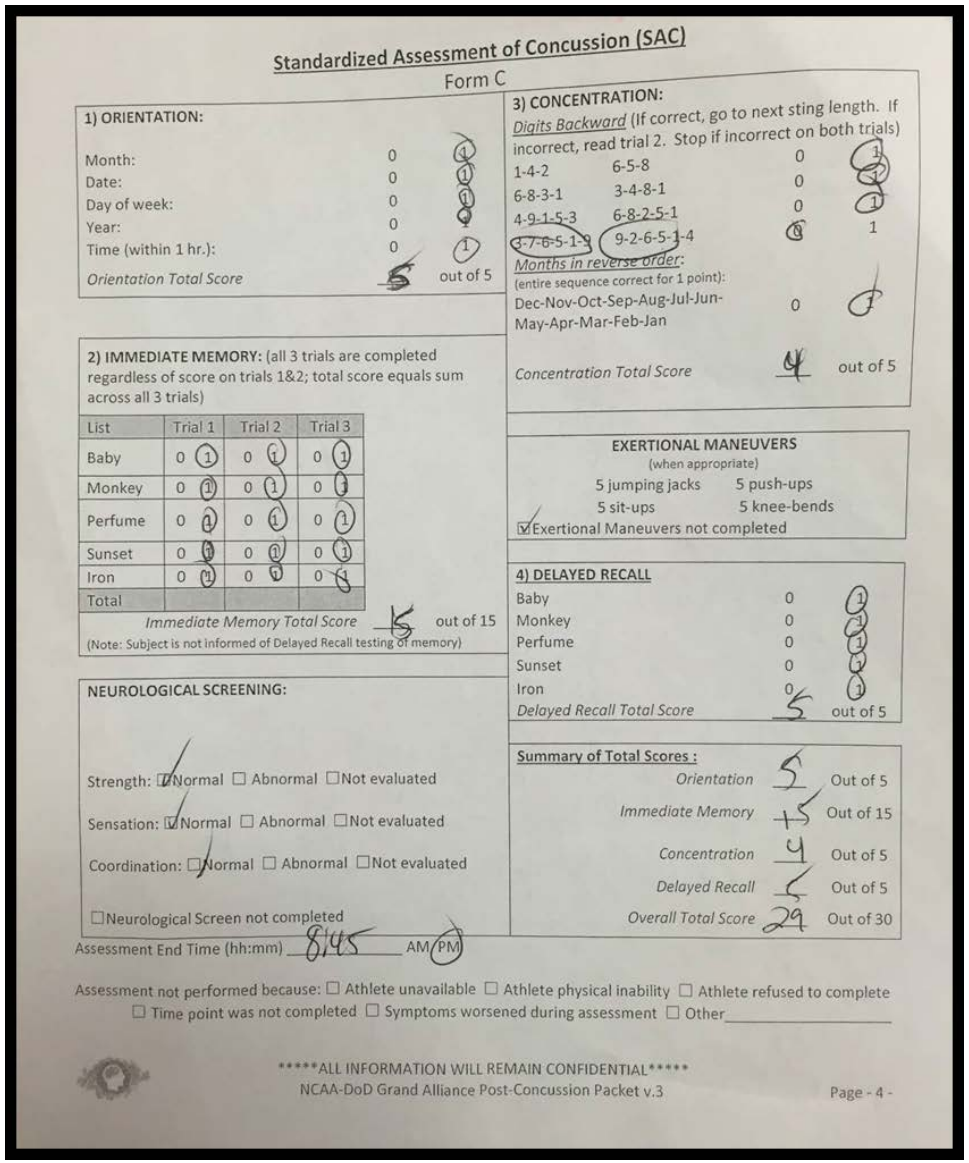
Removed from Play:

Within 10 min, symptom free, would not leave sideline for further evaluation

Evaluated at Halftime

- SCAT 3 Symptom Score: 0
- SAC: 29
- BESS: 7
- VOMS: normal



Standardized Assessment of Concussion (SAC)

Form C

1) ORIENTATION:

Month:	0	1
Date:	0	1
Day of week:	0	1
Year:	0	1
Time (within 1 hr.):	0	1
Orientation Total Score	5	out of 5

2) IMMEDIATE MEMORY: (all 3 trials are completed regardless of score on trials 1&2; total score equals sum across all 3 trials)

List	Trial 1	Trial 2	Trial 3
Baby	0 1	0 1	0 1
Monkey	0 1	0 1	0 1
Perfume	0 1	0 1	0 1
Sunset	0 1	0 1	0 1
Iron	0 1	0 1	0 1
Total			

Immediate Memory Total Score 15 out of 15

(Note: Subject is not informed of Delayed Recall testing of memory)

NEUROLOGICAL SCREENING:

Strength: ☑ Normal ☐ Abnormal ☐ Not evaluated

Sensation: ☑ Normal ☐ Abnormal ☐ Not evaluated

Coordination: ☑ Normal ☐ Abnormal ☐ Not evaluated

☐ Neurological Screen not completed

3) CONCENTRATION:

Digits Backward (If correct, go to next sting length. If incorrect, read trial 2. Stop if incorrect on both trials)

1-4-2	6-5-8	0 1
6-8-3-1	3-4-8-1	0 1
4-9-1-5-3	6-8-2-5-1	0 1
3-7-6-5-1-9	9-2-6-5-1-4	0 1

Months in reverse order: (entire sequence correct for 1 point): Dec-Nov-Oct-Sep-Aug-Jul-Jun-May-Apr-Mar-Feb-Jan 0 1

Concentration Total Score 4 out of 5

EXERTIONAL MANEUVERS (when appropriate)

5 jumping jacks 5 push-ups

5 sit-ups 5 knee-bends

☑ Exertional Maneuvers not completed

4) DELAYED RECALL

Baby	0	1
Monkey	0	1
Perfume	0	1
Sunset	0	1
Iron	0	1
Delayed Recall Total Score	5	out of 5

Summary of Total Scores :

Orientation	5	Out of 5
Immediate Memory	15	Out of 15
Concentration	4	Out of 5
Delayed Recall	5	Out of 5
Overall Total Score	29	Out of 30

