New Developments in the Management of Concussions

David Marshall, MD
Medical Director
Sports Medicine Program
Children’s Healthcare of Atlanta
Concussions in the News

NHL stars’ injuries place spotlight upon concussions
- USA Today

Mayo Clinic summit to look into hockey concussions – USA Today

Concussions force hard look inward around NFL
By Gary Minoces, USA TODAY

“A Silent Epidemic…”

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NY concussion bill would pull students from play for at least 24 hours
Published: Thursday, March 17, 2011, 12:06 PM   Updated: Thursday, March 17, 2011, 12:53 PM

Why Bell-Ringers and Dings Should Be Taken Seriously

Why Concussed Kids Must Be Treated With Extra Caution
Brianna Binowski, a sophomore at Bridgewater-Raritan High in New Jersey, says that nearly a year after suffering a concussion in a basketball game, she struggled with schoolwork, constantly felt tired and had daily headaches.

By Robert Deutsch, USA TODAY
High school athletes face serious concussion risks

By Janice Lloyd, USA TODAY

When high school athletes suffer concussions, as many as 40.5% return to action prematurely and set themselves up for more severe injuries, new research shows.

The study from the Center for Injury Research and Policy at Nationwide Children’s Hospital in Columbus, Ohio, adds fuel to growing concerns about the long-term side effects of concussions. It also shines new light on inadequately trained personnel on the sidelines unprepared to make accurate diagnoses and informed decisions about sending players back on the field.

FOOTBALL TOPS LIST

Highest numbers of high school concussions last year were in:

- Football: 55,007
- Girls' soccer: 29,167
- Boys' soccer: 20,929

Source: Center for Injury Research and Policy at Nationwide Children’s Hospital in Columbus, Ohio

STUDENT ATHLETES: Trainers pushing for 'athletic health care' in high schools

"We find these numbers about athletes returning to play tremendously alarming," says Dawn Comstock, the study's director of research.

Concussions account for almost one in 10 sports injuries, according to the Centers for Disease Control and Prevention, and for young people ages 15-24, sports are second only to motor vehicle accidents as the leading cause of brain injury. Comstock estimated that more than 130,000 concussions..."
“New Guidelines on Young Athletes’ Concussions Stir Controversy”
Introduction

- Definition
- Epidemiology of concussions
- Pathophysiology
- Background of grading
- On field / in office assessment
- Return to play decision making
- Neurocognitive testing
- What you can do as a pediatrician
Definition of Concussion

- A **BRAIN INJURY** involving rapid but transient alteration in cognitive functioning secondary to a blow to the head or a blow to another part of the body resulting in acceleration forces to the brain.
- May or may not involve loss of consciousness
- Recovery follows a sequential course
- Standard imaging (CT, MRI) normal
- A type of “minimal traumatic brain injury” (MTBI)
Epidemiology
“137,000 concussions in high school athletes during 2007-08 school year
- Football - 55,000
- Girls soccer - 29,000
- Boys soccer - 21,000
- Girls basketball - 7000
- Lacrosse, cheerleading, gymnastics, ice hockey
Epidemiology—“Silent Epidemic”

- CDC study estimates 300,000 sports and recreation-related concussions per year
  - Study included only those with LOC
- Other studies show concussions resulting in LOC account for only 8% - 19% of injuries
- Therefore 1.6 - 3.8 million concussions occur each year
  - About one half of injuries are recognized and reported
    - Number may be doubled
Pathophysiology

- Functional injury vs structural
- Metabolic crisis
- Ionic shifts involving glutamate, Na, K, Ca
- Results in hyperglycolysis and increased energy demand
- Ca released from endothelial lining causing cerebral vasoconstriction
- This metabolic mismatch between energy supply and demand is thought to propagate neural cellular vulnerability
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Signs

- Appears dazed
- Vacant stare
- Confused
- Disorientation
- Emotional lability
- Clumsiness
- Slow answering ?s
- Behavior changes

Symptoms

- Headache
- Nausea/vomiting
- Dizziness
- double/blurred vision
- Sensitive to light/noise
- Foggy, “out of it”
- Changes in sleep
- Impaired concentration
- Emotional, irritable, sadness
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Symptoms of Concussion

