Sports Medicine Update: Sport Related Concussion

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Financial Disclosures

• None
• No product in this lecture is an endorsement but simply used for demonstration purposes
Objectives

- What exactly is a concussion?
- Diagnosis and treatment of concussions
- Facts and myths

- Questions at anytime!!
Epidemiology

1. 1.6-3.8 million sport-related concussions annually in US

2. Increased recognition
3. Popular culture
4. Media attention
5. Legal ramifications

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Knowledge and Compassion Focused on You
### TABLE 1
Concussion Rates Among High School Athletes by Sport: High School Sports-Related Injury Surveillance Study, United States, 2008-2010 School Years

<table>
<thead>
<tr>
<th>Sport</th>
<th>Concussions</th>
<th>Athlete Exposures (AEs)</th>
<th>Rate per 10,000 AEs</th>
<th>Rate Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Competition</td>
<td>Practice</td>
<td>Total</td>
<td>Competition</td>
</tr>
<tr>
<td>Football</td>
<td>548</td>
<td>364</td>
<td>912</td>
<td>239,445</td>
</tr>
<tr>
<td>Boys’ ice hockey</td>
<td>69</td>
<td>11</td>
<td>80</td>
<td>47,418</td>
</tr>
<tr>
<td>Boys’ lacrosse</td>
<td>75</td>
<td>18</td>
<td>93</td>
<td>71,990</td>
</tr>
<tr>
<td>Girls’ soccer</td>
<td>133</td>
<td>26</td>
<td>159</td>
<td>145,139</td>
</tr>
<tr>
<td>Girls’ lacrosse</td>
<td>45</td>
<td>15</td>
<td>60</td>
<td>52,331</td>
</tr>
<tr>
<td>Girls’ basketball</td>
<td>85</td>
<td>22</td>
<td>107</td>
<td>153,655</td>
</tr>
<tr>
<td>Boys’ soccer</td>
<td>88</td>
<td>15</td>
<td>103</td>
<td>166,572</td>
</tr>
<tr>
<td>Boys’ wrestling</td>
<td>63</td>
<td>49</td>
<td>112</td>
<td>132,203</td>
</tr>
<tr>
<td>Girls’ field hockey</td>
<td>29</td>
<td>22</td>
<td>51</td>
<td>70,430</td>
</tr>
<tr>
<td>Boys’ basketball</td>
<td>71</td>
<td>25</td>
<td>96</td>
<td>181,941</td>
</tr>
<tr>
<td>Girls’ softball</td>
<td>36</td>
<td>22</td>
<td>58</td>
<td>123,815</td>
</tr>
<tr>
<td>Girls’ gymnastics</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>8,431</td>
</tr>
<tr>
<td>Cheerleading</td>
<td>2</td>
<td>21</td>
<td>23</td>
<td>16,412</td>
</tr>
<tr>
<td>Boys’ baseball</td>
<td>19</td>
<td>4</td>
<td>23</td>
<td>167,233</td>
</tr>
<tr>
<td>Girls’ volleyball</td>
<td>16</td>
<td>15</td>
<td>31</td>
<td>162,854</td>
</tr>
<tr>
<td>Girls’ swim/dive</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>45,564</td>
</tr>
<tr>
<td>Girls’ track/field</td>
<td>3</td>
<td>5</td>
<td>8</td>
<td>82,360</td>
</tr>
<tr>
<td>Boys’ track/field</td>
<td>3</td>
<td>8</td>
<td>11</td>
<td>100,050</td>
</tr>
<tr>
<td>Boys’ swim/dive</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>37,556</td>
</tr>
</tbody>
</table>

Gender comparable

| Boys | 181 | 54 | 235 | 653,352 | 1,731,957 | 2,385,309 | 2.8 | 0.3 | 1.0 | 9.3 (6.6-12.0) |
| Girls | 259 | 77 | 336 | 550,533 | 1,462,518 | 2,013,051 | 4.7 | 0.5 | 1.7 | 9.4 (6.9-11.5) |

Total

| Boys | 936 | 496 | 1432 | 1,144,408 | 3,534,170 | 4,678,578 | 8.2 | 1.4 | 3.1 | 5.9 (5.2-6.5) |
| Girls | 353 | 151 | 504 | 860,991 | 2,240,495 | 3,101,486 | 4.1 | 0.7 | 1.6 | 5.9 (5.0-7.4) |
Concussion - Definition

• Concussion is a:
  – type of traumatic **BRAIN INJURY**
  – caused by a bump or blow to the head or neck
  – “ding”
  – “getting your bell rung”
What really is a concussion?