Assessment End Time (hh:mm) 8:45 AM PM

Assessment not performed because: ☐ Athlete unavailable ☐ Athlete physical inability ☐ Athlete refused to complete ☐ Time point was not completed ☐ Symptoms worsened during assessment ☐ Other_____

*****ALL INFORMATION WILL REMAIN CONFIDENTIAL*****

NCAA-DoD Grand Alliance Post-Concussion Packet v.3

Page - 4 -

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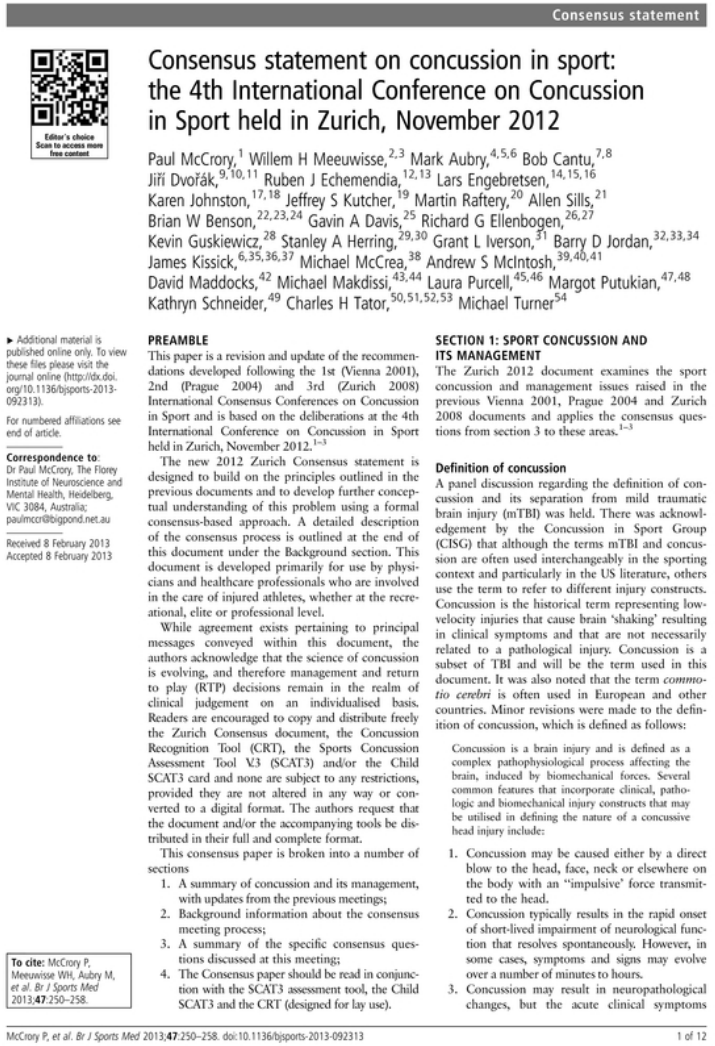
What are we Learning?

- Review of Concussion Practices
- Have we changed in the past few years?
- Discuss Head Injury Management Protocol for D1 Power 5
- Discussion of Medical spotters/observers
- Rule changes and recommendations
- 2 Case Studies



Consensus statement

Consensus statement on concussion in sport: the 4th International Conference on Concussion in Sport held in Zurich, November 2012

Paul McCrory,[1] Willem H Meeuwisse,[2,3] Mark Aubry,[4,5,6] Bob Cantu,[7,8] Jiří Dvořák,[9,10,11] Ruben J Echemendia,[12,13] Lars Engebretsen,[14,15,16] Karen Johnston,[17,18] Jeffrey S Kutcher,[19] Martin Raftery,[20] Allen Sills,[21] Brian W Benson,[22,23,24] Gavin A Davis,[25] Richard G Ellenbogen,[26,27] Kevin Guskiewicz,[28] Stanley A Herring,[29,30] Grant L Iverson,[31] Barry D Jordan,[32,33,34] James Kissick,[6,35,36,37] Michael McCrea,[38] Andrew S McIntosh,[39,40,41] David Maddocks,[42] Michael Makdissi,[43,44] Laura Purcell,[45,46] Margot Putukian,[47,48] Kathryn Schneider,[49] Charles H Tator,[50,51,52,53] Michael Turner[54]

► Additional material is published online only. To view these files please visit the journal online (http://dx.doi.org/10.1136/bjsports-2013-092313).

For numbered affiliations see end of article.

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PREAMBLE

This paper is a revision and update of the recommendations developed following the 1st (Vienna 2001), 2nd (Prague 2004) and 3rd (Zurich 2008) International Consensus Conferences on Concussion in Sport and is based on the deliberations at the 4th International Conference on Concussion in Sport held in Zurich, November 2012.[1–3]

The new 2012 Zurich Consensus statement is designed to build on the principles outlined in the previous documents and to develop further conceptual understanding of this problem using a formal consensus-based approach. A detailed description of the consensus process is outlined at the end of this document under the Background section. This document is developed primarily for use by physicians and healthcare professionals who are involved in the care of injured athletes, whether at the recreational, elite or professional level.

While agreement exists pertaining to principal messages conveyed within this document, the authors acknowledge that the science of concussion is evolving, and therefore management and return to play (RTP) decisions remain in the realm of clinical judgement on an individualised basis. Readers are encouraged to copy and distribute freely the Zurich Consensus document, the Concussion Recognition Tool (CRT), the Sports Concussion Assessment Tool V.3 (SCAT3) and/or the Child SCAT3 card and none are subject to any restrictions, provided they are not altered in any way or converted to a digital format. The authors request that the document and/or the accompanying tools be distributed in their full and complete format.

This consensus paper is broken into a number of sections

1. A summary of concussion and its management, with updates from the previous meetings;
2. Background information about the consensus meeting process;
3. A summary of the specific consensus questions discussed at this meeting;
4. The Consensus paper should be read in conjunction with the SCAT3 assessment tool, the Child SCAT3 and the CRT (designed for lay use).

