Sports Concussion 2017

Consensus statement on concussion in sport—the 5th international conference on concussion in sport held in Berlin, October 2016


Learning objectives

At the end of this session be able to…

1. Identify the 3 components of a sports concussion evaluation
2. Explain the average recovery time for kids and adults after sports concussion
3. Prescribe cognitive rest in concussion recovery
4. Prescribe physical rest in concussion recovery
5. Describe a return to play protocol
6. Identify a patient to consider referring for a multidisciplinary sports concussion evaluation

Concussion definition

- Blow to head, neck, body → force to head
- Rapid onset of neurologic impairment
  - In some cases signs and symptoms can evolve over minutes-hours
- Acute functional injury (rather than structural injury)
  - CT and MRI normal
- Symptoms usually resolve in weeks, spontaneously, but in some cases can be prolonged.
- May or may not include loss of consciousness.
- Cannot be explained by drug, alcohol, medication use, or other injuries or comorbidities

Case #1

- 16 y/o high school soccer goalie
- Presents to you in urgent care with wrist pain
- Also, she hit heads with teammate in practice earlier today and had 15 minutes of headaches and dizziness. She took a nap after practice as she felt unusually tired.
- Now she has no headache: “I feel fine.”
- What do you do next?

3-pronged evaluation recommended

1. Self-reported symptom assessment
2. Motor control: Neurologic exam including balance. Balance Error Scoring System (BESS or modified BESS)
3. Mental status: Standardized Assessment of Concussion (SAC)

1. Self-reported symptom assessment

Please hand the form to the athlete

<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>&quot;Pressure in head&quot;</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Neck Pain</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Nausea or vomiting</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>Blurred vision</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>
</tbody>
</table>

### Symptom norms

<table>
<thead>
<tr>
<th></th>
<th>9th grade</th>
<th>10th grade</th>
<th>11th grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symptom score</td>
<td>17 +/- 5</td>
<td>16 +/- 5</td>
<td>17 +/- 6</td>
</tr>
</tbody>
</table>

Valovich McLeod TC et al. Representative baseline values on the sport concussion assessment tool 2 (SCAT2) in adolescent athletes vary by gender, grade and concussion history. AJSM 2012.

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### 2. Neurological exam with balance

**Balance Error Scoring System: BESS**

BESS scoring

- Each error is counted as one point
- Score = the sum of the error points for all six trials
- Errors
  - Eyes opening
  - Hands coming off the hips
  - Hip flexion or abduction of greater than 30
  - Changing foot placement from the stance
  - Remaining out of the test position for > 5 seconds
- Max score 10 errors
- Also if cannot maintain for minimum 5 seconds then score = 10

BESS norms: ages 10-17

Table 2. BESS score means, medians, and percentiles

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>SD</th>
<th>Median</th>
<th>&gt;90th</th>
<th>76th to 90th</th>
<th>75th to 25th</th>
<th>24th to 10th</th>
<th>9th to 2nd</th>
<th>&lt;2nd</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firm surface</td>
<td>5.37</td>
<td>4.40</td>
<td>4.00</td>
<td>0-0</td>
<td>1-2</td>
<td>2-6</td>
<td>8-11</td>
<td>12-17</td>
<td>17-20</td>
</tr>
<tr>
<td>Foam surface</td>
<td>12.28</td>
<td>4.43</td>
<td>12.00</td>
<td>0-0</td>
<td>0-2</td>
<td>2-5</td>
<td>5-10</td>
<td>10-10</td>
<td>10-10</td>
</tr>
<tr>
<td>Total BESS score</td>
<td>17.64</td>
<td>7.52</td>
<td>17.00</td>
<td>2-7</td>
<td>7-9</td>
<td>10-15</td>
<td>15-18</td>
<td>20-21</td>
<td>21-23</td>
</tr>
</tbody>
</table>

BESS, Balance Error Scoring System.

BESS norms: adults

Table 1. Normative reference values for the BESS stratified by age.

