Head Games: The Sports Concussion Crisis

www.sportslegacy.org

Christopher Nowinski
SLI Co-Founder & President
Co-Director, CSTE at BUSM

Center for the Study of Traumatic Encephalopathy

NCSI
May 2009
When Wrestling Goes Wrong
One Athlete’s Experience

• I was forced to retire from the WWE from concussions received in football and wrestling

• 2 undiagnosed concussions

• 4 undiagnosed concussions, leading to:
  – Headaches
  – Memory impairment
  – Depression
  – Sleep activity

• Retired in 2003 at age 24
  – Symptoms persist to this day
My Concussors
An Education Comes Too Late

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

After my symptoms persist and 8 doctors can’t help me, I visit Dr. Robert Cantu. Shockingly, he is the first to tell me that:

- Concussions are cumulative and can have long-term effects
- “Resting concussions” helps them heal

I wrote Head Games to warn others because studies show athletes are not informed of the risks. If the damage is partially preventable, how can we not tell athletes how to protect themselves?
Agenda

- As worker’s compensation professionals and self-insurers, how does information about the long-term effects of brain trauma affect you?

We will cover:

- What does brain damage from trauma look like
  - Focus on: Chronic Traumatic Encephalopathy

- Trauma in the workplace

- How CTE may affect workers
  - Repetitive trauma in the workplace
  - Worker with trauma histories
First Cases of CTE in Former NFL Players

Mike Webster

Died at 50

Terry Long

Suicide at age 45

• Symptoms - symptoms of CTE are insidious, first manifest by deteriorations in attention, concentration, and memory, as well as disorientation and confusion, and occasionally accompanied by dizziness and headaches. With progressive deterioration, additional symptoms, such as lack of insight, poor judgment, and overt dementia, become manifest. Severe cases are accompanied by a progressive slowing of muscular movements, a staggered, propulsive gait, masked facies, impeded speech, tremors, vertigo, and deafness

• Pathology - next section
Andre Waters and CTE

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

• Waters 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.”
What is a Concussion?

• Concussion is a complex pathophysiological process affecting the brain.
  • Most concussions do not immediately cause physical damage to the brain. Instead, they cause chemical and metabolic fluctuations in the brain.

• It is induced by biomechanical forces.
  • Concussion may be caused by a direct blow to the head; or a blow elsewhere on the body with impulsive forces transmitted to the head.
Andre Waters Images and History of CTE

• CTE was first identified in 1928.

• The medical examiner wrote it was characteristic of boxers “who take considerable head punishment seeking only to land a knockout blow” and also “common in second rate fighters used for training purposes.”

• It was not known whether concussions or the thousands of subconcussive blows each athlete received was more responsible for creating the brain damage found

* Cantu, R
Prominent Former Athletes are Stepping Forward
With Similar Symptoms

The Ted Johnson Story

• Ted Johnson played linebacker for the New England Patriots from 1995-2004
• Retired as 3-time Super Bowl champion due to "post-concussion syndrome"
• As of May 2008, suffering from depression, memory impairment, other symptoms
• Has been unable to return to the workforce
Sports Legacy Institute

“(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, ESPN

- Incorporated June 14th, 2007

- The Institute will initially focus its efforts on the study of degenerative brain conditions including Chronic Traumatic Encephalopathy, or CTE, a condition caused by repetitive concussive and sub-concussive brain injuries.
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
James Beck, MD, PhD, Prof. of
Psychiatry, Harvard Medical School
Ann McKee, MD, Assoc. Prof. of
Neurology and Pathology, BU
Medical School
David Hovda, PhD. Director of UCLA
Brain Injury Research Center

**Athlete Advisory Board**
Ted Johnson, NFL
Pat LaFontaine, NHL
Isaiah Kacyvenski, NFL
Cindy Parlow, Soccer
Brent Boyd, NFL
Ben Lynch, NFL
Malcolm Huckaby, NBA
Booker T, Pro wrestler
Rob Van Dam, Pro wrestler
Noah Welch, NHL

**Board of Directors**
Christopher Nowinski
Eleanor Perfetto, Senior Director, Pfizer
John Corcoran, Founder and Managing Partner, Trinity Partners
Isaiah Kacyvenski, NFL veteran
Scott McCabe, Merrill Lynch

**Honorary Trustees**
Vin Ferrara, Founder CEO, Xenith Inc.
Matt Henshon, Esq. Henshon, Parker LLP
Tina Cantu, RN, MBA, JD Neurosurgical Surgery, Inc.

*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

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.
...and Inspired Real Change
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 medical 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

"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 at 45 years old

• 73 year old boxer with dementia
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.