SECTION 1: SPORT CONCUSSION AND ITS MANAGEMENT

The Zurich 2012 document examines the sport concussion and management issues raised in the previous Vienna 2001, Prague 2004 and Zurich 2008 documents and applies the consensus questions from section 3 to these areas.[1–3]

Definition of concussion

A panel discussion regarding the definition of concussion and its separation from mild traumatic brain injury (mTBI) was held. There was acknowledgement by the Concussion in Sport Group (CISG) that although the terms mTBI and concussion are often used interchangeably in the sporting context and particularly in the US literature, others use the term to refer to different injury constructs. Concussion is the historical term representing low-velocity injuries that cause brain 'shaking' resulting in clinical symptoms and that are not necessarily related to a pathological injury. Concussion is a subset of TBI and will be the term used in this document. It was also noted that the term *commotio cerebri* is often used in European and other countries. Minor revisions were made to the definition of concussion, which is defined as follows:

> Concussion is a brain injury and is defined as a complex pathophysiological process affecting the brain, induced by biomechanical forces. Several common features that incorporate clinical, pathologic and biomechanical injury constructs that may be utilised in defining the nature of a concussive head injury include:
>
> 1. Concussion may be caused either by a direct blow to the head, face, neck or elsewhere on the body with an "impulsive' force transmitted to the head.
> 2. Concussion typically results in the rapid onset of short-lived impairment of neurological function that resolves spontaneously. However, in some cases, symptoms and signs may evolve over a number of minutes to hours.
> 3. Concussion may result in neuropathological changes, but the acute clinical symptoms

2015 NCAA Mandate for Concussion Safety Protocol for NCAA Power 5 Conference

- Outline and Checklist for Requirements
  - Pre-Season Education
  - Pre-Participation Assessment
  - Recognition and Diagnosis of Concussion
  - Post-Concussion Management
  - Return to Play
  - Return to Learn
  - Reducing Exposure to Head Trauma
  - Administrative Oversight

http://www.ncaa.org/about/resources/media-center/news/new-guidelines-aim-improve-student-athlete-safety

Pre-Season Education

- Must provide education to:
  - Student-Athletes, Coaches, Team Physicians, Athletic Trainers, and Directors of Athletics
- NCAA Concussion Fact Sheet
- UW – formal presentation to athletes
- Signed acknowledgement of review and presentation of concussion materials

Pre-Participation Exam

- Documentation that each SA has received at least one pre-participation baseline concussion assessment including:
  - Brain Injury and Concussion History
  - Symptom Evaluation
  - Cognitive Assessment
  - Balance Evaluation
- Team Physician determines pre-participation clearance or need for further testing

Recognition and Diagnosis of Concussion

Any SA with signs/symptoms/behaviors consistent with concussion must be:

- Removed from practice or competition
- Evaluated by an ATC or physician with concussion experience
- Removed from practice/play for that calendar day if concussion is confirmed

Recognition and Diagnosis of Concussion

Initial suspected concussion management plan that specifies:

- Symptoms assessment
- Physical and neurological exam
- Cognitive assessment
- Balance exam
- Clinical assessment for cervical spine trauma, skull fracture and intracranial bleed

(SAC, SCAT 3 Symptom, BESS, ImPACT, VOMS, clinical eval)

Post-Concussion Management

- EAP
- Mechanism for serial evaluation and monitoring following injury
- Documentation of oral and/or written care to both SA and another responsible adult
- Evaluation by a physician for SA with a prolonged recovery in order to consider additional diagnosis and best management options.

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Return to Play

- Final determination of return to play must be from a physician or medically qualified physician designee
- SA with concussion must go thru a supervised stepwise progression by a health care provider
  - Light aerobic exercise without resistance training
  - Sport-specific exercise and activity without head impact
  - Non-contact practice with progressive resistance training
  - Unrestricted training
  - Return to competition

Return to Learn

- Identify a point person that will navigate return to learn
- Identify a multi-disciplinary team to assist with prolonged cases
- Compliance with ADAAA
- No classroom activity on same day as concussion
- Individualized initial plan to return to cognitive activity
- Re-eval by physician if symptoms worsen with academic challenges
- Modifications of academic schedule for up to 2 weeks and physician f/u if longer
- Engaging campus resources

Reducing Exposure to Head Trauma

- *"While the Committee acknowledges that 'reducing' may be difficult to quantify, it is important to emphasize ways to minimize head trauma exposure."*
  - Safety in College Football Summit: http://www.ncaa.org/health-and-safety/appendix
  - Inner-association taskforce guidelines and Independent Medical Care guidelines provided to coaches
  - Education of student athletes

Guskiewicz K, Putukian M. Standardized assessment and return to play. *Safety in College Football Summit.* Presented January 23, 2014, Atlanta, GA

Administrative

- Management plan submitted to NCAA Concussion Safety Protocol Committee by May 1, 2015 for review
- Written certificate of compliance signed by Director of Athletics that accompanies the plan

Dear Brian,

Attached is the University of Wisconsin – Madison Division of Intercollegiate Athletics Concussion Management Plan. As the Director of Athletics I certify that we will adhere to the plan as submitted. We look at this submission as a "living and breathing" document that will continue to evolve over time as additional evidence-based information becomes available and/or as NCAA protocol are established.

Thank you,

Barry Alvarez

http://www.ncaa.org/sites/default/files/concussionpolicyWisconsin2015.pdf

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Big Ten Mandate for Medical Spotters

- Summer 2015 Big Ten Mandated neutral concussion spotter / medical observer for all home Big Ten games.
- What about non-conference or neutral site game?
- What about bowl games?
- Concerns and limitations.

- Jan 2016 – 2nd Power 5 Conference Autonomy Session

  "I believe it's the most important piece of legislation in the history of the NCAA."