<table>
<thead>
<tr>
<th>Age</th>
<th>k</th>
<th>M</th>
<th>Median</th>
<th>SD</th>
<th>&gt;90th</th>
<th>76–90th</th>
<th>25–75th</th>
<th>10–24th</th>
<th>2–9th</th>
<th>&lt;2nd</th>
</tr>
</thead>
<tbody>
<tr>
<td>20–39</td>
<td>104</td>
<td>10.97</td>
<td>10</td>
<td>5.05</td>
<td>0–3</td>
<td>4–6</td>
<td>7–14</td>
<td>15–17</td>
<td>18–22</td>
<td>23+</td>
</tr>
<tr>
<td>40–49</td>
<td>172</td>
<td>11.88</td>
<td>11</td>
<td>5.49</td>
<td>0–5</td>
<td>6–7</td>
<td>8–15</td>
<td>16–19</td>
<td>20–25</td>
<td>26+</td>
</tr>
<tr>
<td>50–54</td>
<td>96</td>
<td>12.73</td>
<td>11</td>
<td>6.07</td>
<td>0–6</td>
<td>7–8</td>
<td>9–15</td>
<td>16–20</td>
<td>21–31</td>
<td>32+</td>
</tr>
<tr>
<td>55–59</td>
<td>89</td>
<td>14.85</td>
<td>13</td>
<td>7.32</td>
<td>0–7</td>
<td>8–9</td>
<td>10–17</td>
<td>18–24</td>
<td>25–33</td>
<td>34+</td>
</tr>
<tr>
<td>60–64</td>
<td>80</td>
<td>17.20</td>
<td>16</td>
<td>7.83</td>
<td>0–11</td>
<td>8–11</td>
<td>12–21</td>
<td>22–28</td>
<td>29–35</td>
<td>36+</td>
</tr>
</tbody>
</table>

Notes: The BESS scores are not normally distributed. Therefore, the percentile ranks corresponding to the natural distributions of scores are presented. For example, for 20–39 year olds, a score of 2 falls in the top 10% and a score of 19 falls in the bottom 10% of the 104 subjects.

3. Mental status

**IMMEDIATE MEMORY**
This Immediate Memory component can be completed using the traditional 5-word list or a 10-word list, depending. Each list is constructed individually, as follows: The words on each list are your own words. They must be remembered in any order, even if you are not sure what they are.

<table>
<thead>
<tr>
<th>List</th>
<th>1st Word</th>
<th>2nd Word</th>
<th>3rd Word</th>
<th>4th Word</th>
<th>5th Word</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pen</td>
<td>Paper</td>
<td>Pencil</td>
<td>Paper</td>
<td>Pencil</td>
</tr>
<tr>
<td>2</td>
<td>Baby</td>
<td>Monday</td>
<td>Parties</td>
<td>Monday</td>
<td>Parties</td>
</tr>
<tr>
<td>3</td>
<td>Bike</td>
<td>Pine</td>
<td>Window</td>
<td>Pine</td>
<td>Window</td>
</tr>
<tr>
<td>4</td>
<td>Power</td>
<td>Paper</td>
<td>Pencil</td>
<td>Paper</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Paper</td>
<td>Pencil</td>
<td>Power</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**CONCENTRATION DIGITS BACKWARDS**
Please circle the Digit List chosen (A, B, C, D, E, F). Administer at the rate of one digit per second reading DOWN the selected column.

<table>
<thead>
<tr>
<th>List A</th>
<th>List B</th>
<th>List C</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
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<td>4</td>
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<tr>
<td>5</td>
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<td>3</td>
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<tr>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

I am going to read a string of numbers and when I am done, I will ask you to repeat them back to me in reverse order of how I read them to you. For example, if I say 2-0-6, you should say 6-0-2.
How severe is my concussion?

- Concussion severity is determined retrospectively
- Does not correlate with LOC nor amnesia
  - Grading scales no longer used
- Typical time to resolve
  - Adults: 10-14 days
  - Kids: Up to 4 weeks


Factors associated with slower recovery

- Higher severity of symptoms in first days post injury
- Development of subacute
  - Depression
  - Migraine
- Children, adolescents, young adults with pre-injury
  - Mental health problems
  - Migraine

Case #2

- 25 y/o woman presents to your office for ER follow-up two days after bike accident.
- Slid out while crossing streetcar tracks on wet city streets.
- No loss of consciousness.
- Taken by ambulance to ER.
- Had trauma work-up including head CT (-).
- Has headache, fatigue, dizziness, light sensitivity. Sleeping more than usual.
- Normal neck and neurologic exam.

How would you treat this patient?

A. Order urgent head CT to rule out subtle post traumatic bleed, return to clinic after CT.
B. Gradually return to work now as tolerated, rest from biking, f/u 1 week.
C. Rest from work and from biking until symptom free, f/u 1 week.
D. Return to work and biking now.
Concussion treatment

- Cognitive rest
- Physical rest
- Medication
  - Tylenol
  - Ibuprofen after first 72 hours
- No driving
- No Etoh

How much rest after a concussion?

