Solving the Concussion Crisis

Christopher Nowinski
SLI Co-Founder, President, and CEO
Co-Director, CSTE at Boston University School of Medicine
NFLPA Mackey/White TBI Research Committee
Board of Directors, Brain Injury Association of America

Pacific Coast Brain Injury Conference
November 18, 2010
My Brain Trauma History

• I had a big future (in wrestling)

• All-Ivy defensive tackle at Harvard University

• Named “2002 Newcomer of the Year” by WWE and youngest male Hardcore Champion in WWE History
When Wrestling Goes Wrong
My “First” Concussion

- I received a concussion against the Dudley Boyz in June 2003

Aftermath
- Headaches
- Memory impairment
- Depression
- Sleep activity
My True Concussion History

- Dr. Robert Cantu helped me remember 5 prior concussions

- After my symptoms persist and 8 doctors can’t help me, I visit Dr. Robert Cantu

- At least 2 undiagnosed concussions in football

- 4 undiagnosed concussions in wrestling
My Concussors

1

2

3

4

5

6
An Education Comes Too Late

Shockingly, he is the first to tell me:

• The definition of a concussion
• “Resting concussions” helps them heal
• Concussions are cumulative and can have long-term effects

I didn’t have the right information to protect myself from concussions.

I wrote *Head Games* to warn others. If the damage is partially preventable, how can we not tell athletes how to protect themselves?
Mike Webster dies near Pittsburgh in 2002 after exhibiting cognitive and other neurological problems

- Dr. Bennet Omalu examines his brain post-mortem and diagnoses him with Chronic Traumatic Encephalopathy, or CTE

Terry Long commits suicide near Pittsburgh in 2005 after exhibiting bizarre behaviors

- Dr. Bennet Omalu examines his brain post-mortem and diagnoses him with CTE

Both cases are published by Dr. Omalu

The research was criticized by the NFL, and widely ignored by the national media and sports community at large
Putting Concussions on the Map

The mysterious death of Andre Waters

By DAVE SCHEIBER
Published December 11, 2006

- Andre Waters was an NFL safety from 1984-1995, mostly with the Philadelphia Eagles where he was an All-Pro.

- He committed suicide on November 20, 2006.

- Asked in 1994 by The Philadelphia Inquirer to count his career concussions, Mr. Waters replied, “I think I lost count at 15.” He later added: “I just wouldn’t say anything. I’d sniff some smelling salts, then go back in there.”
• Waters was diagnosed with Chronic Traumatic Encephalopathy (CTE)

• Family reported that Waters was depressed, his often lost his way home, he grew unengaged, and he was growing increasingly paranoid.
The Curious Case of Wayne Chrebet – Ch. 5

- In 2005, NY Jets wide receiver Wayne Chrebet was **knocked unconscious for over one minute** – and against all published guidelines **returned to the game 10 minutes later**

- The Jets team doctor was Elliott Pellman, the chair of the NFL’s Mild Traumatic Brain Injury Committee

- Chrebet retired after the season from post-concussion syndrome
The Concussion Crisis Revealed

In 2007, we continued to accumulate pathological evidence repetitive brain trauma caused a unique brain disease called Chronic Traumatic Encephalopathy, or CTE, that eventually leads to dementia. CTE is preventable, but nothing was being done to prevent it.

Justin Strzelczyk
Died at 36

Andre Waters
Suicide at age 44

Murder/Suicide age 40

Dungeon of Death
Chris Benoit and the Hart Family Curse

Suicide at age 44
The Sports Legacy Institute was founded in 2007 to “Solve the Sports Concussion Crisis.” SLI is a 501(c)(3) non-profit dedicated to study, treatment and prevention of concussions and the degenerative brain disease **Chronic Traumatic Encephalopathy, or CTE.**

“This groundbreaking research may be providing the most significant concussion discoveries and the most startling and potentially devastating findings (in sports medicine).” August 5, 2007

- Bob Ley

- Incorporated June 14th, 2007

- The mission of the Sports Legacy Institute is to advance the study, treatment and prevention of the effects of brain trauma in athletes and other at-risk groups.
Sports Legacy Institute Team

Founding Members

CHRISTOPHER NOWINSKI—President
Consultant, Trinity Partners LLC, Waltham, MA
Author, Head Games: Football’s Concussion Crisis
Former WWE professional wrestler

ROBERT CANTU, MD
Chief of Neurosurgery Service and Director of Sports Medicine, Emerson Hospital, Concord, MA
Co-Director, Neurologic Sports Injury Center Brigham and Women’s Hospital, Boston, MA