  Brian Hainline, the NCAA's chief medical officer, on legislation passed giving team doctors and trainers final say on whether injured athletes can return to play

- Jan 2017 – NCAA Updated Best Practices and Recommendations

INTERASSOCIATION CONSENSUS:

YEAR-ROUND FOOTBALL PRACTICE CONTACT FOR COLLEGE STUDENT-ATHLETES RECOMMENDATIONS

Unique Cases

- Importance of the protocol / management plan
- Examples of importance of monitoring
- Role of diagnostics

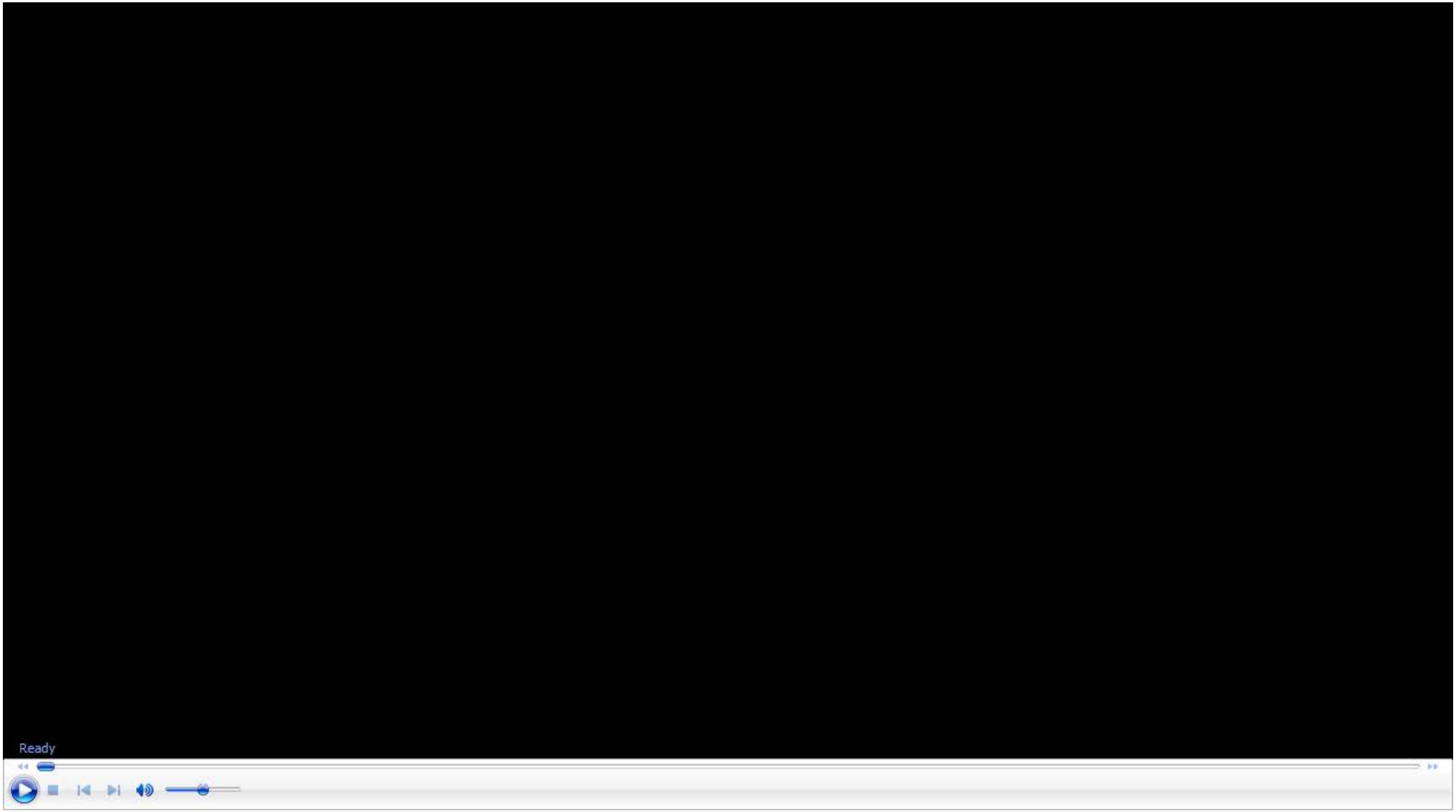
Case 1 – Injury History

- Healthy 20 year old male offensive guard who reported on a Tuesday for evaluation of persistent headache that began the day before.
- In addition to headache, reported mild blurry vision and difficulty focusing vision.
- Denied any other symptoms to physician.
- HX of one concussion in high school, reports no other neurological issues.
- Reported playing special teams in a game on Saturday and received a blow to the side of his head while blocking on a field goal attempt. States he felt dizzy for brief period after the hit.
- Experienced no symptoms after the game or on Sunday.
- Had participated in walk-thru practice on Monday, reported HA was relieved somewhat with ibuprophen.

Case 1 – Initial Eval, Tues

- GCS 15
- Alert and oriented x 3
- Balance testing normal
- Normal cranial nerve testing
- Normal cognitive tests
- CSI – 18
- Impression: likely concussion

Symptom	Score
Headache	3
Nausea	1
Vomiting	0
Balance Problems	1
Dizziness	2
Fatigue	0
Trouble falling asleep	0
Sleeping more than usual	0
Sleeping less than usual	0
Drowsiness	1
Sensitivity to light	2
Sensitivity to noise	1
Irritability	0
Sadness	0
Nervousness	0
Feeling more emotional	0
Numbness or tingling	0
Feeling slowed down	2
Feeling mentally "foggy"	2
Difficulty concentrating	1
Difficulty remembering	1
Visual Problems	1
Total Symptom Score	18


Ready

Case 1 - Treatment/Plan

- Hold from practice, meetings and class
- ImPACT test
- Monitor symptoms
- F/U with team physician Thurs.

Composite Scores	Percentile scores if available are listed in small type.					
Memory composite (verbal)	81	36%	78	25%		
Memory composite (visual)	76	52%	81	70%		
Vis. motor speed composite	42.33	59%	43.83	67%		
Reaction time composite	0.57	43%	0.55	55%		
Impulse control composite	12		17			
Total Symptom Score	0		14			
Cognitive Efficiency Index:	**0.29**		**0.2**			

