Youth Concussion Prevention and Education

‘It’s better to miss one game than the season’

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Disclosures

- Nothing to disclose
Objectives

- Culture change
- Epidemiology
- PPE
- Equipment/Rule Changes/Strength Programs
- Online resources
  - educating athlete/parents/coaches/medical
- DHA
The Culture of Sport

- Similar to hydration culture years ago
- toughness vs safety
- difficult compared to visible injuries
- Education of players and coaches at an early age
  - recreation leagues through college
- symptoms and management
BIG HITS SELL TICKETS
LONG TERM CONSEQUENCES?
Thoughts on Concussion

- Brains are individual and dynamic

- would same blow to 100 age and gender matched athletes produce same concussion symptoms and recovery?

- some would argue there is more inter-individual difference in brain function vs other organs/injuries

- Also concussion is “dynamic” based on:
  - sleep deprivation, hydration, fatigue, co-morbid states

Concussion remains a diagnosis dominated by subjective information given by athlete while the clinician seeks objective data to support clinical decisions.

- Is management affected by “honesty” of athlete?

- Or anosognosia (the state of being unaware of one’s own neurologic deficit) aka.... loss of introspection.

- Has been described in many brain diseases.
Objective Measures

- need some “gold standard” to validate other measures
- fMRI, blood test, etc
- cannot rely on NP testing
  - especially in pediatric population
- even HITS system has not found “number” for concussion severity
Concussion Penumbra

- similar to ischemic stroke
- ischemic penumbra, tissue around the stroke that remains susceptible to risk of dying
- Concussion penumbra
- area of injury more susceptible to extension or increased severity of injury
- factors include physical and mental exertion, sleep deprivation, dehydration, hypoglycemia
Epidemiology

- CDC reports approximately 300,000 concussions per year\(^1\)
- 10x that in reality
- High School FB estimates 3-20% rate per season
- Approx. 62,816 MTBI in HS, 63% in football\(^2\)

\(^1\)THURMAN D, BRANCHE C, ET AL. *J HEAD TRAUMA REHABIL.*, 1998;13, 1-8
\(^2\)POWELL JW, BARBER-FOSS KD. *JAMA* 1999;282:958-63
Epidemiology in HS and Collegiate Athletes

- Surveys to ATCs of 17,549 FB players over 3 yrs
- 888 (5.1%) sustained a concussion
- 131 (14.7% of the 888) sustained 2\textsuperscript{nd} injury in the same season
- Players with 1\textsuperscript{st} concussion were 3x more likely to sustain a 2\textsuperscript{nd} during the season
- Artificial turf greater injury than grass
- 30.8% of players RTP same day

Age Differences HS vs College

- Prospective study ‘97-00
- 371 college athletes, 183 HS athletes
- 54 concussions, 38 within sample control group
- HS athletes still with deficits 7 days out (P < 0.005)
- College improved to matched controls after 3 days

- Self-reported symptoms not predictive of poor performance on neuropsych testing

FIELD M, COLLINS MW, LOVELL MR, ET. AL. J PEDIATR, 2003;142:546-53
Grade 1 Concussions in HS Athletes

- 43 HS athletes dx with grade 1 concussion
- Underwent neuropsych testing baseline and 2x during 1st week of injury
- 36h post-injury, dec. in memory and inc. in sx
- RTP guidelines too liberal for HS?
- RTP same day?

LOVELL M, COLLINS M, ET AL. AMER J SPORTS MED 2004;32: 47-54
Unreported Concussions in HS

- Retrospective, confidential survey from 1,532 high school FB players

- 29.9% previous hx of concussion
- 15.3% sustained one this season
- 47.3% reported injury
- 76.7% reported to ATC

Why not reported?

- 66.4% felt not serious enough
- 41.0% did not want to be withheld from competition
- 36.1% unaware of sx of concussion

Which Signs/Symptoms Predict Protracted Recovery from HS FB Players?

- 107 Male FB athletes over 5 years, cohort study
  - on-field signs/symptoms recorded
  - grouped in rapid (<7 days) vs protracted (>21 days) recovery
  - 62 with rapid, 36 with protracted recovery

- Dizziness was symptom linked most to protracted recovery

LAU B, KONTOS A, COLLINS M, ET AL. AJSM 2011
Pre-Participation Physical

- Important to obtain good history
- previous #, severity, protracted recovery?
- comorbid conditions leading to longer recovery
  - ADD, migraines, psych
- Opportunity to educate about concussions
  - video, handouts
Baseline Testing

- SCAT 2 symptom score
- BESS testing, Wii
- Computerized neuropsychological testing
  - ImPACT, CogSport
EQUIPMENT
Biomechanics of Head Injury

