Headbangers
Concussion Assessment & Management both on the Sidelines and in the Office

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I, Siobhan Statuta, have no relevant financial disclosures related to the content of this presentation.
SOCCEEER
You hit the BALL with your head
Difficult to recognize
No universally accepted definition
Emerging data
No direct diagnostic tests available
No “treatments”
Limited prospective data to guide return-to-play decisions
Objectives

- Understand what a concussion is.
- Explain the “normal” progression.
- Recognize “trouble” cases.
- Feel comfortable assessing a possible concussion and managing it appropriately.
Let’s Learn!

- Epidemiology
- Mechanism
- Presentation
- Sideline Assessment
- In Office Assessment
- Management
Concussion

Derived from the Latin word: 

Concutere

“to shake violently”
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 Shane Groglio, 7 Robert C Cantu, 8 David Cassidy, 9 Ruben J Echemendia, 10,11
Consensus Statement: 5th Annual Meeting, Berlin (Oct 2016)

- SRC science: evolving
  - Individual management decisions remain in the realm of clinical provider’s judgement

- Not meant to be a clinical practice guideline or legal standard of care

- http://bjsm.bmj.com/content/51/11/838
Generalities

- Females > males
  - Sport specific: F higher in soccer, basketball
  - Mechanism of injury varies though...

- Highest incidence sports
  - Football -- Hockey -- Rugby -- Soccer (F > M) -- Basketball

- Greatest risk during competitions
Youth athletes

- Brain still developing
- May have prolonged recovery (normal 4wks)
- More susceptible to concussion accompanied by a catastrophic injury

Complicated diagnoses & management

- Preinjury mood disorders
- Migraine HAs
- Learning disorders
- Attention deficit disorders (ADD, ADHD)

- AMSSM Position Statement
Epidemiology

- ~3.8 million concussions per year
  - Estimated 25% are from sports (SRC)
  - Subset of mild traumatic brain injury (mTBI)

- Only 7-15% of athletes with concussion symptoms report them

Bottom Line?

*Lots of concussions - reported and unreported!*
NCAA Sports:
Rates per 1,000 AE

Women’s
- Basketball: 0.53
- Ice hockey: 0.78
- Soccer: 0.54
- Softball: 0.26
- Volleyball: 0.37

Men’s
- Basketball: 0.38
- Football: 0.75
- Ice hockey: 0.74
- Soccer: 0.26
- Wrestling: 0.89

Kerr, Journal of Athletic Training, 2017
Harmon, BJSM/CJSM 2019
What about in children <18yo?

- ~1.0 - 1.8 million SRCs annually
- 400,000 SRCs in high school athletes

Mersine A. Bryan et al. Pediatrics 2016;138:e20154635
Mechanism

- Traumatically induced transient disturbance of brain function, involving a complex pathophysiologic cascade.

- Acute clinical symptoms largely reflect a functional disturbance (rather than a structural injury).

Consensus statement on concussion in sport--5th international conf. on concussion in (Berlin). BJSM. 2017
Caused by rotational and angular forces to the brain
Direct impact to head NOT required
Shear forces disrupt neural membranes
  K+ efflux into extracellular space
  Ca and excitatory amino acids increase
  Further K+ efflux
Suppression of neuron activity
Neurometabolic Cascade Following Cerebral Concussion/mTBI

From Giza CC, et al.[10]
Needed: More energy!

Na+ pumps restore balance yet...

paradoxical *decrease* in cerebral blood flow!

- Disruptions of autonomic regulation can persist for several weeks and the brain may be vulnerable to additional injury
Symptoms

- Headache
- Dizziness
- Balance disturbances
- Disorientation
- Loss of consciousness
- Anxiety, nervousness
- Difficulty initiating sleep
- Personality changes
- Drowsiness
- Irritability
- Fatigue
- Difficulty concentrating
- Problems remembering
- Sadness
Diagnosis

- Challenging, based on clinical assessment
- Lack of validated, objective diagnostic tests
- Reliance of self-reported symptoms
- Non-specific symptoms all associated with concussion, but can originate from other etiologies
- Symptoms may be delayed in onset of initially unrecognized
Presentation

- **Functional** injury
  - Physical
  - Cognitive
  - Emotional
  - Sleep

- Consider concussion if *any* of these affected

- For diagnosis, a clear temporal relationship between insult and onset/ worsening symptoms should exist
Assessment Tools

- Sports Concussion Assessment Tool 5th edition (SCAT 5)
- Computerized neuropsychological tests
  - Cogsport
  - Immediate Post-concussions Assessment and Cognitive Testing (ImPACT)
- NCAA Baseline
  - Symptom checklist
  - Cognitive evaluation
  - Balance assessment
Assessment Tools

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Baseline testing may be helpful, but not necessary, required or standard of care (SORT B)
LOOK UP... LOOK DOWN... LOOK AT MY THUMB. GEE, YOU'RE...