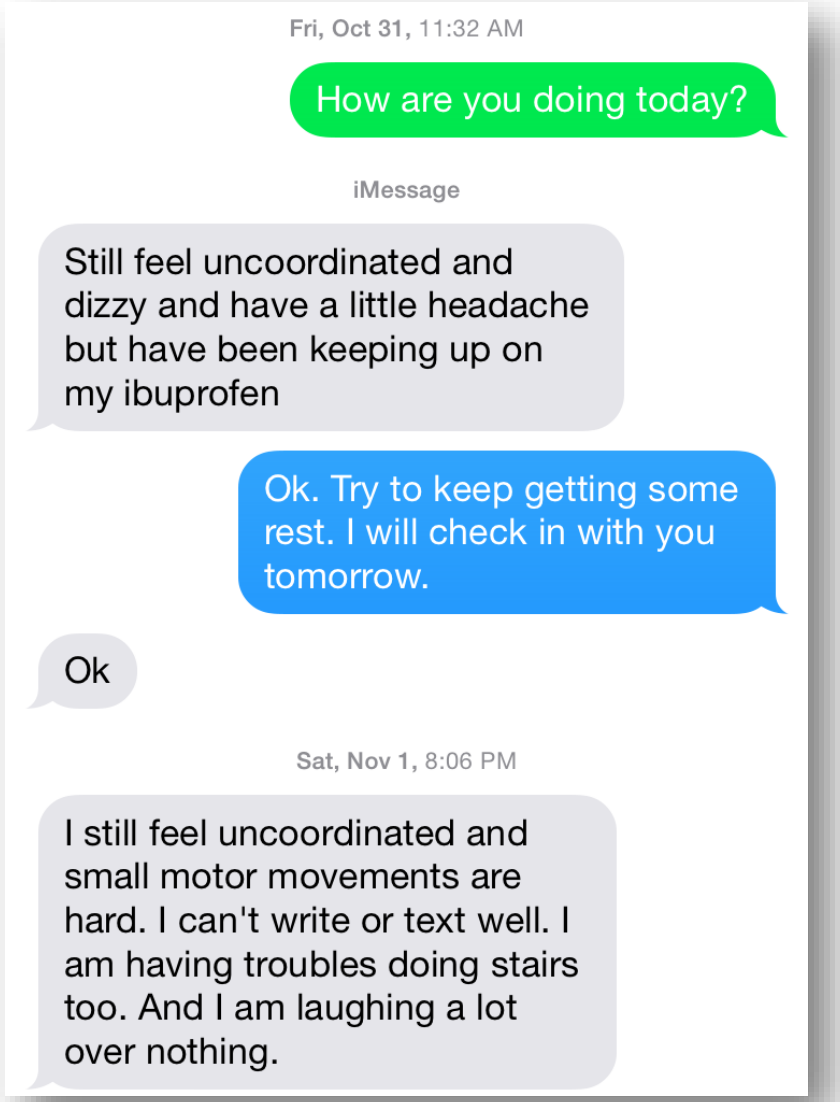
Case 1 – Physician F/U, Thurs

- Wed, CSI was 7
- Thurs, CSI was 16
- Stated increased HA with class and walking on campus
- Ibuprophen continued to improve HA

- Objective exam:
  - Cranial nerves normal
  - Normal coordination and rapid alternating finger movements
  - Some difficulty with tandem gait backwards, but normal forwards
  - Difficulty with tandem stance with BESS eye closed
  - “Overall exam quite good”
- Refrain from class, no practice, monitor symptoms

Case 1 – Friday/Saturday

- Travel day for FB and athlete did not travel or check in prior to departure. Contact via text Friday and Saturday.
- Athlete was at home 90 min from Madison.



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Case 1 – Physician F/U Sunday

- Notes difficulty with writing and texting, slight slurring of speech, some difficulty with walking stairs quickly, appears in no distress
- Mentioned father has Hx of 2 seizure episodes
- Normal cranial nerve exam, normal upper and lower extremity strength, normal reflexes, temp 98.6, heart and lung exam normal, face symmetric, tongue midline
- Difficulty with heel/toe tandem gait, difficulty with heel to shin coordination, decreased fine motor skills worse on right, + dysdiadochokinesis

Symptom	Score
Headache	1
Nausea	0
Vomiting	0
Balance Problems	5
Dizziness	1
Fatigue	0
Trouble falling asleep	0
Sleeping more than usual	0
Sleeping less than usual	0
Drowsiness	0
Sensitivity to light	1
Sensitivity to noise	1
Irritability	0
Sadness	0
Nervousness	0
Feeling more emotional	1
Numbness or tingling	0
Feeling slowed down	4
Feeling mentally "foggy"	
Difficulty concentrating	0
Difficulty remembering	0
Visual Problems	0
Total Symptom Score	14