1. Headache  71%
2. Feeling slow  58%
3. Difficulty concentrating  57%
4. Dizziness  55%
5. Fogginess  53%
6. Fatigue  50%
7. Blurred/double vision  49%
8. Light sensitivity  47%
9. Memory dysfunction  43%
10. Balance problems  43%
What grade is it?
When can he go back to play?
### American Academy of Neurology

<table>
<thead>
<tr>
<th>Grade</th>
<th>One</th>
<th>Two</th>
<th>Three</th>
</tr>
</thead>
<tbody>
<tr>
<td>Criteria</td>
<td>Sx clear &lt; 15 min</td>
<td>Sx &gt; 15 min</td>
<td>Any LOC</td>
</tr>
<tr>
<td>RTP</td>
<td>20 min after sx clear</td>
<td>1-2 weeks after sx clear</td>
<td>2-4 weeks after sx clear</td>
</tr>
</tbody>
</table>
Multiple Concussions

- 2nd grade 1 out 2 weeks
- 2nd grade 2 out 1 month
- 2nd grade 3 out for season
- 3rd any grade done for season
The “bell ringer” - not so trivial

- 64 high school football players age 13-17 who suffered grade 1 concussions with all symptoms resolving within 15 minutes

- Average time for full neurocognitive recovery was **7 days**

2nd Study

- Same group of high school kids with “grade 1” concussions showed significant decline in memory function and an increase in symptom reporting at 36 hours post-injury.

- Those who were asymptomatic by 5 min returned to baseline on day 4.

What about Grading?

- It doesn’t matter!!!
- Criteria for returning to play are the same for all individuals regardless of their initial symptoms or presentation
  - Asymptomatic after rest (physical and cognitive)
  - Asymptomatic after return to school and activity
  - “Normal” neurocognitive testing
- Get away from minimizing terms like “bell ringer” and “ding”
- Similar to ankle sprain
Is this ankle ready to play?
Assessment
On the field Assessment: “Did a concussion occur?”

- Symptoms of concussion vary widely from individual to individual
- May have only a single symptom or a constellation of symptoms
**HEADS UP CONCUSSION IN HIGH SCHOOL SPORTS**

**SIGNS AND SYMPTOMS**

Athletes who experience **one or more** of the signs and symptoms listed below after a bump, blow, or jolt to the head or body may have a concussion.

<table>
<thead>
<tr>
<th>Signs Observed by Coaching Staff</th>
<th>Symptoms Reported by Athlete</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appears dazed or stunned</td>
<td>Headache or “pressure” in head</td>
</tr>
<tr>
<td>Is confused about assignment or position</td>
<td>Nausea or vomiting</td>
</tr>
<tr>
<td>Forgets an instruction</td>
<td>Balance problems or dizziness</td>
</tr>
<tr>
<td>Is unsure of game, score, or opponent</td>
<td>Double or blurry vision</td>
</tr>
<tr>
<td>Moves clumsily</td>
<td>Sensitivity to light</td>
</tr>
<tr>
<td>Answers questions slowly</td>
<td>Sensitivity to noise</td>
</tr>
<tr>
<td>Loses consciousness (even briefly)</td>
<td>Feeling sluggish, hazy, foggy, or groggy</td>
</tr>
<tr>
<td>Shows mood, behavior, or personality changes</td>
<td>Concentration or memory problems</td>
</tr>
<tr>
<td>Can’t recall events prior to hit or fall</td>
<td>Confusion</td>
</tr>
<tr>
<td>Can’t recall events after hit or fall</td>
<td>Just not “feeling right” or is “feeling down”</td>
</tr>
</tbody>
</table>

**ACTION PLAN**

If you suspect that an athlete has a concussion, you should take the following four steps:

1. **Remove the athlete from play.**
2. Ensure that the athlete is evaluated by a health care professional experienced in evaluating for concussion. Do not try to judge the seriousness of the injury yourself.
3. Inform the athlete’s parents or guardians about the possible concussion and give them the fact sheet on concussion.
4. Keep the athlete out of play the day of the injury and until a health care professional, experienced in evaluating for concussion, says the athlete is symptom-free and it’s OK to return to play.