**Pathology** - Neurofibrillary Tangles, astrocytic tangles, and dot-like and spindle-shaped NNs are common in the dorsolateral frontal, subcallosal, insular, temporal, dorsolateral parietal, and inferior occipital cortices. The tau-immunoreactive neurofibrillary pathology is characteristically irregular in distribution with multifocal patches of dense NFTs in the superficial cortical layers, often in a perivascular arrangement.
The CSTE Brain Bank Registry

• Living athletes are lining up to be part of this groundbreaking research

**National Football League (34)**
- Ted Johnson
- Joe DeLamielleure
- Isaiah Kacyvenski
- Ben Lynch
- Bernie Parrish
- Ralph Wenzel
- Frank Wycheck
- Bruce Laird
- Brent Boyd
- Mel Owens
- Dan Pastorini
- Billy Ray Smith
- Ken Gray
- Harry Jacobs (more)

**National Hockey League (5)**
- Keith Primeau
- Noah Welch
- Steve Heinze
- Ryan Vandenbussche

**Pro Wrestling (15)**
- Rob Van Dam
- Lance Storm
- Chris Nowinski
- Spike Dudley
- Molly Holly
- April Hunter
- Al Snow

**Level** | **Donors**
--- | ---
Pro | 73
Amateur | 45

**Boxing**
- Termite Watkins

**Soccer**
- Cindy Parlow

**Swimming**
- Jenny Thompson

• As of May 2009
Wrestler Kills Wife and Child, Then Self
June 23rd-25th, 2007

• Between June 23rd and June 25th, World Wrestling Entertainment performer and 23-year pro wrestling veteran Chris Benoit killed his wife Nancy and 7 year-old son before hanging himself.

• The media and even the US Congress focused on the fact that Benoit had steroids in his system.

• Had told numerous people, including SLI president Chris Nowinski, that he’d experienced ‘more concussions than he could count’ and had exhibited depression, memory impairment, and erratic behavior, including paranoia, in the years preceding the events.
Earliest Evidence of CTE - 18 Year-Old Boy
As worker’s compensation professionals and self-insurers, how does information about the long-term effects of brain trauma affect you?

We will cover:

- What does brain damage from trauma look like
  - Focus on: Chronic Traumatic Encephalopathy

- Trauma in the workplace

- How CTE may affect workers
  - Repetitive trauma in the workplace
  - Worker with trauma histories
Brain Trauma in the Workplace

- When the NFL stories started breaking, our doctors were deluged with phone calls not primarily from athletes but from
  - Policemen
  - Firefighters
  - Manual laborers
Brain Trauma in the Workplace

• **Case #1** - I was advised to contact you and tell you about our problem. On August 22, 2006, when at work, my daughter was struck on the head by the handle of a steel handcart/dolly. The blow sent her to her knees and stunned her. Her head hurt, but, as she put it 'we all get hit on the head. I tried to walk it off.'… Please, I fear for her life.

• **Case #2** - My boyfriend is a welder. He was at work at was struck in the head by an 85lb steel frame that brought him to the ground. This was in 2001. His employer refuses to acknowledge that the problems he has today is a result of his injury at work. Workmans comp says “prove it first then well take a look at it.” The problem is if you are unemployed and no health insurance its kind of hard to find a neurologist to do the neuropsychological testings that is needed with out any money. The state wont help him with medical because they state even though there is only 1 household income that it exceeds poverty standards they cant help him unless he goes to live in a shelter then reapply he would then qualify for medical…
Brain Trauma in the Workplace cont.

• **Case #3** - A pair of bolt cutters (15-20 pounds) fell maybe 2 feet off the wall a slammed into the front left part of my head I was stupid for a short period off time before I was able to walk. My first concussion was 3 weeks prior…I am still suffering from balance impairment, stabbing headaches, blurred vision, the inability to run or do any exercising, and a tic that impairs my speech. PLEASE HELP ME!!

• **Case #4** - (Police officer) On Jan. 19, 2002, I had just made a stop on a vehicle and was writing a ticket outside of the patrol car. I got a call from an Anaheim Gang Officer and was reaching into my patrol car on the front passengers side (the door was open) to hang up my cell phone. As my torso and head were in the car and my legs were out, I heard my partner yell "Watch Out!". The next thing I remember is six months later and I was in the office of a neurologist..From what I was told, a drunk driver had rear my backup units patrol car and shoved it into mine at approximately 50 mph.
Agenda

• As worker’s compensation professionals and self-insurers, how does information about the long-term effects of brain trauma affect you?