• Blow to the head or neck area
• Injury to the brain cells disrupt connections to other brain cells
• Reversible
Pathophysiology

Figure 4. Neurometabolic Cascade of mTBI

- K+
- Ionic flux
- Cell Death
- Protease activation
- Energy Crisis
- Ca2+
- Altered neurotransmission
- Axonal injury
- Glutamate
- K+
- Ionic flux
- ADP
- Pump
- Energy
- Mito
- atp

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Knowledge and Compassion Focused on You
Symptoms – as told by the Athlete

- Headache or “pressure” in head
- Nausea or vomiting
- Really tired
- Feels “wobbly”
- Double vision or blurry vision
- Eyes hurt with bright lights or loud sounds
- Feels “foggy” or “hazy” or “out of it”
Signs – as seen by the Parents or Coaching Staff

- Loses consciousness or “knocked out,” even for a moment
- Appears dazed or stunned
- Confused about the play or assignment
- Moves clumsily
- Answers questions slowly
- Cannot recall events prior to or right after the hit or fall
- Shows extreme mood changes (angry or tired)

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Knowledge and Compassion Focused on You
Emergency! – call 911 or take directly to Emergency Room

- One pupil much larger than the other
- So drowsy you cannot wake them
- WORST headache of their life
- Vomiting MULTIPLE times
- Slurred speech
- Decreased coordination and easily falling down
- Convulsions or seizures
- Very confused when trying to make conversation
- Cannot recognize people or places
What to do if you suspect a concussion?

• IMMEDIATELY come out of the game or practice
• Meet with the athletic trainer at the school (if you have one)
• See a doctor specializing in concussion management
What problems can you have during a concussion?

- Thinking/concentration
- Balance
- Visual tracking
Initial Evaluation

• Past medical history
  – Headaches
  – ADHD
  – Concussion
  – Depression/Anxiety
## Symptoms

<table>
<thead>
<tr>
<th>SYMPTOM</th>
<th>None</th>
<th>Mild</th>
<th>Moderate</th>
<th>Severe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Headache</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Nausea</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Vomiting</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Balance Problems</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Dizziness</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Fatigue</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Trouble Falling Asleep</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Sleeping More Than Usual</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Sleeping Less Than Usual</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Drowsiness</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Sensitivity to Light</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Sensitivity to Noise</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Irritability</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Sadness</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Nervousness</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Feeling More Emotional</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Numbness or Tingling</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
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<tr>
<td>Feeling Slowed Down</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Feeling Mentally “Foggy”</td>
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<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Difficulty Concentrating</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Difficulty Remembering</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Visual Problems</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Total Score = __________

---

Initial Exam

• Full neurological exam
• Thinking/concentration
  – Orientation
  – Immediate memory
  – Concentration
  – Delayed memory
Initial Exam

• Balance
Initial Exam

• Visual Tracking
Final Diagnosis

• Compare measures vs. baseline if available
• No one good test
• Art of Medicine?
• Error on side of caution with good medical reasoning
ImPACT

• Computerized neurocognitive testing
• 30-40 minute test
• Developed in 1990’s:
  – Mark Lovell, PhD, FACPN, DSCI, Software Developer, ImPACT
  – Micky Collins, PhD - UPMC Dept. of Orthopaedic Surgery
  – Joseph Maroon, MD - UPMC Dept. of Neurological Surgery
### ImPACT Clinical Report

**Exam Type**

<table>
<thead>
<tr>
<th>Date Tested</th>
<th>Baseline</th>
<th>Post-concussion</th>
<th>Post-concussion</th>
<th>Post-concussion</th>
<th>Post-concussion</th>
<th>Post-concussion</th>
<th>Post-concussion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exam Language</td>
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<td>English</td>
<td>English</td>
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<td>English</td>
<td>English</td>
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<tr>
<td>Test Version</td>
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<td>2.2.729</td>
<td>2.2.729</td>
<td>2.2.729</td>
<td>2.2.729</td>
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<td></td>
</tr>
</tbody>
</table>

