The Honest Truth About Sports Concussions

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45+5min

Credit where credit deserved!

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Advisor: LoveYourBrain, MLS, NBA, NCAA, USFSF
Consultant: Neural Analytics, NFL NCP, NTLPA

Outline

1. Definitions of Concussion
2. Diagnosis
3. Initial Management
4. Return to School and Return to Activity
5. Prolonged Symptoms and Long-term Sequelae
6. Media vs Science vs Policy
7. Conclusions
What is a Concussion?
“A Brain Movement Injury”

- A **biological process** affecting the brain induced by physical forces
  - Biomechanical event
  - Symptoms start quickly
  - Neurological symptoms occur but not only rarely unconsciousness
  - Gets better with time if you don’t get whacked again
  - [Symptoms not caused by something else]

McCrory P et al., Concussion in Sport, (5th), Br J Sport Med 2017

Acute Signs/Symptoms of Concussion

- Headache
- Dizziness
- Nausea and Vomiting
- Vacant stare (looks ‘out of it’)
- Slow to talk or do things
- Confusion and inattention
- Disorientation
- Slurred or incoherent speech
- Loss of coordination
- Emotions out of proportion
- Memory loss (amnesia)
- Any period of unconsciousness

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What if you think your athlete had a concussion?

**When in Doubt, Sit it Out!**

**Recognize, Remove, Re-evaluate**

**STEP 1:** Recognize: Suspect Concussion? Yes / No?
- Concussion not suspected
- Concussion suspected

**STEP 2:** Remove & Evaluate
- Mechanism
- Symptoms
- SCAT5
- ChildSCAT5
- Concussion diagnosed
- Concussion not diagnosed or unsure

**STEP 3:** Re-evaluate
- Recognize & Remove

- **NO SINGLE test to diagnose concussion**
- **Using SCAT5 - test conditions are important**
  - Quiet conditions
  - Minimum 10 minutes
- **Helmet/impact sensors not for diagnosis**

**SCAT5**: SPORT CONCUSSION ASSESSMENT TOOL – 5TH EDITION
Developed by the Concussion in Sport Group
FOR USE BY MEDICAL PROFESSIONALS ONLY

**Child SCAT5**: SPORT CONCUSSION ASSESSMENT TOOL
FOR CHILDREN AGES 7 TO 12 YEARS
FOR USE BY MEDICAL PROFESSIONALS ONLY

- Video may help?
Sport Concussion Assessment Tool
SCAT5
Symptom Checklist
Sensitivity 0.64-0.89
Specificity 0.91-1.0

Cognitive assessment:
Standardized Assessment of Concussion (SAC)
1. Orientation: month, date, day, year, time
2. Immediate memory: 5 words x 3 tries
3. Concentration:
   a. Digits backwards (3, 4, 5, 6)
   b. Months in reverse order
4. Test Balance and Coordination
5. Delayed recall: same 5 words, one try.
Sensitivity 0.80-0.94
Specificity 0.76-0.91

Balance assessment: Balance Error Scoring System (BESS)
Sensitivity 0.34-0.64
Specificity 0.91

Concussion Pathophysiology and Imaging: Research Only!

Positron Emission Tomography (PET)
Profound reductions in cerebral glucose uptake occur after TBI, even without LOC or coma.

Magnetic Resonance Spectroscopy (MRS)
MRS shows significant reductions of NAA/Cr for 30 days after 1 concussion and 45 days after 2 concussions.
Vagnozzi, et. al. Brain, 2010

Abnormalities in DTI correlated well with post-concussion symptoms.
Concussion blood biomarkers?

Facts: FDA approval for test that helps predict a positive CT scan in cases of mild TBI NOT concussion!

Definite, Probable, Possible

STEP 2: Clinical Evaluation
- Mechanism
- Symptoms
- Neurological
- Cognition
- Coordination

1. Is there a mechanism?
2. Typical signs, symptoms and course?
3. No other cause of symptoms?

1. Is there a mechanism?
2. Typical signs, symptoms and course?
3. No other cause of symptoms?

Definite

PROBABLE

POSSIBLE OR UNLIKELY

Treat as concussed

Situational

Adapted from Kutcher & Giza, Continuum 2014

Concussion Diagnostic Certainty

Reclassifying the Concussion Diagnosis by Degree of Certainty

<table>
<thead>
<tr>
<th>Concussion Diagnosis</th>
<th>Total #</th>
<th>% patients w Sx &lt;10 @ 6-12m</th>
<th>% patients w overall rating 95% @ 6-12m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definite</td>
<td>23</td>
<td>87% (20)</td>
<td>91.3% (21)</td>
</tr>
<tr>
<td>Probable</td>
<td>15</td>
<td>66.7% (10)</td>
<td>53.3% (8)</td>
</tr>
<tr>
<td>Possible</td>
<td>8</td>
<td>50% (4)</td>
<td>37.5% (3)</td>
</tr>
<tr>
<td>Not a concussion</td>
<td>1</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>TOTAL</td>
<td>47</td>
<td>72.3% (34)</td>
<td>68% (32)</td>
</tr>
</tbody>
</table>

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Why is a Concussion Bad?