We will cover:

• What does brain damage from trauma look like
  – Focus on: Chronic Traumatic Encephalopathy

• Trauma in the workplace

• How CTE may affect workers
  – Repetitive trauma in the workplace
  – Workers with trauma histories
Depression and Memory Impairment in NFL Retirees

- A survey of 2,552 former NFL players with >3 years NFL experience found that those who remembered having more concussions had a significantly higher incidence of being diagnosed with depression.
- Similar data exists for self-diagnosed memory impairment.

* Center for the Study of Retired Athletes
Age-Adjusted Death Rates from Lung Cancer by Smoking Level, CPS-I

Rate/100,000 person-years

Source: Lilienfeld (p.207)

Source: Patrick Remington, MD, MPH: Prevention and the Continuum of Disease Causation
Analog - Smoking and Lung Cancer

It took 50 years for meaningful change after discovering that smoking causes lung cancer.

### Smoking and Lung Cancer Timeline

- **1950** - first small study finds smokers twice as likely to die from lung cancer
- **1953** - Big Tobacco forms Tobacco Institute Research Committee ("TIRC")
- **1965** - Surgeon General warning added to packaging
- **1984** - American Association for Cancer Research accepts the evidence gathered by cancer scientists
- **1994**: Seven Dwarves testify before Congress
- **1997**: US tobacco firms agree a multi-billion-dollar settlement to cover healthcare costs incurred by treating people with smoking-related illnesses

### Concussions and CTE Timeline

- **1953** - Benoit tragedy
- **1957** - Andre Waters suicide linked to brain damage from concussions
- **2007** - SLI/Boston University Center for the Study of Traumatic Encephalopathy - Brain Bank established
- **2007** - Al Toon of NY Jets retires from post-concussion syndrome
- **1992** - NFL founds Committee on Mild Traumatic Brain Injury
- **1994**: SLI/Boston University Center for the Study of Traumatic Encephalopathy - Brain Bank established
- **2007**: Benoit tragedy
- **2008**: SLI/Boston University Center for the Study of Traumatic Encephalopathy - Brain Bank established
Incidence of Concussion in Football - Trainer Data

- 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

- 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.

- Concussion is the most common head injury in football!
You Can’t See a Concussion

THAT’S GOTTA HURT...
Pittsburgh Steelers running back Destry Wight lies injured on the field Sunday night after he dislocated his right ankle and broke his right leg.
Incidence of Concussion in Football

**Data Source Comparison**

- Due to a lack of awareness of the symptoms and consequences of concussions, youth athletes aren’t reporting concussions to adults
  - Fewer than 10% of concussions are being reported to athletic trainers
  - Less than half of high schools can even afford part-time athletic trainers

<table>
<thead>
<tr>
<th>Data Source in published study:</th>
<th>Trainer:</th>
<th>Athlete:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent of players reporting concussions:</td>
<td>3.6 %</td>
<td>47.2 %</td>
</tr>
<tr>
<td></td>
<td>5.6 %</td>
<td>70.2 %</td>
</tr>
<tr>
<td></td>
<td>6.3 %</td>
<td>47.8 %</td>
</tr>
<tr>
<td></td>
<td>3.8 %</td>
<td>19.0 %</td>
</tr>
<tr>
<td></td>
<td>4.1 %</td>
<td>61.2 %</td>
</tr>
<tr>
<td></td>
<td>2.4 %</td>
<td>15.3 %</td>
</tr>
<tr>
<td></td>
<td>5.6 %</td>
<td>65.2 %</td>
</tr>
</tbody>
</table>
Contact Sports Participation - High School Boys

1 in 8 boys plays tackle football

Percent of Male Students

- Football
- Hockey
- Lacrosse
- Soccer
- Basketball
- Non-contact
- None

* Center for the Study of Retired Athletes
The Past
Conclusions

• As worker’s compensation professionals and self-insurers, how does information about the long-term effects of brain trauma affect you?

Key Take-Aways:

• Repetitive head injuries in the workplace can trigger CTE

• Some unknown share of employees already have CTE, meaning a head injury in the workplace could be more likely to cause extended symptoms/PCS

• Return to work protocols after head injury are key
Post-concussion syndrome

- Every athlete has post-concussion symptoms – post-concussion syndrome (PCS) is name given to the varied constellation of prolonged symptoms that around 5-10% of athletes seem to suffer.
  - An athlete usually isn’t considered as having PCS until his symptoms have persisted for over 4 weeks

- As of 2008, there is no way to predict which athletes will recover more quickly and which will suffer PCS.