### Composite Scores *

<table>
<thead>
<tr>
<th>Composite Scores</th>
<th>Baseline</th>
<th>Post-concussion</th>
<th>Post-concussion</th>
<th>Post-concussion</th>
<th>Post-concussion</th>
<th>Post-concussion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory composite (verbal)</td>
<td>93</td>
<td>75%</td>
<td>66</td>
<td>1%</td>
<td>57</td>
<td>&lt;1%</td>
</tr>
<tr>
<td>Memory composite (visual) †</td>
<td>70</td>
<td>23%</td>
<td>41</td>
<td>&lt;1%</td>
<td>49</td>
<td>1%</td>
</tr>
<tr>
<td>Visual motor speed composite</td>
<td>45.88</td>
<td>85%</td>
<td>46.38</td>
<td>86%</td>
<td>40.13</td>
<td>65%</td>
</tr>
<tr>
<td>Reaction time composite</td>
<td>0.54</td>
<td>46%</td>
<td>0.60</td>
<td>22%</td>
<td>0.66</td>
<td>6%</td>
</tr>
<tr>
<td>Impulse control composite</td>
<td>8</td>
<td>46%</td>
<td>14</td>
<td>22%</td>
<td>10</td>
<td>6%</td>
</tr>
<tr>
<td>Total Symptom Score</td>
<td>0</td>
<td>0%</td>
<td>14</td>
<td>1%</td>
<td>3</td>
<td>1%</td>
</tr>
</tbody>
</table>

* Scores in **bold** type indicate scores that exceed the Reliable Change Index score (RCI) when compared to the baseline score. However, scores that do not exceed the RCI index may still be clinically significant. Percentile scores, if available, are listed in small type. Please consult your ImPACT User Manual for more details.

† Clinical composite score is available only for exams taken in ImPACT version 2.0 or later.
ImPACT

• Controversy?
• Unreliable?
Initial Treatment

• “Energy Crisis”
• Relative BRAIN REST
• Physical Rest
• Avoid repeat head trauma

• How much rest?
Initial Treatment – 0-1 week

• Brain AND Physical Rest

• Sleep – practice good sleep hygiene, more sleep than usual
• Thinking Activity – limit reading, video games, TV, computer, work to less than 30 minutes at a time then take a 45-60 minute break
• Physical Activity – take light walks outside
• School – no school until feeling better
• Headaches – use Tylenol as needed
• NO DRIVING!
Initial Treatment – 1-3 weeks

- Highly dependent on symptom severity
- Sleep – limit naps
- Thinking Activity – may increase load
- Physical Activity – may increase frequency/duration
School

- Slow return only when feeling well
- School letter provided
- Reduce homework by 25-50%
- No standardized tests/quizzes
- Allow extra time to complete projects/assignments
- Allow rest breaks during day if needed
- No PE

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Treatment

• Follow weekly
• Retest previously abnormal areas
• Discuss medications vs therapy vs continued interventions
Recovery

Collins M, et al. 2006

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80%
Prognosis

- **Age**
  - Younger athletes associated with prolonged recovery

- **Gender – Female**
  - Higher # of symptoms
  - Greater severity of symptoms
  - Higher *rate* of concussion vs. males

- **Genetics**

- **Previous concussion**
  - 2-5.8 x higher risk of sustaining another concussion

Sports

- Going to school full-time and in process of doing all homework
- AND not having any symptoms of a concussion
- AND normal exam
- Start return to play process

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Maryland HS Concussion Law

• Passed in 2011
• Form of “Zackery Lystedt Law”
• Prohibits an athlete with a suspected concussion from returning to game/practice until cleared by a licensed health-care provider
Return to Play/Sports

• 6 steps
• Each step = 1 day
• No symptoms during each step to progress
• Repeat days if having symptoms during the steps
## Graduated Return to Play Protocol

<table>
<thead>
<tr>
<th>Description of Stage</th>
<th>Date Completed</th>
<th>Supervised by</th>
</tr>
</thead>
</table>
| **STAGE 1: LIGHT AEROBIC ACTIVITY**  
Begin stage 1 when: Student is cleared by health care provider and has no symptoms.  
Sample activities for stage 1: 20-30 minutes jogging, stationary bike or treadmill. | | |
| **STAGE 2: HEAVY AEROBIC AND STRENGTH ACTIVITY**  
Begin stage 2 when: 24 hours have passed since student began stage 1 AND student has not experienced any return of symptoms in the previous 24 hours.  
Sample activities for stage 2: Progressive resistance training workout consisting of all of the following:  
• 4 laps around field or 10 minutes on stationary bike, and  
• Ten 60 yard sprints, and  
• 5 sets of 5 reps: Front squats/push-ups/shoulder press, and  
• 3-5 laps or walking lunges | | |
| **STAGE 3: FUNCTIONAL, INDIVIDUAL, SPORT-SPECIFIC DRILLS WITHOUT RISK OF CONTACT**  
Begin stage 3 when: 24 hours have passed since student began stage 2 AND student has not experienced any return of symptoms in the previous 24 hours.  
Sample activities for stage 3: 30-45 minutes of functional/sport specific drills coordinated by coach or athletic trainer. NOTE: no heading of soccer ball or drills involving blocking sled. | | |
| **STAGE 4: NON-CONTACT PRACTICE**  
Begin stage 4 when: 24 hours have passed since student began stage 3 AND student has not experienced any return of symptoms in the previous 24 hours.  
Sample activities for stage 4: Full participation in team’s regular strength and conditioning program. NOTE: no heading of soccer ball or drills involving blocking sled permitted. | | |
| **STAGE 5: FULL-CONTACT PRACTICE AND FULL PARTICIPATION IN PHYSICAL EDUCATION**  
Begin stage 5 when: 24 hours have passed since student began stage 4 AND student has not experienced any return of symptoms in the previous 24 hours.  
Sample activities for stage 5: Unrestricted participation in practices and physical education. | | |
| **STAGE 6: RETURN TO GAME**  
Begin stage 6 when: 24 hours have passed since student began stage 5 AND student has not experienced any return of symptoms in the previous 24 hours. | | |
Return to Play