**IMPORTANT PHONE NUMBERS**

- **Emergency Medical Services**
  - Name: __________________________
  - Phone: ________________________

- **Health Care Professional**
  - Name: __________________________
  - Phone: ________________________

- **School Staff Available During Practices**
  - Name: __________________________
  - Phone: ________________________

- **School Staff Available During Games**
  - Name: __________________________
  - Phone: ________________________

**It’s better to miss one game than the whole season.**

For more information and to order additional materials free-of-charge, visit: www.cdc.gov/concussion.
Concussion in Sports
This palm card provides information and tools to help medical staff with the on-field recognition and management of concussion.

Concussion Signs and Symptoms

<table>
<thead>
<tr>
<th>Signs Observed by Medical Staff</th>
<th>Symptoms Reported by Athlete</th>
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<td>Forgets sports plays</td>
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<td>Is unsure of game, score, opponent</td>
<td>Double or fuzzy vision</td>
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<td>Answers questions slowly</td>
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</tr>
<tr>
<td>Loses consciousness (even briefly)</td>
<td>Feeling sluggish or slowed down</td>
</tr>
<tr>
<td>Shows behavior or personality changes</td>
<td>Feeling foggy or groggy</td>
</tr>
<tr>
<td>Can’t recall events prior to hit or fall (retrograde amnesia)</td>
<td>Does not “feel right”</td>
</tr>
</tbody>
</table>

This palm card is part of the “Needs Up Brain Injury in Your Practice” tool kit developed by the Centers for Disease Control and Prevention (CDC). For more information, visit: www.cdc.gov/ncbddd.

On-Field Mental Status Evaluation
(This mental status assessment is recommended for high school-age athletes and older. Any inability of the athlete to respond correctly to the question’s below should be considered abnormal)

<table>
<thead>
<tr>
<th>Orientation</th>
<th>Anterograde Amnesia</th>
</tr>
</thead>
<tbody>
<tr>
<td>What time is it?</td>
<td>Ask the athlete to repeat the following words: Girl, Dog, Green</td>
</tr>
<tr>
<td>Who is the opposing team?</td>
<td>Anterograde Amnesia</td>
</tr>
<tr>
<td>Who scored last?</td>
<td>Retrograde Amnesia</td>
</tr>
<tr>
<td>What team did we play last?</td>
<td>Concentration</td>
</tr>
</tbody>
</table>

Concentration
Ask the athlete to do the following:
Repeat the date of the week backwards (starting with today)
Repeat the months of the year backwards (starting with December)
Repeat the se number backwards (36, 36, 1991, 4294, 4294)

Word List Memory
Ask the athlete to repeat the three words from earlier: Girl, Dog, Green

Signs of Deteriorating Neurological Function
An athlete should be taken to the emergency department if any of the following signs and symptoms are present:
• Headaches that worsen
• Seizures
• Focal neurologic signs
• Looks very dizzy or can’t be awakened
• Repeated vomiting
• Slurred speech
• Can’t recognize people or places
• Increasing confusion or irritability
• Weakness or numbness in arms or legs
• Neck pain
• Unusual behavior change
• Significant irritability
• Any loss of consciousness greater than 30 seconds or longer (Brief loss of consciousness [under 30 seconds] should be taken seriously and the patient should be carefully monitored.)

No Return to Play
Any athlete who exhibits signs and symptoms of concussion should be removed from play and should not participate in games or practices until they have been evaluated and given permission by an appropriate health care provider. Research indicates that high school athletes with less than 15 minutes of on-field symptoms exhibited deficits on formal neuropsychological testing and re-emergence of active symptoms, lasting up to one week post-injury.

Exertion
Symptoms will typically worsen or re-emerge with exertion, indicating incomplete recovery. If the athlete is symptom-free, provoking with exertion is recommended (e.g., 5 push-ups, 5 sit-ups, 5 knee bends, 40-yard sprint).

Return to play should occur gradually. Individuals should be monitored by an appropriate health care provider for symptoms and cognitive function carefully during each stage of increased exertion.

Repeated Evaluation
On-field, follow-up evaluation (e.g. every 5 minutes) is important, as signs and symptoms of concussion may evolve over time.

Off-Field Management
The physician should provide information to parents/caregivers regarding the athlete’s condition. For example, the athlete:
• Should not operate a motor vehicle or participate in activities such as sports, PE class, riding a bicycle, playing basketball, etc.
• May experience cognitive/behavioral difficulties at home, making it necessary to reduce physical and cognitive exertion (e.g., running, lifting weights, playing video games) until fully recovered.
• Should receive follow-up medical and neuropsychological evaluation, both for managing injury and determining return to sports.