Medical Advisory Board
Robert Cantu, MD, (Chairman)
Robert Stern, PhD, Assoc. Prof. of Neurology, BU Medical School
Ann McKee, MD, Assoc. Prof. of Neurology and Pathology, BU Medical School
David Hovda, PhD, Director of UCLA Brain Injury Research Center

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Barbara Jones, Greenberg Taurig

Pro bono legal counsel provided by:
Center for the Study of Traumatic Encephalopathy

• September 2008 SLI and BU founded the first ever research center dedicated to CTE

A Collaboration Between Sports Legacy Institute and Boston University School of Medicine

Goals

1. Establishment of Brain Donation Registry
   • Current or retired athletes, with and without history of concussion, to agree to donate brain tissue following death.

2. Conduct Clinical Research
   • Examinations of retired athletes, including cognitive, mood, and neurological assessments, as well as brain MRI and spinal taps (to measure proteins in cerebrospinal fluid). Study longitudinally and examine brains following death.

3. Expansion of Brain Bank
   • Brain tissue repository for the examination of the underlying neuropathology associated with repetitive concussion in athletes.
The BU CSTE Research Team

Ann McKee, M.D.,
Associate Professor of Neurology and Pathology at BUSM. Neuropathologist for:
• Framingham Heart Study
• Centenarian Study
• BU ADC Center
• All NE VA Medical Centers
• National VA ALS Bank
• CSTE Brain Bank

Robert Cantu, M.D.,
Clinical Professor of Neurosurgery at BUSM; Chief of Neurosurgery Service at Emerson Hospital; and a world-renowned expert on concussion.

Robert A. Stern, Ph.D.,
Associate Professor of Neurology at BUSM, and Co-Director of the BU Alzheimer’s Disease Clinical and Research Program (ADCRP).
A Potential Public Health Epidemic

• **One in four boys** plays contact sports in high school

1 in 8 boys plays tackle football

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• **One in sixteen girls** plays contact sports in high school

Percent of Male Students

- Football: 49%
- Hockey: 13%
- Lacrosse: 1%
- Soccer: 7%
- Basketball: 25%
- Non-contact: 0%
- None: 5%

* Center for the Study of Retired Athletes
Epidemiology

1. Incidence of reported concussions
2. Incidence of unreported concussions
3. Reporting habits
4. Athletes at greatest risk
Incidence of Concussion in Football – Trainer Data

- According to medical professionals, concussion is rare in football

- When athletic trainers are surveyed on how many concussions they see each season, they consistently find that between 2% and 6% of football players suffer concussions each season.*

<table>
<thead>
<tr>
<th>Source</th>
<th>Level</th>
<th>Incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Powell et al (1999)</td>
<td>High School</td>
<td>3.6 %</td>
</tr>
<tr>
<td>Guskiewicz et al (2000)</td>
<td>HS/College</td>
<td>5.6 %</td>
</tr>
<tr>
<td>Guskiewicz et al (2003)</td>
<td>NCAA</td>
<td>6.3 %</td>
</tr>
<tr>
<td>McCrea et al (2002)</td>
<td>HS/College</td>
<td>3.8 %</td>
</tr>
<tr>
<td>Zemper (2003)</td>
<td>HS/College</td>
<td>4.1 %</td>
</tr>
<tr>
<td>Gerberich et al (1983)</td>
<td>High School</td>
<td>2.4 %</td>
</tr>
</tbody>
</table>

* Football will be used as the primary example because it has been studied more extensively than other sports. However, concussion data for ice hockey, lacrosse, soccer, and other sports is similar.
Incidence of Concussion in Football – Player Data

- Players simply do not report concussions, so they don’t exist in medical records

- When players are surveyed directly, anonymously, after the season, and the word “concussion” is removed from the questions (instead, they ask about symptoms), players appear to be suffering 10 to 50 times more concussions than they tell athletic trainers (or coaches).