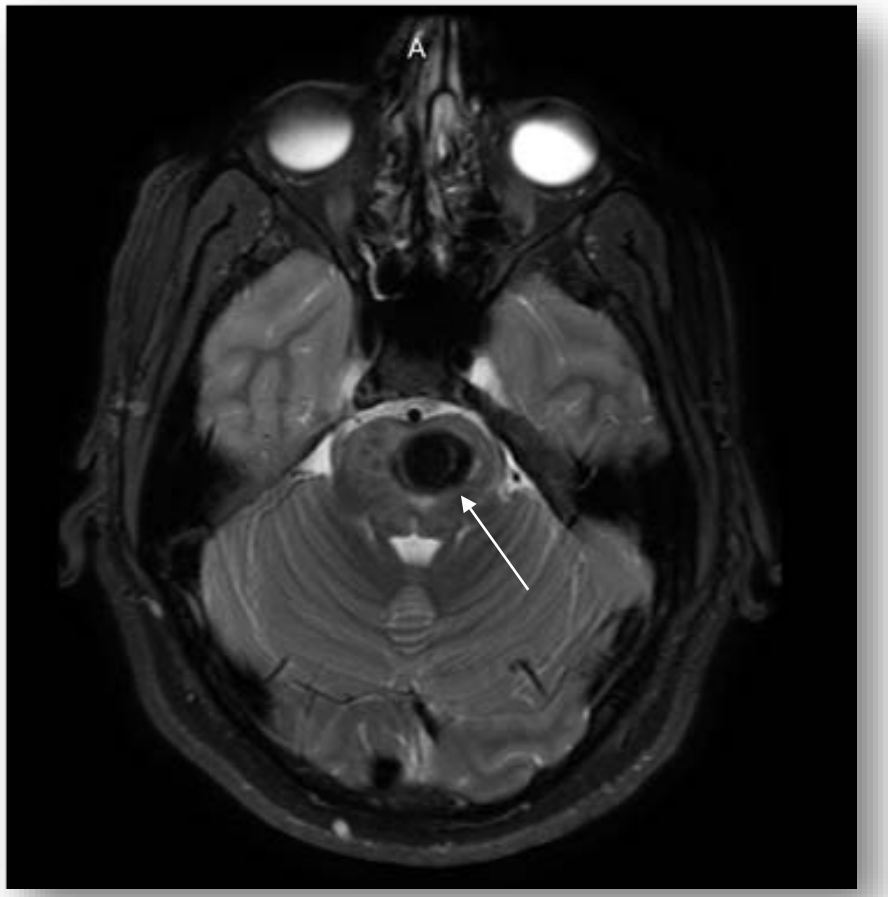
Case 1 – Referral to ER

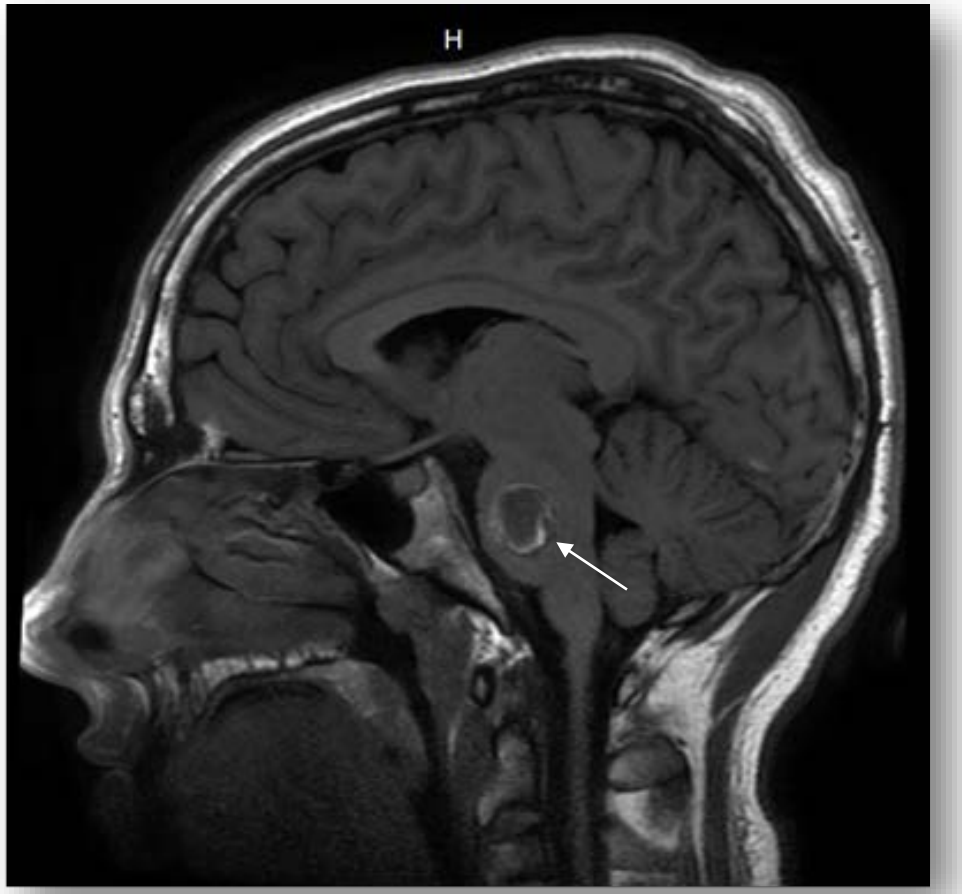
- CT shows recently bled cavernoma in the mid pons with mild cerebral edema with brainstem compression
- MRI/MRA shows multiple cavernous malformations, large 2.5 cm transverse diameter pontine lesion with surrounding edema
- Admitted to hospital for observation under neurology care
- No intervention recommended

Case 1 – What is a Cavernoma?

- A cavernoma looks like a blackberry. It is made up of abnormal blood vessels.
- Cavernomas can measure from a few millimeters to several centimeters.
- A cavernoma can get bigger, but this growth is not cancerous, and it does not spread to other parts of the body.
- Sometimes the cells lining the blood vessels ooze small amounts of blood (inwards) within the cavernoma, or (outwards) into surrounding tissue.
- The risk of re-bleeding varies widely, and is difficult to predict accurately.