88 patients (11-22 y/o) seen at pediatric ED randomized
Strict rest x 5 days vs. “usual care” of 1-2 days rest, then stepwise return to activity
Neurocognitive and balance outcomes same at 3 and 10d post injury
Strict rest group had more daily post concussive symptoms and slower symptom resolution over the 10d study period


Slide courtesy of Cindy Chang, MD
Berlin Consensus 2017 on Rest

- “There is currently insufficient evidence that prescribing complete rest achieves these objectives.” (those of mitigating symptoms and/or promoting recovery by minimizing brain energy demands post concussion)
- “After a brief period of rest …24-48 hours after injury, patients can be encouraged to become gradually and progressively more active while staying below their cognitive and physical symptom-exacerbation thresholds…”
- “The exact amount and duration of rest is not yet well defined in the literature and requires further study.”


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Return to learn / work progression

- No school.
- OK to do light reading, little bit TV, drawing, cooking as long as doesn’t worsen symptoms.
- 15 min cognitive activity at a time.
- 30 min schoolwork at a time until can do 1-2 hours.
- Return to ½ day of school.
- Return to full day of school.

http://www.chop.edu/service/concussion-care-for-kids/returning-to-school.html
Concussion Information Sheet
- Acute Concussion Notification Form
- Graded Concussion Symptom Checklist
- Physician Letter to School After Concussion Visit
- Concussion Return to Learn (RTL) Protocol
- Physician Recommended School Accommodations Following Concussion
- Concussion Return to Play (RTP) Protocol


Case #3
- 15 y/o high school girls soccer player
- Concussion f/u in clinic
- Injured 1 week ago
- Rested at home x 2 days then gradually returned to school with RTL protocol
- Tolerating school 100%
- Has not done any physical activity
- No concussion symptoms
- Soccer championship game in 2 days. She requests your clearance to play.
- What do you recommend?
What do you recommend?

A. Clear her for game play in 2 days.
B. Clear her to practice today and if no symptoms, clear for game in 2 days.
C. Clear her for practice today and to follow a gradual return to play protocol of 7 days.
D. Recommend 1 more week of rest from physical activity then f/u in office.
E. Recommend 1 month out of soccer post injury then f/u in office.

California concussion legislation

- **AB 25 – Concussion Law 2012**
  - 3 parts (education, remove from play, written medical note to return)
- **AB 1451—Coaches Concussion Training Law 2013**
  - Mandatory education every 2 years
- **AB 2127 – Concussion Safety Law 2015**
  - Limit FB full-contact practices
  - Mandatory RTP protocol of **no less than 7 days from the diagnosed date of concussion**
  - RTP under the supervision of LHCP
- **AB 2007 Concussion Mgmt in Youth Sports Act 2016**
  - Requires youth sports participants to undergo the same safety protocols as high school athletes

Slide courtesy of Cindy Chang, MD
Return to play progression

Return to play activity examples

<table>
<thead>
<tr>
<th>Step</th>
<th>Objective</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Symptom-limited activity</td>
<td>Gradually reintroduce work/school</td>
</tr>
<tr>
<td>2</td>
<td>Light aerobic activity:</td>
<td>Walking, swimming, or stationary bike. &lt; 70% max heart rate. No weights.</td>
</tr>
<tr>
<td></td>
<td>Increase heart rate</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Sport Specific: Add movement</td>
<td>Skating drills in hockey, running drills in soccer. No head impact activities.</td>
</tr>
<tr>
<td>4</td>
<td>Non contact training: Add coordination and cognitive load</td>
<td>More complex drills (passing). Can start weights.</td>
</tr>
<tr>
<td>5</td>
<td>Restore confidence and assess functional skills by coaching staff</td>
<td>Full-contact practice</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>Normal game play</td>
</tr>
</tbody>
</table>

Concussion Information Sheet
• Acute Concussion Notification Form
• Graded Concussion Symptom Checklist
• Physician Letter to School After Concussion Visit
• Concussion Return to Learn (RTL) Protocol
• Physician Recommended School Accommodations Following Concussion
• Concussion Return to Play (RTP) Protocol


CIF: Return to play handout
Case #4

A 23 y/o semi pro rugby player presents to you 3 months after her 5th concussion sustained when she was elbowed in the head during a game. She has had a headache with light sensitivity since the injury. She would like to know if and when she can return to rugby.

- What is her diagnosis?
- What do you worry about?