<table>
<thead>
<tr>
<th>Source</th>
<th>Level</th>
<th>Incidence</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Langburt et al (2001)</td>
<td>High School</td>
<td>47.2 %</td>
<td>3</td>
</tr>
<tr>
<td>Delaney et al (2002)</td>
<td>College</td>
<td>70.2 %</td>
<td>4</td>
</tr>
<tr>
<td>Delaney et al (2000)</td>
<td>CFL</td>
<td>47.8 %</td>
<td></td>
</tr>
<tr>
<td>Woronzoff (2001)</td>
<td>College</td>
<td>61.2 %</td>
<td></td>
</tr>
<tr>
<td>McCrea et al (2004)</td>
<td>High School</td>
<td>15.3 %</td>
<td></td>
</tr>
<tr>
<td>Moreau (2005)</td>
<td>High School</td>
<td>65.2 %</td>
<td></td>
</tr>
</tbody>
</table>

- This high concussion incidence is supported by other studies, including one that found that 21% of high school football players suffered a headache in the last game, yet only one in five told a coach or athletic trainer
To monitor concussions in a youth ice hockey league (ages 11-19) in British Columbia, data was gathered in 3 ways:\(^1\)

1. Official injury reports
2. Direct survey of athletes
3. Observers placed in stands

* E.g. for every 1 concussion in the Official Injury Report, females reported suffering 54 concussions according to retrospective survey – ratios are approximate

Unreported Concussions in Youth Ice Hockey

- The study revealed that 2-4% of potential concussions were being diagnosed by team officials, and observers watching closely identified only half of potential concussions reported by athletes.

<table>
<thead>
<tr>
<th>Concussion-like Event Ratio by Reporting System*</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>BCAHA Official Injury Reports</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Direct Observation</td>
<td>14</td>
<td>33</td>
</tr>
<tr>
<td>Retrospective Survey</td>
<td>27</td>
<td>54</td>
</tr>
</tbody>
</table>

* E.g. for every 1 concussion in the Official Injury Report, females reported suffering 54 concussions according to retrospective survey – ratios are approximate

Why Players Don’t Report Concussions

- Historically, the general consensus had been that athletes didn’t report symptoms because they didn’t want to be held out of the game. Research shows that is not true.
- The top reason high school athletes don’t report concussions is that they do not believe a concussion is a serious injury!

Why Concussion Was Not Reported

<table>
<thead>
<tr>
<th>Reason</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Did not think it was serious enough</td>
<td>66%</td>
</tr>
<tr>
<td>Did not want to leave the game</td>
<td>41%</td>
</tr>
<tr>
<td>Did not know it was a concussion</td>
<td>36%</td>
</tr>
<tr>
<td>Did not want to let down teammates</td>
<td>22%</td>
</tr>
</tbody>
</table>

- This groundbreaking study revealed that athletes are poorly educated on concussions.
  - Another recent study found that fewer than half of college athletes were aware that concussions can have negative consequences.
You Can’t See a Concussion

THAT’S GOTTA HURT...
Pittsburgh Steelers running back Denny Wright was injured on the field Sunday night after he dislocated his right ankle and broke his right leg.
Normal Neuron Function

Signal arrives at neuron
Normal Neuron Function

Signal travels down axon to another cell
Normal Neuron Function

Neurotransmitters are released in an organized manner, triggering the next cell with a specific coded message.
During injury, potassium ions (K⁺) rush out of the cell...
Neuron During Injury

...and toxic calcium ions (Ca^{2+}) rush into the cell, leading to metabolic dysfunction.
Neuron Following Concussion

Metabolic dysfunction results in **ENERGY CRISIS**

Nerve cell is extremely **vulnerable** in this condition, and further injury or stress may cause **cell death or serious cell damage**.

Massive release of neurotransmitters interferes with cell communications.
Neuron Following Concussion

Metabolic dysfunction results in ENERGY CRISIS

Massive release of neurotransmitters interferes with cell communications

It may take many days for the nerve cells to return to their normal condition.
Neuron Following Concussion

Metabolic dysfunction results in ENERGY CRISIS

Massive release of neurotransmitters interferes with cell communications

After several days
Neuron Following Concussion

After many days
Normal Neuron

After many days
The period between the concussion and recovery is often referred to as a “window of vulnerability”, as return-to-play during this time could cause more severe or even catastrophic brain injury.

It is unsafe to return to competition until brain activity has returned to normal.
Even athletes who said they had ‘recovered’ within minutes of a concussion still showed abnormalities on cognitive tests 36 hours later

No youth athlete “recovers” on the same day of injury
Legislation has passed in 9 states mandating 3 principles

1. Mandatory concussion education
2. Athlete must be removed when a concussion is suspected – no RTP same day
3. Athlete must see a medical professional and receive clearance to return to practice
Long-term Consequences

1. Chronic Traumatic Encephalopathy (CTE)
2. Chronic Traumatic Encephalomyelopathy (CTEM)
The History of CTE

- First described in boxers by Martland in 1928
  - *Martland HS: Punch drunk. JAMA 91:1103–1107, 1928*