Case 1 – MRI Images





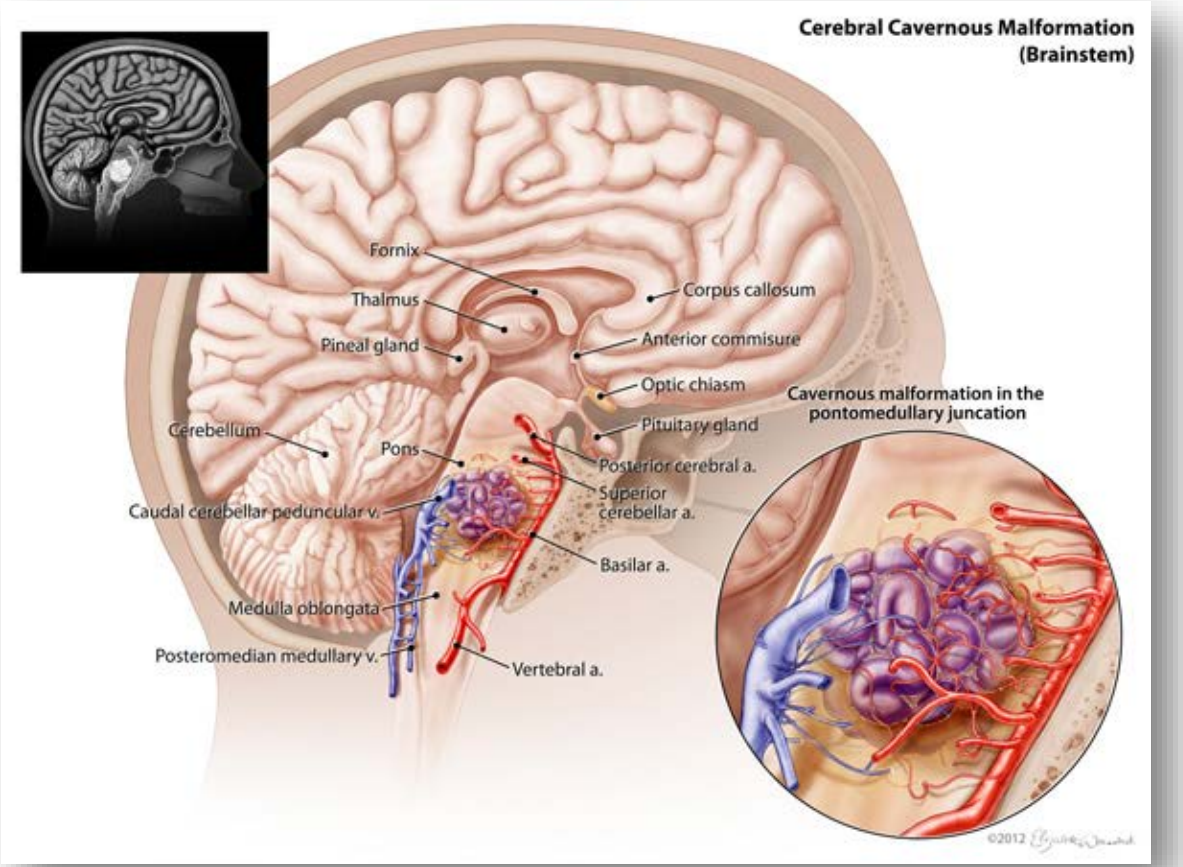
Case 1 – F/U and referral for Rehab

- Released from hospital after overnight stay and instructed to monitor symptoms and return if any issues or worsening of symptoms
- Instructed not to return to classes or any athletic participation at this time
- Symptoms of slurred speech, loss of balance, difficulty with fine motor skills on right side and walking continued to persist
- Referred for PT, OT, Speech

Case 1 - What Now?

- F/U with Team Physician 10 days post symptoms
  - Symptoms essentially unchanged or mildly worse than previous
  - Pt had questions about playing future
  - Discussed risks associated with cavernoma
  - Made plans for second opinion visit

Case 1 – Prognosis



- The risks of having another bleed vary widely. These risks range from roughly one in 25 people (4%) a year, to roughly one in four people (23%) a year
- Higher risk of bleeding for cavernoma in the brain stem
- Very little direction in the literature on participating with cavernoma

Case 1 – Second Opinion and Neurology f/u

- Obtained 2nd opinion 2 weeks after onset of symptoms.
  - Review of history and family history, images and records
  - Physical examination revealed very similar symptoms to previous exam
  - Discussed unknown risk of further bleeding and significant ramifications if the cavernoma would change
- 6 week follow up with Neurosurgeon
  - Continued to exhibit similar symptoms with mild improvement
  - Discussed 2nd opinion visit
  - Recommended no surgical intervention at this time
  - Instructed to avoid any intense exercise or heavy lifting
  - Scheduled follow up for 3 month with repeat of MRI

Case 1 – Retirement

- He was a walk-on that had been placed on scholarship at the beginning of season, applied for and granted a medical non-counter waiver
- Returned to classes and did well completing his courses in the fall semester

"I am doing good, almost fully recovered. I can dunk a basketball again!"

Case 2 – Injury History

- 21 year old football defensive lineman reported headaches during spring football practice without noted trauma.
- Complained of frontal headache on right side with wave-like visual alteration and mild photophobia. Noted no other symptoms.

Case 2 – Previous Medical History

- History of migraine 1-2 x annually, treated with sumatriptan.
- Previous MTBI: 1 in HS, 1 Freshman, 2 Sophomore, None Junior year
- Family history of migraine