- Athletes who suffer from PCS sometimes need to take time away from school, and often suffer from headaches, anxiety, depression, and fatigue.
A concussion is not an event – it is a process!

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.

* Giza and Hovda (2000)
Gender and Concussions

**The Facts**

- Females tend to suffer more reported concussions than males that play the same sport.
  - High school basketball – Females are diagnosed with 3x more concussions
  - High school soccer - Females are diagnosed with 68% more concussions
- Females tend to have longer recoveries than males in the same sport.

**The Theories**

- **Honesty** - females are more likely to report concussion symptoms than males.
- **Physiologic** - hormone differences between males and females may account for a differing concussion experience.
- **Biomechanical** - males tend to have stronger necks, which may absorb some of the force of a blow.
Special Considerations

Concussion History

• Athletes with a **history of concussion** tend to have prolonged symptoms and worse outcomes. Return-to-play with those athletes should be managed *even more* cautiously.

Recent Concussion

• Athletes who have had a **recent concussion** tend to have prolonged symptoms and worse outcomes. Return-to-play with those athletes should be managed *even more* cautiously.

Severity of Hit that Produces Concussion

• If a **minor impact** produces **severe or prolonged concussion symptoms**, it raises a red flag. Return-to-play with those athletes should be managed *even more* cautiously.
Athletes Aren’t Getting What they Need

• An urgent need exists for:
  - Research
  - Treatment
  - Prevention
  - Education

• Yet there are virtually no programs in place focused on filling those needs
Corporate Partner Program

- SLI’s corporate partners enable this groundbreaking and world-changing research, as well as provide SLI the means to educate young athletes and youth coaches on how to prevent brain damage in sports.

www.sportslegacy.org

The most trusted resource on concussions in sports

- SLI has 4 levels of corporate partnerships
  - $ 50K - Founding partner
  - $25K - Platinum partner
  - $10K - Gold partner
  - $5K - Silver partner
Founding and Platinum Partners Program

• Founding Partner: Annual contribution of $50,000 and above
  • Recognition as title sponsor at 3 fundraising events w/VIP status
    • Fall dinner (2008 keynote speaker Jesse Ventura)
    • Spring party
    • Summer outdoor event (golf, picnic)
  • Revolving logo on SLI website front page and partners page
  • Recognition and ad space in SLI e-newsletter
  • One complimentary “Concussion Clinic” presentation for employees, school, etc.

• $50,000 can:
  • Operate the brain bank for 6 months
  • Educate 1,250 coaches, protecting 25,000 kids
  • Put the concussion clinic program online for free for coaches

• Platinum Partner: Annual contribution of $25,000 and above
  • Recognition as at 2 fundraising events
  • Revolving logo on SLI website front page and partners page
  • Recognition and ad space in SLI e-newsletter
  • Discounted “Concussion Clinic” presentation for employees, school, etc.

• $25,000 can:
  • Operate the brain bank for 3 months
  • Educate 675 coaches, protecting 12,500 kids
  • Grow the brain donation registry by 500 names, making research move faster
Gold and Silver Partners Program

• Gold Partner: Annual contribution of $10,000 and above
  • Recognition as at 1 fundraising event
    • TBD
  • Logo on SLI website partners page
  • Recognition and ad space in SLI e-newsletter

• Silver Partner: Annual contribution of $5,000 and above
  • Logo on SLI website partners page
  • Recognition and ad space in SLI e-newsletter

• $10,000 can:
  • Add 2 more case studies to the brain bank
  • Educate 250 coaches, protecting 5,000 kids

• $5,000 can:
  • Add 1 more case studies to the brain bank
  • Educate 125 coaches, protecting 2,500 kids
Benefits of the Sports Legacy Institute

• Immediate:
  - **Prevent** CTE tragedies (suicides, murders) by educating and encouraging ex-athletes to seek treatment
  - Drive potentially millions of ‘silent sufferers’ to seek **treatment**
  - **Educate** - Prevent brain damage in active athletes and deaths of HS athletes from Second-Impact Syndrome

• Long-term:
  - Develop better **evaluation and treatment protocols** for this unique population suffering from Alzheimer’s-like symptoms caused by repetitive brain trauma
  - Develop new **pharmaceutical interventions** using the data generated by the brain bank - currently **no cure** or studies on concussion-caused brain damage and CTE
  - Improve our understanding of the relationship between repetitive concussions and long-term CTE
  - Determine relationship between repeated concussions and later psychiatric and cognitive impairments
    - **Prevent suffering**
    - **Save lives**

Thank You

Questions?
nowinski@post.harvard.edu

www.sportslegacy.org
www.chrisnowinski.com