Post Concussion Syndrome

- Frequency unclear (0-15%).
- Concussion symptoms persist x months, usually <1 year.
- Patients benefit from multidisciplinary approach to treatment.
Repeat concussion: short term risks

- Increased risk of
  - Repeat injury
  - More severe symptoms
  - Longer duration of symptoms
  - Interruption of school / work / physical activity


Repeat concussion: long term concerns

Chronic Traumatic Encephalopathy

- Athletes, military personnel, survivors of intimate partner violence
- Chronic, progressive neurodegenerative syndrome
- Depression, cognitive impairment, aggression
- Diagnosed at autopsy: tau protein deposition in specific pattern
- Difficult to draw causality – no prospective data yet – however no reports of CTE without preceding traumatic brain injury.
- Concerning association between participation in collision sports and long term neuropsychiatric problems

Think about post concussion syndrome when…

- Symptoms not improving
  - Adults: expected recovery 10-14 days
  - Kids: expected recovery around 4 weeks
- Unable to return to school or work after 1-2 weeks of treatment.
- History of migraine, anxiety, depression, sleep disorder.
- History of concussion.

Post concussion syndrome treatment: Multidisciplinary approach
How Many Concussions is Too Many?

- Individualized to athlete.
- Concussion hx.
  - Number.
  - Less force.
  - More frequent.
  - Increased severity of sx.
  - Increased duration of sx.
  - Age: possibly more consequences if younger at time of concussion.

Corrigan JD, Concussion webcast 10/18/2011.

Have you thought about playing sports other than soccer / football / rugby?
Lower concussion risk by decreasing exposure

**Figure 3: Impact expectation by sport**

<table>
<thead>
<tr>
<th>Sport</th>
<th>Male</th>
<th>Female</th>
<th>Pooled incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rugby</td>
<td>4.18</td>
<td>NR</td>
<td>4.18</td>
</tr>
<tr>
<td>Hockey</td>
<td>NR</td>
<td>NR</td>
<td>1.20</td>
</tr>
<tr>
<td>American football</td>
<td>0.53</td>
<td>NR</td>
<td>0.53</td>
</tr>
<tr>
<td>Lacrosse</td>
<td>0.29</td>
<td>0.17</td>
<td>0.24</td>
</tr>
<tr>
<td>Soccer</td>
<td>0.19</td>
<td>0.27</td>
<td>0.23</td>
</tr>
<tr>
<td>Wrestling</td>
<td>0.17</td>
<td>NR</td>
<td>0.17</td>
</tr>
<tr>
<td>Basketball</td>
<td>0.10</td>
<td>0.17</td>
<td>0.13</td>
</tr>
<tr>
<td>Softball</td>
<td>NR</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>Field hockey</td>
<td>NR</td>
<td>0.10</td>
<td>0.10</td>
</tr>
<tr>
<td>Cheerleading</td>
<td>NR</td>
<td>0.07</td>
<td>0.07</td>
</tr>
<tr>
<td>Baseball</td>
<td>0.06</td>
<td>NR</td>
<td>0.06</td>
</tr>
<tr>
<td>Volleyball</td>
<td>NR</td>
<td>0.03</td>
<td>0.03</td>
</tr>
</tbody>
</table>

Highest risk positions by sport

- **Football – 1. quarterback, 2. running back, 3. linebacker** (Powell JW. Traumatic brain injury in high school athletes. JAMA. 1999 Sep 8;282(10):958-63.)
- **Soccer – goalkeepers and defensive midfield players due to collision with other player** (Helmich I. Game-specific characteristics of sport-related concussions. J Sports Med Phys Fitness. 2016 Sep 14.)
- **Volleyball – “libero” position due to hits from the ball** (Helmich I. Game-specific characteristics of sport-related concussions. J Sports Med Phys Fitness. 2016 Sep 14.)

Concussion resources

- **UCSF Sports Concussion Program**
  - concussion@ucsf.edu
- **California Interscholastic Federation** http://www.cifstate.org/sports-medicine/concussions/index
- **Consensus statement on concussion in sport, 2017.**
  - [http://bjsm.bmj.com/content/early/2017/04/26/bjsports-2017-097699](http://bjsm.bmj.com/content/early/2017/04/26/bjsports-2017-097699)
- **CDC concussion toolkit for physicians**
  www.cdc.gov/concussion/HeadsUp/physicians_tool_kit.html
Keys to managing sports concussion in 2017

- Recovery time on average 10-14 days (adults), 4 weeks (kids)
- 3-pronged evaluation: Symptoms, Neuro/balance exam, Cognitive
- Gradual return to learn or work 24-48 hours post injury
- RTP protocol at least 7 days since day of diagnosis (in California)
- Consider referral for post concussion syndrome
- Repeat injuries: individual approach