1. **Light aerobic exercise**
2. **Heavy aerobic exercise**
3. **Sport-specific exercise**
4. **Non-contact training drills**
5. **Full contact practice**
6. **Return to game**

Consensus Statement on Concussion in Sport – 2012

Knowledge and Compassion *Focused on You*
Return to Play

1. Light aerobic exercise
2. Heavy aerobic exercise
3. Sport-specific exercise
4. Non-contact training drills
5. Full contact practice
6. Return to game
Return to Play

1. Light aerobic exercise
2. Heavy aerobic exercise
3. Sport-specific exercise
4. Non-contact training drills
5. Full contact practice
6. Return to game
Return to Play

1. Light aerobic exercise
2. Heavy aerobic exercise
3. Sport-specific exercise
4. Non-contact training drills
5. Full contact practice
6. Return to game
Return to Play

1. Light aerobic exercise
2. Heavy aerobic exercise
3. Sport-specific exercise
4. Non-contact training drills
5. Full contact practice
6. Return to game
Return to Play

1. Light aerobic exercise
2. Heavy aerobic exercise
3. Sport-specific exercise
4. Non-contact training drills
5. Full contact practice
6. Return to game
Prevention

- Protective Equipment
  - Mouthguards
    - No evidence to reduce concussion
    - Reduces incidence of oral/tooth injuries
  - Helmets
    - No studies with decreased concussion incidence
    - Reduces skull fractures

- Type of Sport
- Rule changes
  - Soccer heading?
  - Football spearing
  - Heads-up tackling


www.epru.org
So you have a concussion, what’s the big deal?

• Sam is a 15 year old soccer player who gets a concussion
• Appropriately sits out
• Follows doctors orders
• Returns fully back to competition in 3 weeks
So you have a concussion, what’s the big deal?

• Jen is a 15 year old soccer player who suspects she has a concussion after getting hit by a flying elbow in practice
• Bad headaches, feels woozy and nauseous
• “Fights through” and continues practice
• Next day – continues to have headaches and feel woozy but participates in a game
• Elbowed in the head again and has another concussion
• Sits out for 7 months before returning to back to soccer and grades have fallen from straight A’s, now to C’s and D’s
Concussion FAQ #1

• I think I have a concussion, is it ok that I fall asleep? Or will I fall into a coma and never wake up again?

• It is ok to sleep as long as you don’t have any of the “EMERGENCY” signs
Concussion FAQ #2

• I just got knocked out on the soccer field and I know I have a concussion. Because I was knocked out unconscious, does that mean my concussion is SEVERE and is going to take a long time to recover?

• Not necessarily

• No more grading of concussions
Concussion FAQ #3

• I was diagnosed with having a concussion, which is a brain injury….don’t I need a CT scan or MRI of my head?

• NO (most of the time) as usual scanning of the brain will be normal.

• Only need a scan if you have an “EMERGENCY sign”
Concussion FAQ #4

• I was diagnosed with having a concussion, how long will I be out from sports?

• Hard to predict
• 80% of HS athletes will recover within 3 weeks
Concussion FAQ #5

• How many concussions can I have before I have long-term brain damage?

• Medical literature not clear = “we don’t know” but we are trying
Concussion FAQ #6

• How many concussions can I have before I have to quit playing contact sports?

• Medical literature not clear = “we don’t know” but we are trying

• Multiple concussions in quick succession?

• What are your long-term goals in life? Playing professional sports? Or working for NASA?
Questions???