Concussed athletes are 3x more likely to get another concussion!!!

1. Brain energy crisis
2. Slow reflexes & reaction time
3. Poor balance
4. Slower thinking
5. Bad playing style

Now, 0% of repeat in-season concussions occurred within 10 days of 1st concussion.

McCrea et al., Neurosurgery 2009, Guskiewicz et al., JAMA 2003

Athletes with repeated concussions take longer to recover – and miss more school and more games.

Guskiewicz et al., JAMA 2003
Why is a Concussion Bad?

Concussed athletes are 3x more likely to suffer an orthopedic injury!!

Don’t Play Thru A Concussion

Athletes with delayed removal from play after concussion take longer to recover.

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Is Rest Best?

Giza CC, et al., JAMA Neurol 2018

What about Return to School?

REST
• 1-2 days
• Limited/ no work

BEGINNING RECOVERY
• Start cognitive effort
• Partial return to school
• Monitor symptoms

GRADUAL ACTIVITY
• Increase cognitive effort
• Return to school
• Monitor symptoms
• May start non-contact risk exercise

RETURN TO NORMALCY
• Return to normal school
• Monitor symptoms
• Begin/ continue return to play progression

What about Return to Play?

Athletes should NOT return to play the same day of injury
“Return to Play” only after “Return to Learn” starts

1. Symptom-limited rest (physical and mental rest)
2. Light aerobic exercise (add aerobic, stationary bike, swim)
3. Sport-specific exercise (add balance, running, balance)
4. Non-contact training drills (add thinking, resistance training)
5. Full contact training (after medical clearance)
6. Return to competition (game play)

48 hours for high school and younger

Treatment: Activity & Exercise

- Forced rest prolongs recovery
- Active rehab is beneficial
- Exercise + cognitive behavioral therapy improves recovery & reduces anxiety

Benefits of Strict Rest After Acute Concussion: A Randomized Controlled Trial

Forced rest prolongs recovery
Active rehab is beneficial
Exercise + cognitive behavioral therapy improves recovery & reduces anxiety

Persistent Post-Concussion Symptoms (PPCS)

1. Additional diagnostic considerations?
   A. Neuropsychological evaluation - ADHD, anxiety, depression, learning problems, MCI
   B. Imaging (include SWI) – usually normal – evidence of prior TBI, chronic SDH, ventriculomegaly, atrophy, low pressure headache
   C. Sleep study – sleep issues frequently comorbid
   D. Cervical/musculoskeletal examination – PT/OT/rehab consultation
   E. Other: Autonomic – orthostatics, etc; Vestibular, BPPV; Hormonal; Etc.

Not all chronic problems are CTE!
PPCS Diagnosis & Management

Treat identifiable conditions

A. **Deconditioning** – PT, graduated exercise
B. **Headaches** (migraine, chronic daily headache, cervicogenic, tension, medication overuse) –
   1. Headache diary, avoid triggers
   2. Preventive medications – avoid drugs assoc w cognitive impairment
   3. PT/musculoskeletal interventions
   4. Anti-inflammatories
   5. Reduce abortive agents/opiates, avoid rebound
   6. Alternative treatments
C. **Anxiety** – reassurance, cognitive restructuring, psychiatric/ psychological consultation, cognitive behavioral therapy, medications
D. **Depression** – psychiatric/ psychological consultation, cognitive behavioral therapy, medications
E. **Sleep problems** – sleep hygiene, melatonin, sleep consult/study
F. **Dizziness** – PT, vestibular desensitization, migraine tx?, autonomic tx?, hydration / orthostatic precautions, rarely medication
G. **ADHD** – treat as indicated if diagnosed, stimulant medication
H. **Chronic pain** – may benefit from multidisciplinary clinic

Long-term Brain Health

3. Offer evidence-based recommendations for preservation of cognition

A. **Aerobic exercise** – monitor hydration, avoid hypoglycemia
B. **Promote vascular health** – good primary care follow-up, treat hypertension & diabetes, avoid/reduce smoking
C. **Cognitive activity** – assess for daily cognitive activities; caution with ‘pay-to-play brain games’
D. **Sleep hygiene**
E. **Nutrition** –
   1. DOs: Include balanced healthy diet and omega-3 fatty acids, dietary fish; possibly also antioxidants, curcumin, etc.
   2. DON Ts: Excess alcohol, recreational drugs – caution with cannabis
F. **Stress reduction** – mindfulness, relaxation, etc.

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Contact Sports & CTE

1. Convenience sample: brain donations
2. Selection bias: deceased, exposure to repetitive head trauma, all subjects had symptoms
3. Lack of specificity for CTE: nonspecific symptoms
4. Recall bias: retrospective clinical evaluation
5. No control group; other studies show tau+ sz, no TBI
6. Largest clinicopathological study of CTE: half cases previously published

What did this study add to our understanding?

Mez J et al., JAMA 2017

Does age at 1st exposure predict late degeneration?