QUIT MESSING AROUND, DOC! DOES HE HAVE A CONCUSSION OR NOT?
Sideline Assessment

- Begins at time of play and observing player come off field
- Remove essential piece of equipment
- Notify coaching staff player is not available until released
Sideline Assessment

- Experience/ anecdotal knowledge
- SCAT 5/ Child SCAT 5 provide a standardized framework
- GOAL: Determine *any* chance of concussion
  - Player is automatically out of play for the following 24 hrs.

*When in doubt, sit them out!*
Sideline Assessment Tools

- Symptoms
- SAC
- BESS
  - Balance Error Scoring System
- King-Devick
- Poor test-retest reliability
- Multimodal assessments increases sensitivity/specificity
When to send to the ER?

- Most patients who have injury with LOC
- Worsening symptoms: reported
- Worsening evaluation:
  - Focal deficit
  - Somnolence
  - Confusion
  - Slurred speech
  - Ataxia
- (Comfort of the family/ friends)
Imaging

- Contributes little to management but helps rule out:
  - More serious brain injuries
  - Skull fractures
  - Cervical spine injuries

- CT: test of choice acutely
  - ICH
  - Other neurosurgical emergencies

- MRI: may offer value in prolonged deficits or atypical recovery
Concussion

- Serial assessments imperative as symptoms evolve
- Complete a thorough eval before sending home
  - Locker room
  - SCAT 5
- Provide handout to athlete/ caregiver
  - What to expect
  - Red flag signs
  - Safe medicines
  - What to do in case of emergency
- Arrange follow-up in 24-36hrs
Patient Handout

- You have had a head injury and must be watched closely by another person for 24 hrs.
- If you display any of the following signs or symptoms after your head injury, call your doctor or go to the nearest ER:
  - A very bad HA that is getting worse.
  - Vomiting that is worsening or begins several hours after your injury.
  - Any fainting spells or being more sleepy than usual.
  - Worsening confusion.
  - Change in behavior (acting strange, saying things that don’t make sense).
  - Cannot remember new events.
  - Seizure.
- You may use Tylenol but do not use any strong pain pills, NSAIDs, or...
This means...

- NO sports
- NO school work
- NO screens
- NO computers
- NO video games
- NO TV

REST your injury!
In Office Evaluation

- Injury mechanism
- Symptom trajectory
- Neurocognitive functioning
- Cervical spine exam
- Sleep/ wake disturbances
- Vestibular/ ocular function
- Gait/ balance

ASSESS FOR THE “BONUS PRIZE”!
Vestibular/Ocular Motor Screening (VOMS)

<table>
<thead>
<tr>
<th>Vestibular/Ocular Motor Test</th>
<th>Vestibular Headache</th>
<th>Ocular Headache</th>
<th>Dizziness</th>
<th>Dizziness</th>
<th>Nausea</th>
<th>Nausea</th>
<th>Fogginess</th>
<th>Fogginess</th>
<th>Comments</th>
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<tbody>
<tr>
<td>Baseline Symptoms:</td>
<td>N/A</td>
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<td>Smooth Pursuits</td>
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<tr>
<td>Convergence (Near Point in cm):</td>
<td>Measure 1:</td>
<td>Measure 2:</td>
<td>Measure 3:</td>
<td>Measure 4:</td>
<td>Measure 5:</td>
<td>Measure 6:</td>
<td>Measure 7:</td>
<td>Measure 8:</td>
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<tr>
<td>VOR – Horizontal</td>
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<td>VOR – Vertical</td>
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<tr>
<td>Visual Motion Sensitivity Test</td>
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</table>

Smooth Pursuits (Horizontal & Vertical)
Both patient and clinician are seated. Patient follows target with eyes. Do not move head, just move eyes. 2 steps at rate of 2 sec/step. Complete for both horizontal and vertical.