- Two types of biomechanical stresses
  - Acceleration/deceleration
    - Linear, tensile, and compressive forces
  - Rotational or angular acceleration
- More likely to result in injury to the brain
  - Holbrun 1943 and Gennerelli later
Neck Strength

- HIC (best assessment of concussion risk)
- Change in velocity to head displacement
- Small decreases in change of head velocity will have large effect on concussion risk as this affects the HIC by a factor to the fourth power
- Stronger necks = diminished head displacement

Neck Strength

- A 10% reduction in head velocity will result in 34% reduction in HIC
- May explain increased concussions in:
  - HS athletes
    - Less neck strength
    - Underdeveloped nervous system
    - Tackling techniques
  - Some female athletes
  - Different positional FB players
- Neck rolls/cowboy collars?
Figure 1. The Player Unit consisting of six accelerometers in spring-loaded holders, frequency modulation antenna, and rechargeable battery pack.
VT Experience

- 11,604 impacts from 2003-4
- 22 games, 62 practices
- 52 players
- Cross section of all types of players
- Real-time measurement in vivo vs Hybrid III dummies

VT Experience

- Mean impacts were measured at 20.9g +/-18.7g
- Maximum value 172.6g
- 290 of the impacts were 75g or greater
- 3 players sustained concussions
Helmet Design

- Energy absorption obviously key
- Many other factors
  - Good vision
  - Lightweight
  - Durability
  - Position maintenance
  - Hockey and lacrosse
- Comfort
- Economics
STAR Rating System

- Independent study from manufacturers
- VT/WF collaboration
- bought 3 new helmets of each type
- tested twice
- robotic fall from a few feet
A total of 10 adult football helmet models were evaluated using the STAR evaluation system for May 2011 release. All 10 are publicly available at the time of publication. Helmets with lower STAR values provide a reduction in concussion risk compared to helmets with higher STAR values. Based on this, the best overall rating of ‘5 Stars’ has the lowest STAR value. Group rankings are differentiated by statistical significance.

5 Stars: Best Available  

<table>
<thead>
<tr>
<th>Riddell Revolution Speed</th>
<th>STAR Value: 0.297</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cost: $243.99</td>
</tr>
<tr>
<td>Helmet</td>
<td>STAR Value</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>------------</td>
</tr>
<tr>
<td>Schutt ION 4D</td>
<td>0.351</td>
</tr>
<tr>
<td>Schutt DNA Pro +</td>
<td>0.352</td>
</tr>
<tr>
<td>Xenith X1</td>
<td>0.356</td>
</tr>
<tr>
<td>Riddell Revolution</td>
<td>0.362</td>
</tr>
<tr>
<td>Riddell Revolution IQ</td>
<td>0.369</td>
</tr>
</tbody>
</table>

Significantly better than 3, 2, 1, NR Star groups
No significant difference between the 5 in this group
<table>
<thead>
<tr>
<th>Rating</th>
<th>Product</th>
<th>STAR Value</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 Stars: Good</td>
<td>Schutt Air XP</td>
<td>0.434</td>
<td>$179.95</td>
</tr>
<tr>
<td>2 Stars: Adequate</td>
<td>Schutt Air Advantage</td>
<td>0.678</td>
<td>$159.99</td>
</tr>
<tr>
<td>1 Star: Marginal</td>
<td>Riddell VSR4</td>
<td>0.791</td>
<td>Not Applicable</td>
</tr>
</tbody>
</table>

Significantly better than 2,1,NR Star groups

Used helmets were tested to provide a reference.
Helmets

- extensive review by Benson et al 2009
- Helmets prevent more serious injury
  - hematoma, skull fracture
  - inconclusive for concussion prevention
- full facial shields in hockey may lessen concussion severity

Mouthguards

- Mouthguards do not reduce risk of concussion
- They do reduce risk of dental injury

RULE CHANGES
Data Collection for FB

- 1975 Joseph Torg
- Initiated the central registry for severe neck injury
- Recommend tackling technique changes
  - “head down” techniques and “spearing”
- Large decrease in head and neck injuries
- 1978 college FB helmet standards initiated by NOCSAE, 1980 for HS FB
NCCSI

Since 1982 the NCAA has funded the National Center for Catastrophic Sports Injury Research

Dr. Fred Mueller, Director

Dr. Robert Cantu, Medical Director

http://www.unc.edu/depts/nccsi/
Cantu and Mueller Data

- 497 FB fatalities related to brain and spine injuries from 1945-1999
- 69% from brain injury
- 16% from cervical spine
- Greatest number of deaths 1945-69
- Correlates with helmet safety and tackling changes
- 74% decrease in fatalities
Youth Hockey