- As of 2007, there were only **45 cases of CTE** in the medical literature! Yet all had histories of repetitive brain trauma*

<table>
<thead>
<tr>
<th>Primary Trauma Source</th>
<th>45</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boxing</td>
<td>39</td>
</tr>
<tr>
<td>Soccer</td>
<td>1</td>
</tr>
<tr>
<td>Battered spouse</td>
<td>1</td>
</tr>
<tr>
<td>Head banging behavior</td>
<td>2</td>
</tr>
<tr>
<td>Circus clown</td>
<td>1</td>
</tr>
<tr>
<td>Epilepsy</td>
<td>1</td>
</tr>
</tbody>
</table>

Harrison S. Martland
(1883-1954)
- First full time paid pathologist
- Newark city Hospital, 1909-1927
- Chief Medical examiner Essex county

* Source: McKeet A et al. 2009
Circus Case

DEMENTIA PUGILISTICA IN AN ALCOHOLIC ACHONDROPLASTIC DWARF

Pathology (1996), 28, pp. 102-104

David J. Williams* and Anthony E. G. Tannenberg†

John Tonge Centre, Forensic Pathology and Biology, Brisbane*, and Department of Neuropathology, Mater Hospital, Brisbane†, Qld

- 33 years old when he died
- CTE did not appear to be caused by falls during alcoholic episodes
- “Knocked out” at least 12 times in the circus
The Research

In 2009, the NFL was still unconvinced

In Early 2009...

- NFL still denying that CTE exists in football players
- Claims
  - Not caused by trauma
  - Different disease than CTE in boxers
  - Could be caused by drugs
  - Could be another disease
  - No ‘proof’
- Anyone can get Alzheimer’s Disease
John Grimsley

- 1st NFL case studied at BU – 5th overall. Died Feb 2008 of self-inflicted gunshot wound

- Houston Oilers 1984-1990
- Miami Dolphins 1991-1993
- Linebacker; Named to Pro-Bowl, 1988
- No history of performance-enhancing drugs
- No significant history
- Concussion history:
  - 3 concussions during college football at Kentucky
  - At least 8 concussions during NFL career
  - Only one "cerebral concussion" medically confirmed
- Died of gunshot wound to chest, apparently while cleaning gun. Police report: no evidence of suicide, believed to be a “very tragic accident.”

Celebrating the Life of
John Grimsley


"I have fought the good fight, I have finished the race, I have kept the faith."   
2 Timothy 4:7
John Grimsley Findings

- John Grimsley had remarkable brain damage for a 45 year-old man

- For the 5 years prior to his death at age 45, he reportedly was experiencing **worsening memory and cognitive functioning**, as well as increasing “short fuse.”

- Although **increasing use of alcohol**, no evidence of depression, sadness, hopelessness. No alcohol in blood at time of death.

- 65 yr old healthy control
- Grimsley 45 yr old CTE
- 73 yr old boxer with dementia and CTE
Tom McHale

- 6th NFL Case of CTE. Died of a drug overdose
- Defensive lineman at Cornell and Maryland
- Offensive lineman in college
- Tampa Bay Buc 1987-1992
- Philadelphia Eagles 1993-1994
- Miami Dolphins 1995
- No recorded concussion history, although teammates have come forward with at least one story of Tom being unable to remember plays on the field

Tau immunostaining

TM  65 y.o control  TM
Tom McHale

- 6th NFL Case of CTE

- Tom opened and operated multiple successful restaurants after retiring
- Began experiencing problems with drugs, beginning with painkillers from a back problem. In and out of rehab in the last years of his life
Chronic Traumatic Encephalopathy  Alzheimer’s Disease
CTE is entirely distinct from Alzheimer's disease

- Normal: no Aβ, no tau
- CTE: tau, no Aβ
- Alzheimer's disease: tau and Aβ
Football player: 9 years in NFL
death at age 45 years: depression, poor decision making, substance abuse

Orbital frontal  Hippocampus  Temporal  Amygdala

Aβ: rare diffuse plaques
What We Learned

CTE: Unique, predictable pattern of tau neurofibrillary change very distinct from Alzheimer’s disease or any other tauopathy
First symptoms of CTE include:
- Memory impairment
- Cognitive impairment
- Loss of impulse control
- Depression
- Personality change

CTE progresses to dementia if the athlete lives long enough

Average onset of symptoms: 43 years old
Mr. Lou Creekmur – Hall of Famer

- Hall of Fame lineman for Detroit Lions
- **Played in era before anabolic steroids**
- Famously suffered 13 broken noses
- Wife Caroline claims Mr. Creekmur began acting “punchy” in his early 50’s
- Mr. Creekmur died in 2009 from complications of dementia
Reggie Fleming
April 21, 1936 - July 11, 2009

NHL player for the Montreal Canadiens, Chicago Blackhawks, Boston Bruins, New York Rangers, Philadelphia Flyers and Buffalo Sabres.