Does a convenience cohort of 211 deceased FB players represent youth athletes in general?
Are early sx due to AFE<12y?
Or illicit drug use?
Is AFE>12 assoc w stroke?

Demographic / Athletic

<table>
<thead>
<tr>
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<th>AFE &lt; 12y</th>
<th>AFE ≥ 12y</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age of death (SD)</td>
<td>53.5 (16.9)</td>
<td>69.2 (15.7)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Age of cognitive symptom onset (SD)</td>
<td>45.6 (16.1)</td>
<td>58.1 (16.0)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Age of behavioral symptom onset (SD)</td>
<td>39.0 (17.4)</td>
<td>51.0 (19.2)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Hypertension (%)</td>
<td>30 (42.9)</td>
<td>65 (60.1)</td>
<td>0.024</td>
</tr>
<tr>
<td>Stroke (%)</td>
<td>3 (4.2)</td>
<td>20 (18.5)</td>
<td>0.005</td>
</tr>
<tr>
<td>Illicit drug use (%)</td>
<td>39 (47.0)</td>
<td>40 (31.5)</td>
<td>0.023</td>
</tr>
</tbody>
</table>

Alosco, et al., Ann Neurol 2018

High school football & cognition

JAMA Neurol | Original Investigation
Association of Playing High School Football With Cognition and Mental Health Later in Life

1. Cohort study; n=2692 subjects; 834 played football; 1858 no football
2. Primary outcomes: depression & composite cognitive score
3. Matched for demographics, IQ, education, etc.
4. No difference in cognition, lower depression scores
5. Football was different in 1950s
6. Unable to control for prior mTBI; subgroups

No cognitive or mood problems in prior HS FB players

Deshpande et al., JAMA Neurol 2017
High School Football and Risk of Neurodegeneration: A Community-Based Study
Rudolfo Savica, MD, MSc; Joseph E. Parisi, MD; Lester E. Weitz, MD; Keith A. Josephs, MD, MSc; and J. Eric Ahlskog, PhD, MD

1946-1956

High School Football and Late-Life Risk of Neurodegenerative Syndromes. 1956-1970
Peter H. Janssen, Jay Mandelker, Ph.D; Michelle M. Melotz, Ph.D; J. Eric Ahlskog, PhD, MD; Bradley F. Boeve, MD; Keith Josephs, MD; and Rudolfo Savica, MD, PhD

1956-1970

No significant difference between HS football athletes and band members

<table>
<thead>
<tr>
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<th>Football</th>
<th>Band</th>
<th>p-value</th>
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<tbody>
<tr>
<td>N</td>
<td>438</td>
<td>140</td>
<td></td>
</tr>
<tr>
<td>Dementia</td>
<td>3.0%</td>
<td>1.4%</td>
<td>0.55</td>
</tr>
<tr>
<td>Parkinson</td>
<td>2.3%</td>
<td>3.6%</td>
<td>0.19</td>
</tr>
<tr>
<td>ALS</td>
<td>0.5%</td>
<td>0.7%</td>
<td>0.59</td>
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</table>

No significant difference between HS football athletes and other sport athletes

<table>
<thead>
<tr>
<th></th>
<th>Football</th>
<th>Other sports</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>296</td>
<td>190</td>
<td></td>
</tr>
<tr>
<td>Dementia</td>
<td>5.0%</td>
<td>3.2%</td>
<td>0.26</td>
</tr>
<tr>
<td>Parkinson</td>
<td>3.0%</td>
<td>2.4%</td>
<td>0.52</td>
</tr>
<tr>
<td>ALS</td>
<td>0.0%</td>
<td>0.0%</td>
<td>NA</td>
</tr>
</tbody>
</table>

(1) An athlete who is suspected of sustaining a concussion or head injury in an athletic activity shall be immediately removed from the activity for the remainder of the day, and shall not be permitted to return to the activity until he or she is evaluated by a licensed health care provider, trained in the management of concussions, acting within the scope of his or her practice.

Safety: CA Assembly Bill 2127

- No more than 2 full-contact practices/week
- No more than 90 min per full-contact practice
- No full-contact practice in off-season
Conclusions

1. Concussion is a brain movement injury. It is largely recoverable.
2. Concussion is a clinical diagnosis – characterized by biomechanical mechanism, temporal onset of ‘typical’ signs/symptoms, gradual symptom improvement and separate from comorbid causes of symptoms.
3. There is no single test for concussion.
4. Early removal from contact activity reduces risk of prolonged problems.
5. Avoid prolonged inactivity.
6. Gradual increase in cognitive & safe physical activity may promote recovery.
7. Not all persistent symptoms are due to dementia or CTE – figure out the cause and treat appropriately.
8. Know the difference between science, media & policy.

UCLA Steve Tisch BrainSPORT

Pre-season neuro exams

Sports neurology clinics
12th and Wilshire, Santa Monica
200 Medical Plaza, Westwood
Wasserman Building, Westwood

Email: concussioncare@mednet.ucla.edu
Website: http://neurosurgery.ucla.edu/BrainSPORT