Saccades (Horizontal & Vertical)
Tests ability of eyes to make quick changes in direction.
Both patient and clinician are seated. Patient follows target if great. Patient follows target if poor. Do not move head or neck. 10 steps at rate of 2 sec/step. Note symptoms (0-10). Repeat with patient looking up and down.

Convergence
Measures ability of eyes to maintain focus on a target without double vision.

Visual Motion Sensitivity Test
Patient holds a card with symbols in each hand. Patient looks at symbols in one hand. Patient turns to symbols in other hand. Note symptoms (0-10). Repeat 5 times. Repeat with patient looking up and down.

Vestibular-Ocular Reflex (Horizontal & Vertical)
Assists ability of patient to keep vision as head moves.

Mucha, AJSM, 2014
Recovery

- Vast majority of concussion sx resolve spontaneously
  - 80% - 90% of older adolescents and adults return to baseline within 2 wks
  - In younger athletes, up to 4 weeks is considered normal
- Important to communicate the normal time course of recovery
Recovery

- Teens: vulnerable for persistent symptoms
  - F > M
- “Higher Risk” athletes: at risk for sx > 1 month
  - H/o mental health problems
  - H/o migraine HA
  - Previous protracted recovery
  - Incompletely treated injury
- ADHD/ Learning Disabilities
  - Requires careful planning and intervention for return to school
  - Does not appear to be at greater risk of persisting sx > 1mo!
Treatment

Why trend towards activity? Facilitates recovery

- ↑ brain derived neurotrophic factor (BDNF)
- ↑ focus
- ↓ negative psychosocial impact of activity restriction
- Improves function (compared to no activity or full activity)
  - ↑ visual memory
  - ↓ reaction times
- Subthreshold aerobic exercise restores normal brain fMRI activation patterns

Facilitates Recovery

- Gagnon et al Brain Inj 2009
- Majerske et al J Athl Train 2008
- Leddy et al Sports Health 2012
- Leddy et al J Head Trauma Rehabil 2013
Treatment: REST?

- Consensus guidelines:
  - Brief (cognitive and physical) rest 24-48 hours
  - Gradual progressive increase in activity
  - Sub-symptom threshold

- Optimal time not well defined
Target Treatment

Computerized Neuropsychologic Assessment

- “Doc, I need my concussion BASELINE test...”
- Assists in clinical decision making
  - Just a tool!
- All athletes should have a clinical neurological assessment as part of overall management
- Adds opportunity for athlete/parent education
Future Directions

- MRI advanced technologies: used in research protocols to understand neurobiological effects and recovery

- Biomarkers: potential use to rule out bleeds and structural damage?
  - S100 calcium-binding protein B (s100 B)
  - Ubiquitin carboxy-terminal hydrolase L1 (UCHL1)
What about academics?

- Notify school personnel immediately
- While recovering, students may require cognitive rest and may require academic accommodations
  - Reduced work load
  - Extended time for tests
- SRC can induce changes in attention, processing speed, memory, executive function
  - Learning becomes more difficult
- Those with persisting symptoms should be provided an IEP
## Table 1  Graduated return-to-sport (RTS) strategy

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

**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.
Management

- Symptoms/ serial exams confirm resolution of symptoms
- Graded return-to-play
  - Athletes should not return to play until sx free
  - Free of masking meds
- Prolonged symptoms:
  - Referral to multi-disciplinary team with specific expertise across the scope of concussion management
- Reevaluation several months after recovery to screen for depression
Prevention

- Protective gear
  - Helmets: leather vs hard helmets
  - Mouth guards:
    - Reduce risk of skull and dental fractures
    - Conflicting data on concussions

- Rule changes to eliminate dangerous behaviors in sports provide a more protective effect
  - Football- tackling
  - Hockey- checking
Take Home Points

- Concussions are complex injuries, not fully understood. Most resolve in 1-4wks.
- “Invisible” injury makes diagnosis and management challenging:
  - Self-reported symptoms, comorbid conditions, no objective tests
- Multi-modal assessment tools are key
- Rest is no longer the mainstay of treatment!
  - A brief period of rest, encouraged to gradually increase cognitive and physical activity (below threshold)
- Refer to a multidisciplinary team for prolonged symptoms
Resources

- CDC Heads Up: www.cdc.gov/headsup/resources/custom.html
A CONCUSSION

What results when someone does EXACTLY what you say:
"When I nod my head, you hit it."
References

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