Professional career spanned over 20 years. He was known as an aggressive and popular player with Chicago, he was known for his grit and team spirit.
Mr. Reggie Fleming

- Died at 73 with dementia
- 20 concussions during his life
- Diagnosed with “manic depression” in his early 40’s
- Extreme behavioral outbursts
- Began drinking excessively following retirement
- “GREAT GUY” according to everyone
Mr. Mike Borich – Former BYU Coach Dead at 42

• “I feel like I need to be medicated all the time.”
  - Mike Borich, according to mentor Gary Crowton

• Wide receiver at Snow College and Western Illinois
• Div I Off Coordinator of the Year in 2002, out of football 2 years later
• Died of a drug overdose with strangers
Earliest Evidence of CTE – 18 Year-Old Boy
Owen Thomas

• Co-Captain of 2010 Penn Football Team
• Began playing football at 9 years old

• **Committed suicide April 26, 2010, at the age of 21**

• No history of concussion
• No history of mental illness
• Mentioned doing poorly in two classes to his parents the day before hanging himself in his off-campus apartment
Mr. Wally Hilgenberg

- Former linebacker with Lions and Vikings
- Died in 2008 at 66 of ALS
- Multiple diagnosed concussions

3rd BU CSTE case of CTE in a former NFL player
TDP-43 Proteinopathy and Motor Neuron Disease in Chronic Traumatic Encephalopathy

Ann C. McKee, MD, Brandon E. Gavett, PhD, Robert A. Stern, PhD, Christopher J. Nowinski, AB, Robert C. Cantu, MD, Neil W. Kowall, MD, Daniel P. Perl, MD, E. Tessa Hedley-Whyte, MD, Bruce Price, MD, Chris Sullivan, Peter Morin, MD, PhD, Hyo-Soon Lee, MD, Caroline A. Kibilus, Daniel H. Daneshvar, MA, Megan Wulff, MPH, and Andrew E. Budson, MD
Tau, TDP-43 Relationship

- 100% of CTE cases have extensive tau
- 85% of CTE have extensive TDP-43 in brain
- 3 cases that had clinical ALS had extensive tau and TDP-43 in spinal cord, brain stem
  - Not co-localized

**Table 3. TDP-43 Immunoreactivity**

<table>
<thead>
<tr>
<th>Case</th>
<th>MND</th>
<th>Spinal Cord</th>
<th>Medulla</th>
<th>Midbrain</th>
</tr>
</thead>
<tbody>
<tr>
<td>1*</td>
<td>Yes</td>
<td>+++</td>
<td>++</td>
<td>+++</td>
</tr>
<tr>
<td>2*</td>
<td>Yes</td>
<td>+++</td>
<td>++</td>
<td>+++</td>
</tr>
<tr>
<td>3*</td>
<td>Yes</td>
<td>++</td>
<td>+</td>
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<td>12‡</td>
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<td>NA</td>
<td>NA</td>
<td>0</td>
</tr>
</tbody>
</table>
Congressional Hearings – Wed. October 28, 2009

• House Judiciary Committee calls hearings with the full committee. NFL Commissioner, NFLPA Executive Director, 8 doctors testify
Sept. 2009 – NFL Sponsored Study Finds Risk

- Former NFL players risk of “dementia, Alzheimer’s disease, or other memory-related disease”
  - Age 30-49: 19x normal population
  - Age 50+: 5x normal population
December 21, 2009

N.F.L. Acknowledges Long-Term Concussion Effects

By ALAN SCHWARZ

After weeks of transforming its approach to concussions and its research into their long-term effects among players, the N.F.L. not only announced Sunday that it would support research by its most vocal critics but also conceded publicly for the first time that concussions can have lasting consequences.