- rules that allowed body checking at increased concussion rates
- illegal hits had more concussion risk than legal hits
- education by coaches
- rules
- how to anticipate collisions


AWARENESS AND EDUCATION
Medical Awareness

- Hospital discharge instructions in 70% of mild athletic concussions were inadequate
- only 33% of practitioners who routinely do sideline coverage use standard, objective protocol
- 31% used no concussion guidelines
  - lack of knowledge (71%)
  - confusing guidelines (16%)

Coach Awareness

- 45% youth coaches believed that concussion did not warrant removal from contest or practice

- only 45-62% were able to identify proper management of concussions

- 84% of HS coaches scored well on concussion assessment

Parent and Athlete Awareness

- In many youth sports no medical coverage is available
- Parents or other players may be only people to recognize concussion
Online Resources

http://www.aan.com/go/practice/concussion

Information resources for patients/parents

- http://www.cps.ca/english/statements/HAL/HAL06-01.htm
- http://www.hockeycanada.ca/index.cfm/ci_id/7699/la_id/1.htm

TABLE 2  Concussion Prevention Resources

<table>
<thead>
<tr>
<th>Resource</th>
<th>Description</th>
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</table>
| Bicycle Helmet Safety Institute                                       | Clearinghouse Web site and technical resource for helmet information
| www.helmets.org; 703-486-0100                                           | General information about head injury prevention, as well as brain injuries in several sports
| Brain Injury Association of America                                   | www.biausa.org; 800-444-6443                                                                                                           |
| Canada’s National Brain and Spinal Cord Injury Prevention Foundation  | Includes awareness and education program focused specifically on concussion; “smart hockey” videotapes designed to prevent concussion are available for purchase
| www.thinkfirst.ca; 800-335-6076                                         | Wealth of brain injury information including free concussion fact sheets for athletes through the recently released high school coaches’ tool kit
| Centers for Disease Control and Prevention                            | www.cdc.gov/ncipc/tb/coaches_tool_kit.htm                                                                                                 |
| National Safe Kids Campaign                                            | Dedicated to the prevention of all unintentional childhood injury; available fact sheets are focused on sports and recreational injuries
| Pashby Sports Safety Fund Concussion Site                             | Educational organization focused on reducing injuries in youth sports; sports-safety fact sheets are available for purchase
| www.nysf.org; 617-277-1171                                              | Web site devoted to providing education about concussion specifically, including proper recognition and prevention tips
| www.concussionsafety.com                                                |                                                                                                                                           |
Heads Up Resources

A Fact Sheet for **ATHLETES**

**A QUIZ FOR COACHES, ATHLETES, AND PARENTS**

Review the “Heads Up: Concussion in Youth Sports” materials and test your knowledge of concussion.

A Fact Sheet for **PARENTS**

“Heads Up: Concussion in Youth Sports”
SLICE Program

FIGURE 1. Mean prepresentation and postpresentation concussion quiz scores for all 599 participants and stratified by gender. Asterisks denote significant improvement by paired t tests ($P < 0.0001$). Error bars are standard deviations. Scores overall increased by an average of 22%.

FIGURE 2. Mean prepresentation and postpresentation concussion quiz scores stratified according to age group. Asterisks denote significant improvement by paired t tests ($P < 0.0001$). Error bars are standard deviations.

BAGLEY ET AL. CJSM SEPT 2012
DHA
DHA

- Docosahexanoic Acid (DHA)
- Omega 3 FA
  - along w EPA most common O3FA
  - Fish or algae sources
- well known cardiovascular and anti-inflammatory effects
DHA CNS Benefits

- Improve brain development
- Adults with higher dietary intake had 60-70% less risk of Alzheimer’s dementia (Morris et al)
- 5x increase in retired NFL players for mild cognitive impairment (MCI) if 3 or more concussions
- Studies underway with DHA and lessening of MCI
- Decrease in depression and anxiety
DHA and MTBI

- “neuro-prophylactic”?
- Human brain O3FA content is 97% DHA
  - Retina 93%
- Protection of apoptotic death and other cellular processes
- Modulation of inflammatory cascade
- Anti-oxidant
DHA and MTBI in rats

- Bailes et al

- have shown decreases in axonal injury in rats taking either 10mg/kg or 40mg/kg DHA vs control and sham injury rats

- for 30 days post-injury

- rats also did better with water maze testing post-injury
DHA and Concussion

- consideration of 1 to 3g DHA daily for prophylaxis or post-injury
- 200-350mg capsules available
- being used by some NCAA and NFL teams
- safe
THANK YOU

QUESTIONS?