On-field Cognitive Testing

Orientation
Ask the athlete the following questions.
What stadium is this? What month is it?
What city is this? What day is it?
Who is the opposing team?

Anterograde amnesia
Ask the athlete to repeat the following words.
Girl, dog, green

Retrograde amnesia
Ask the athlete the following questions.
What happened in the prior quarter/period?
What do you remember just prior to the hit?
What was the score of the game prior to the hit?
Do you remember the hit?

Concentration
Ask the athlete to do the following.
Repeat the days of the week backward (starting with today).
Repeat these numbers backward:
63 (36 is correct) 419 (914 is correct)

Word list memory
Ask the athlete to repeat the three words from earlier.
(Girl, dog, green)

Any failure should be considered abnormal.
Consult a physician following a suspected concussion.

The Best Approach To Concussion Management

Concussion Signs and Symptoms Evaluation

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<td>• shows behavior or personality change</td>
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Symptoms may worsen with exertion. Athlete should not return to play until symptom-free.

www.impacttest.com
Assessment

“If injured athlete shows any sign or symptom of concussion, they are held out for that game and given a more comprehensive evaluation and cleared by a qualified medial professional trained in the management of concussions”

- International Symposia on Concussion in Sport, Zurich 2008
Management

- Do not allow return to play till evaluated fully
- Cognitive rest
  - Remember the “metabolic crisis”
- Physical rest
- Neurocognitive testing
Cognitive Rest

- Hold out from school till symptoms improve
- Minimal TV
- Minimal video games
  - texts/tweets/twits
- Do not attend practice if symptomatic
- When symptoms subside, may return to school
- ½ day, core classes only, test modification, etc
School suggestions

- Have Concussion Management Plan
  - Teachers, school nurse, counselors, coaches, administrators need to be aware

- Watch for problems with:
  - Attention/concentration
  - Remembering or learning new information
  - Irritability, less tolerance of stressors
  - HA, fatigue when doing schoolwork
    - math /science
Identify the “Concussion Recovery Team”

- Medical
- School
- Home

Athlete
School options

- No school
- Return to school
  - Shortened day
  - Shortened classes with rest breaks
  - Extended time to complete HW, tests, etc
  - No tests
  - Void tests/coursework completed while symptomatic
  - Probably need letter, 504 form
Physical Rest

- No physical exertion while symptomatic
- When symptoms subside, may begin 5 stage rehab
  - Stage 1-minimal exertion (30-40% max HR)
  - Stage 2-light exercise (40-50% max HR)
  - Stage 3-mod aggressive (60-80% max HR)
  - Stage 4-sport performance (80-90 max HR)
  - Stage 5-sports performance (full exertion with contact)
  - Stage 6-full return without restriction
Stepwise Return to Play

1. NO ACTIVITY. Rest until asymptomatic.
2. Light aerobic exercise. Examples: Light jogging; Stationary bike.
3. Sport-specific exercise. No contact. Examples: Running; Shooting on a side basket.
5. Full-contact sport drills. Examples: Tackling drills; Scrimmaging.
6. Full activity. Practice/Game with no restrictions.

Each step should be separated by 24 hours.

Do not advance to the next step if symptoms reappear.
Return to Play

- Asymptomatic at rest
- Asymptomatic with max exertion
  - Cognitive and physical
- “Normalization” of ImPACT test
Clinical symptoms linked to brain related changes in physiology
Each injury is unique
Physical and cognitive exertion play strong role in recovery
Age, gender, previous concussions, genetics play a role
Mild injuries become severe if not managed properly
Summary – Clinical Facts

- Lack of education and awareness of injury is widespread
- Neurocognitive testing and objective evaluation is helpful in RTP
- Individual management of injury indicated...no 2 concussions are alike
Where are we headed?

- With CDC, continue to educate athletes, parents, coaches, administrators, nurses, trainers, physicians on the recognition and management of concussions
- Demand your people get educated
- Develop a “Concussion Action Plan”
HEADS UP CONCUSSION IN HIGH SCHOOL SPORTS

GUIDE FOR COACHES

U.S. Department of Health and Human Services
Centers for Disease Control and Prevention
Thank You

When in doubt... sit out!!
Children’s Healthcare of Atlanta
Sports Concussion Clinic

404-785-5998