“It’s quite obvious from the medical research that’s been done that concussions can lead to long-term problems,” the league spokesman Greg Aiello said in a telephone interview. He was discussing how the league could donate $1 million or more to the Center for the Study of Traumatic Encephalopathy at Boston University, whose discoveries of brain damage commonly associated with boxers in the brains of deceased football players were regularly discredited by the N.F.L.
Finally, a Change

2009-2010 – Alan Schwarz of the New York Times continues his award winning coverage

Ouster of N.F.L.’s Voice on Concussions Sought
N.F.L. Head Injury Study Leaders Quit
N.F.L. Suspends Its Study on Concussions
N.F.L. Asserts Greater Risks of Head Injury
Concussion Committee Breaks With Predecessor
How Do We Truly Change Outcomes?

- What is the goal?
- How do we get there?
- Who is responsible for us getting there?
A strategy to improve neurological outcomes for athletes must address both concussions and overall brain trauma.

**Concussions**
- Reporting
- Diagnosis
- Management

**Overall Brain Trauma**
- Reduce overall trauma to the brain through:
  - Rule changes
  - Practice style changes
The Path to Safer Sports

At the NFL Judiciary Committee hearings on concussions in sports in October 2009, SLI introduced a “10 Point Plan to Save Football”, a model which can be adapted to fit any sport

**SLI’s 10 Point Plan for Safer Sports**

1. Reevaluate how the game is **practiced**
2. Encourage mandatory brain trauma and concussion **education** for coaches, athletic trainers, parents, and athletes
3. Reevaluate **protective equipment**
4. Develop better methods of concussion detection and **diagnosis**
5. Develop better methods of concussion **management**
6. Consider minimum **medical resources**
7. Reevaluate **techniques** of play
8. Reevaluate the **rules**
9. Reevaluate **rule enforcement** and the role of **referees**
10. Reconsider the **culture** of the game
Changes that Have Been Made

1. Wedge is banned
2. Helmet-to-helmet contact
   • Spearing/unnecessary roughness
   • Defenseless receiver
   • Crack-back blocks
3. Referee intervention
4. Legislation in 9 states
   • Education
   • Return-to-play
7 Steps for Brain Safety
Minimum Recommended Guidelines for Youth Sports

Robert Cantu, MD
SLI Co-Founder and Medical Advisory Board Chair
Co-Director, CSTE at BUSM
Senior Advisor NFL Head Neck and Spine Committee
NFLPA Mackey/White TBI Research Committee
Board of Directors Brain Injury Association of MA
Clinical Professor of Neurosurgery, Boston U. School of Medicine

Christopher Nowinski
SLI Co-Founder, President, and CEO
Co-Director, CSTE at BUSM
NFLPA Mackey/White TBI Research Committee
Board of Directors, Brain Injury Association of America
As a natural evolution of the 10 Point Plan, in September 2010, SLI announced the release of *7 Steps to Brain Safety*, a list of **practical**, **simple**, and **free** solutions to minimize brain trauma.

### SLI’s Minimum Recommended Guidelines

1. Preseason Education for Coaches
2. Preseason Education for Athletes
3. Preseason Education for Parents
4. Coaches Use CDC’s Heads Up Clipboard Sticker
5. Adopt CDC’s Concussion Action Plan for Removal and Return-to-Play
6. Prevention through Neck Strengthening
7. Prevention through Overall Brain Trauma Reduction
A program should require preseason concussion and brain trauma education for coaches, athletes, and parents. Coaches should be required to pass the CDC’s certification program.

**Recommended Program**
- CDC’s “Heads Up” Online Training Course

**Other Recommended Programs:**
1. NFHS Online Training Course
2. USA Football for Youth Coaches Video
3. ACTive – Athletic Concussion Training for Coaches
4. Brain Injury Association of MA – Play Smart

**Additional Resources:**
- CDC Heads Up Program including:
  - Fact sheets
  - Posters
  - Action plans
  - Print out or order for free
Teach Athletes to Report Each Other’s Concussions

- Coaches should have this conversation with their team each season!

- Dr. Edward Nichols,
  - Harvard Football Team Doctor

  “In case any man in any game got hurt by a hit on the head so that he did not realize what he was doing, his teammate should at once insist that time be called and that a doctor come onto the field to see what is the trouble.”
• Why should you report when a teammate has a concussion?
  • A teammate with concussion symptoms may not remember plays, has slower reaction time, and could hurt your team’s chances of winning
  • A concussed teammate is a liability on the field!!
A program should require preseason concussion and brain trauma education for coaches, athletes, and parents.