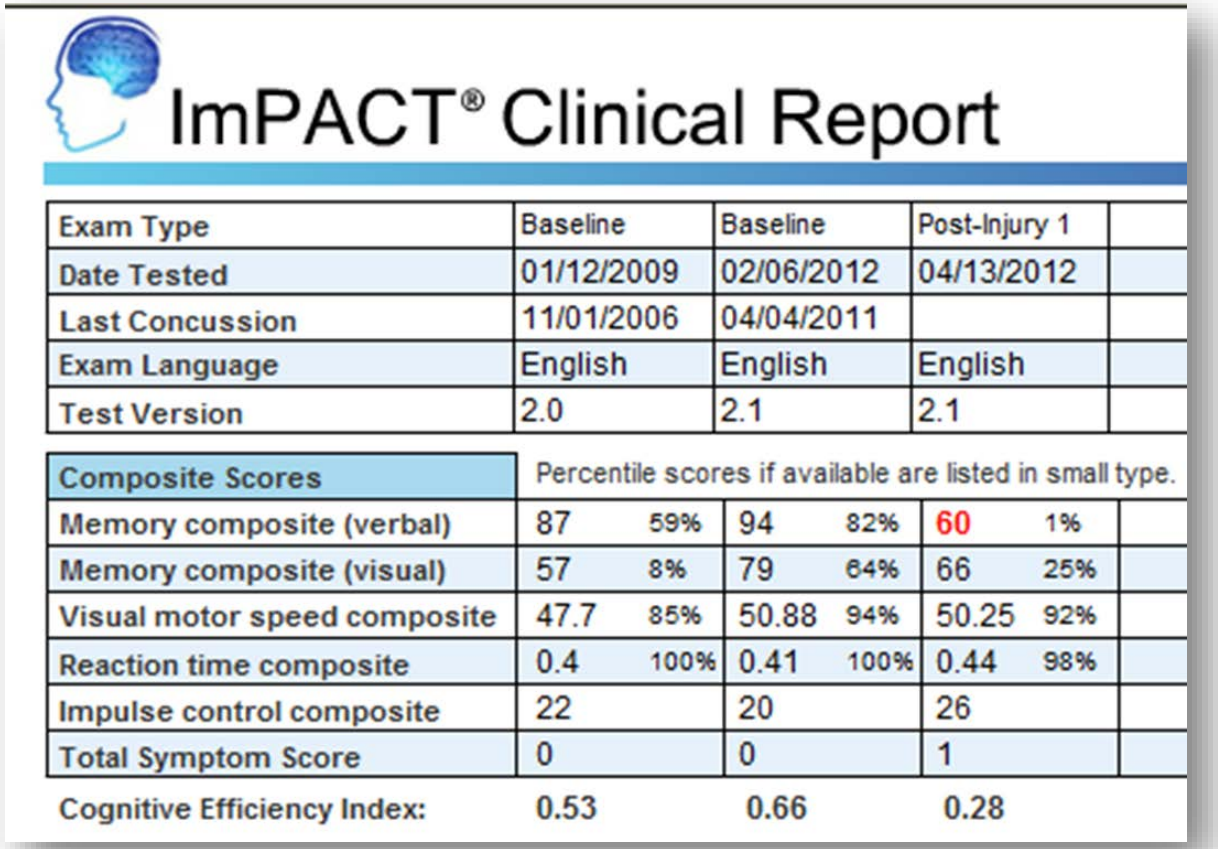
Case 2 – Initial Evaluation

- No acute distress
- Normal cranial nerve tests
- Normal coordination
- Reflexes present and symmetric
- Normal Romberg and BESS
- Immediate and delayed recall intact
- Normal cognitive tests

- Removed from activity and evaluated by physician. With normal neurologic exam he was provisionally diagnosed with exertional migraine.
- Given sumatriptan, and symptoms resolved quickly.

Case 2 – Return to Activity

- With no reported symptoms, he returned to the next practice 2 days later and experienced similar symptoms upon the initiation of contact and was removed from practice and treated with sumptriptan.
- Physician concerned with concussion



ImPACT® Clinical Report

Exam Type	Baseline	Baseline	Post-Injury 1	
Date Tested	01/12/2009	02/06/2012	04/13/2012	
Last Concussion	11/01/2006	04/04/2011		
Exam Language	English	English	English	
Test Version	2.0	2.1	2.1	

Composite Scores	Percentile scores if available are listed in small type.						
Memory composite (verbal)	87	59%	94	82%	60	1%	
Memory composite (visual)	57	8%	79	64%	66	25%	
Visual motor speed composite	47.7	85%	50.88	94%	50.25	92%	
Reaction time composite	0.4	100%	0.41	100%	0.44	98%	
Impulse control composite	22		20		26		
Total Symptom Score	0		0		1		
Cognitive Efficiency Index:	0.53		0.66		0.28		

Case 2 – Second Return to Activity

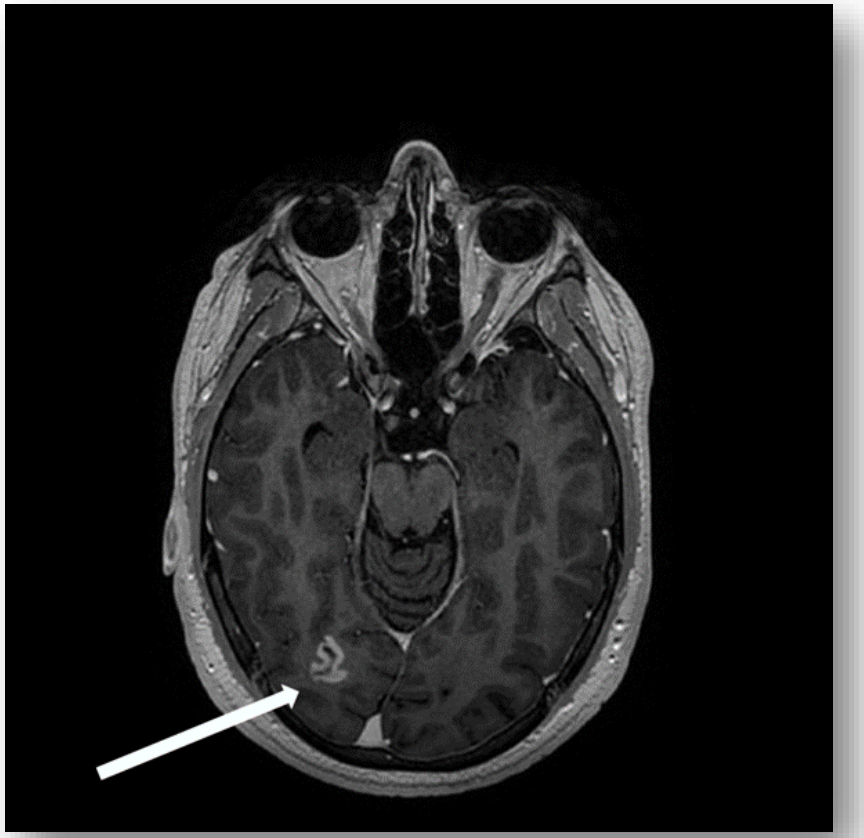
- Over next week, symptoms resolved, normal physical exam, went through activity progression, returned to limited contact and again experienced migraine type headache this time with added symptom of vertigo.

Case 2 – Physician F/U

- Differential Diagnosis
  - Concussion
  - Migraine headache
  - Sinusitis
  - Tension Headache
  - Viral Syndrome
  - Intercranial Process (mass, bleed)
- Testing
  - Had MRI/MRA to evaluate head and neck at 16 days post initial complaints of symptoms, positive for infarct in 2 areas

Case 2 – MRI/MRA Images

Axial T1 with Contrast MRI



Axial T2 MRI

Case 2 – Additional F/U and Testing

- Referral to Neurology
- Echocardogram Bubble Study
- Hypercoagulopathy Labs
- EEG
- Stress Echo
- X-ray, MRI and CT of Spine
- All Normal

Case 2 – Diagnosis: Migrainous Infacrtion

- Rare complication of migraines with aura lasting hours or days
- Migraine intensity often similar to previous
- Must be visualized on MRI or CT for diagnosis
- All other potential causes must be excluded
- More common in females
- 3.36 in 100,000 persons
- Stroke severity is generally mild with good outcome

Case 2 – Neurology and 2nd Opinion

- Cautioned about future participation and increased risk for further stroke
- D/C use of Triptans

- Exam by second neurologist about 2 months after diagnosis.
- Agreed with diagnosis and discussed increased risk with participation.
- D/C Triptans

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Case 2 – Retirement

- Despite aspirations of playing in NFL, decided against returning to football due to increased risk of participation
- Assisted as student coach the following season

What did I learn? What's next? Questions?

Thank You