**Recommended Program**

- Distribute CDC Fact Sheet for Athletes to facilitate discussion of concussive symptoms and why athletes should report them.
  - CDC Fact Sheet for [High School Athletes](#)
  - CDC Fact Sheet for [Youth Athletes](#)
  - Print out or [order for free](#)

**Additional Recommended Resources:**

1. [HeadStrongPlayer.org](#)
2. [CDC – Brandon’s Story](#)
3. [Brain Injury Association of MA – Play Smart](#)
4. [CDC Heads Up](#) Program including:
   - Magnet
   - Quiz
A program should require preseason concussion and brain trauma education for coaches, athletes, and parents.

**Recommended Program**

- Distribute CDC Fact Sheet for Parents:
  - Of High School Athletes
  - Of Youth Athletes

**Other Recommended Resources:**

1. [Brain Injury Association of MA](https://www.brainma.org) – Play Smart
2. [NFHS Online Training Course](https://www.nfhs.com)
3. [CDC Heads Up](https://www.cdc.gov) Program including:
   - Magnet
   - Quiz
Table 2. Parents’ Perceptions of Handling Concussions and Return to Sports

<table>
<thead>
<tr>
<th>Statement</th>
<th>Agree/Strongly agree</th>
<th>Disagree/Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>If my child got a concussion the coaches/trainers would handle the situation appropriately</td>
<td>85%</td>
<td>15%</td>
</tr>
<tr>
<td>I know of parents who would have their child return to sports too soon after a concussion</td>
<td>62%</td>
<td>38%</td>
</tr>
<tr>
<td>I know of coaches who would have a player return to sports too soon after a concussion</td>
<td>50%</td>
<td>50%</td>
</tr>
</tbody>
</table>

Source: C.S. Mott Children’s Hospital National Poll on Children’s Health, 2013
Report Highlights

Among parents whose children 12 to 17 years old play school sports:

- Only 8% have read or heard a lot about the risks of repeat concussions in school sports.
- More than 50% do not know if their children’s school has a policy about returning to sports after a concussion.
Coaches should be required to have the CDC *Heads Up* Stickers on their clipboards for easier access both to a list of common concussive signs and symptoms, as well as to an action plan if an athlete potentially experiences a concussion.

**Recommended Program**
- Use CDC *Heads Up* Clipboard Stickers
  - For [High School Coaches](#)
  - For [Youth Coaches](#)
  - Print out or [order for free](#)

**Other Recommended Resources**
- [CDC *Heads Up*](#) Program including:
  - Magnet
  - Poster
# 5 CDC Concussion Action Plan

Programs should adopt the CDC Heads Up Concussion Action Plan.

**ACTION PLAN**

*If you suspect that a player has a concussion, you should take the following steps:*

1. Remove athlete from play.
2. Ensure athlete is evaluated by an appropriate health care professional. Do not try to judge the seriousness of the injury yourself.
3. Inform athlete’s parents or guardians about the known or possible concussion and give them the fact sheet on concussion.
4. Allow athlete to return to play only with permission from an appropriate health care professional.

*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/ConcussionInYouthSports](http://www.cdc.gov/ConcussionInYouthSports)
# 6 Prevention Through Neck Strengthening

Studies* have revealed that neck strength may be an important factor in reducing the forces on the brain resulting from impacts to the head.

**Group**
Coaches

**Recommended Program**
There is no officially recommended training program for neck strengthening. Please work with a local certified strength and conditioning coach to develop a plan for your team.

**Recommended Reading**
- Article 1
- Article 2
- Article 3

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Neck Strengthening

- Learn from the animals
- “Effective mass”
Coaches should monitor total brain trauma and strive to **reduce** both the **number of hits** to the head that players receive, as well as the **severity**. Research on Chronic Traumatic Encephalopathy from Boston University’s Center for the Study of Traumatic Encephalopathy indicates that risk of CTE may be more correlated to total lifetime brain trauma than concussions.

**Recommend Program**

In 2010, there is no formal program available. SLI asks that coaches attempt to monitor brain trauma, and significantly reduce it going forward. SLI hopes to develop guidelines for brain trauma, starting with football, much like Little League Baseball has developed extensive guidelines for “**Pitch Counts**” to protect the elbows of children.

**Background Reading**

- Article 1
- Article 2
- Article 3
Head Impact Data

Measurement of Head Impacts in Collegiate Football Players: An Investigation of Positional and Event-Type Differences

Mihalik et al. Neurosurgery Volume 61 | Number 6 | December 2007

Key Takeaway
• We can reduce total brain trauma by >50% tomorrow if we restricted hitting in practice
Head Impact Data

Measurement of Head Impacts in Collegiate Football Players: An Investigation of Positional and Event-type Differences

Mihalik et al. Neurosurgery Volume 61 | Number 6 | December 2007

Key Takeaway

- “Helmets only” doesn’t reduce brain trauma
According to a study of three Division I college teams that will be published this month in the *Journal of Athletic Training*, and was sponsored by the *National Institutes of Health*, college players sustain more total hits to the head in practices than in games. During a full season of practice, each team averaged:

- 2,500 total hits to the head that measured as significant blows (50 to 79 g’s of force)
- 300 hits to the head that were considered in the concussion-causing range (80 to 119 g’s)
- *Each team experienced almost 200 practice collisions that measured above 120 g’s, which experts have likened to crashing a car into a concrete wall at 40 miles an hour*
But That’s NFL Data…

Head Impacts During High School Football: A Biomechanical Assessment

<table>
<thead>
<tr>
<th>Level</th>
<th>Mean Linear Acc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>HS</td>
<td>~ 24 g</td>
</tr>
<tr>
<td>College</td>
<td>~ 22 g</td>
</tr>
</tbody>
</table>

Steven P. Broglio, PhD

What About the Kids?

11 reported concussions among 375,000 Pop Warner players

Which do we believe is true?

A. F=MA, and they are too small to generate enough force to create concussions

B. Concussions aren’t being reported because:
   1. There are no medical professionals present
   2. There is no formal injury reporting system or administration
   3. Coaches are not trained to identify concussions
   4. Small changes in gait, ability to remember plays aren’t noticed in younger athletes
   5. The children are too young to verbalize symptoms
Reevaluate How the Game is Practiced

Goal: Learn which parts of practice are most dangerous to the game and eliminate or restrict them. **We need to know:**

- What drills cause the most brain trauma and for whom
- Variability among players and why
No Science Behind It, No Major Risk, and Yet....

### REGULATION VI - PITCHERS:

(a) Any player on a regular season team may pitch. (NOTE: There is no limit to the number of pitchers a team may use in a game.)

(b) Junior, Senior, and Big League Divisions only: A pitcher remaining in the game, but moving to a different position, can return as a pitcher anytime in the remainder of the game, but only once per game.

(c) The manager must remove the pitcher when said pitcher reaches the limit for his/her age group as noted below, but the pitcher may remain in the game at another position:

<table>
<thead>
<tr>
<th>League Age</th>
<th>17-18</th>
<th>13-16</th>
<th>11-12</th>
<th>10 and under</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>105 pitches per day</td>
<td>95 pitches per day</td>
<td>85 pitches per day</td>
<td>75 pitches per day</td>
</tr>
</tbody>
</table>

Exception: If a pitcher reaches the limit imposed in Regulation VI (c) for his/her league age while facing a batter, the pitcher may continue to pitch until that batter reaches base or is put out. Note 1. Intentional Walk: Before a pitch is delivered to the batter, the catcher must inform the umpire-in-chief that the defensive team wishes to give the batter an intentional base-on-balls. The umpire-in-chief waves the batter to first base. The ball is dead.

(d) Pitchers league age 16 and under must adhere to the following rest requirements:

- If a player pitches 61 or more pitches in a day, three (3) calendar days of rest must be observed.
- If a player pitches 41 - 60 pitches in a day, two (2) calendar days of rest must be observed.
- If a player pitches 21 - 40 pitches in a day, one (1) calendar days of rest must be observed.
- If a player pitches 1-20 pitches in a day, no (0) calendar day of rest must be observed.
A Final Word

• As you are thinking about how much to focus on concussions and brain trauma going forward....

• Sports are vital, fun, and help develop character, discipline, and teamwork
  • However, there are certain risks for children that are unacceptable

• Think about how we as a society have reacted to the link between smoking and lung cancer
  • Smoking is linked to developing lung cancer decades later
  • Yet only 20% of smokers die from lung cancer
  • We have banned cigarettes for anyone under 18 and even youth friendly advertising...
A Final Word

• Despite evidence linking brain trauma as a child to Chronic Traumatic Encephalopathy, systematic, voluntary trauma is delivered to children’s brains starting as young as five years old
  • Children are not old enough to voluntarily accept that risk

• Prior to 2010, there was zero required concussion education
  • We have pitch counts for baseball players’ elbows, yet NOTHING for football players brains

• Where will brain trauma fit within your priorities next year?
Funding Sources

• Boston University School of Medicine
• National Institutes of Health (NIH)
• National Football League
• National Operating Committee on Standards in Athletic Equipment (NOCSAE)
• Department of Veteran’s Affairs
• Sports Legacy Institute
Thank You

www.sportslegacy.org

BU School of Medicine

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