The Sports Concussion Crisis

www.sportslegacy.org

Center for the Study of Traumatic Encephalopathy

Fairfield County PAL
January 2010

Christopher Nowinski
SLI Co-Founder, President, and CEO
Co-Director, CSTE at BUSM
NFLPA Concussion and TBI Committee
Board of Directors, Brain Injury Association of America
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How Much Control do We Have?
Where I was in 2003

- I had a big future (in wrestling)

- Named “2002 Newcomer of the Year” by RAW Magazine
- Youngest male Hardcore Champion in WWE History
- Things were going well....
When Wrestling Goes Wrong
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

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?

Shockingly, he is the first to tell me that:

- The definition of a concussion
- Concussions are cumulative and can have long-term effects
- “Resting concussions” helps them heal
Dr. Robert Cantu and I founded SLI in 2007 to solve the sports concussion crisis.

“(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

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

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Co-Director, Neurologic Sports Injury Center
Brigham and Women’s Hospital, Boston, MA

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Tina Cantu, RN, MBA, JD Neurosurgical Surgery, Inc.
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 CSTE Brain Bank Registry

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

- National Football League (61)
  - 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
  - Barry “J.B.” Brown
  - James Houston
  - Chad Levitt
  - David Long
  - Harry Jacobs

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

- Pro Wrestling (25)
  - Rob Van Dam
  - Lance Storm
  - Chris Nowinski
  - Tom Materas

- Boxing
  - Termite Watkins

- Soccer
  - Cindy Parlow

- Swimming
  - Jenny Thompson

- National Basketball Association
  - Paul Grant
  - Malcolm Huckaby

<table>
<thead>
<tr>
<th>Level</th>
<th>Donors</th>
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<tr>
<td>Pro</td>
<td>130</td>
</tr>
<tr>
<td>Amateur</td>
<td>120</td>
</tr>
<tr>
<td>Total</td>
<td>250</td>
</tr>
</tbody>
</table>

- As of May 2009
3 active NFL players promise their brains for concussion research: 'The culture has to change'

Sean Morey  
Arizona Cardinals

Lofa Tatupu  
Seattle Seahawks

Matt Birk  
Minnesota Vikings
Congressional Hearings - Wed. October 28, 2009

- House Judiciary Committee calls hearings with the full committee. NFL Commissioner, NFLPA Executive Director, 8 doctors testify
Finally, a Breakthrough!

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.
NFL Gives Up the Fight - November 25, 2009

- The NFL reversed policy on concussion due to SLI advocacy, BU research, and Congressional hearings

- Roger Goodell memo to NFL teams
  1. NFL Concussion Committee Co-Chairs resign
  2. John Madden leading coaches team to reevaluate practice
  3. Re-evaluating playing rules
  4. Announced mandatory concussion conference in June, 2009
  5. *Players can no longer return to same game when diagnosed with concussion
  6. *Players must see independent neurological experts after concussion
Coaches Concussion Clinic Educational Program

Our 3C educational program is designed to protect the brains of current athletes.

The SLI 3C program includes the following components:

1. 60 minute educational session with Q & A
2. CDC “Heads Up” Online Certification
3. Today only: Brainstorming session
Program Goals

- The goal of the 3C educational program is to provide coaches with the **information** and **inspiration** to provide the safest possible environment for their athletes.

By the end of this program, a coach will know:

1. What a concussion is
2. How to recognize a concussion and proper response
3. The coach’s responsibilities in determining return-to-play
4. How to coordinate concussion care with doctors and parents
5. Concussion prevention
6. Legal issues
7. The latest research on the long-term consequences of concussions and brain trauma
Coaches Concussion Clinic Sponsors

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Part 1 – The Catalysts

1. Andre Waters
2. Chris Benoit
Other Cases of CTE in Former NFL Players

Mike Webster

Died at 50

Terry Long

Suicide at age 45

- Prior to the cases investigated by Dr. Bennet Omalu and SLI, no one had examined athlete brain tissue this extensively

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

- CTE cases appear to consistently share 3 traits (called a triad)
  - Depression
  - Emotional instability (including paranoia)
  - Cognitive impairment, especially recent memory impairment
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)

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.”

The early symptoms he described were a “slight mental confusion, a general slowing in muscular movement, hesitancy in speech, and tremors of the hands.”

Late symptoms included, marked truncal ataxia, Parkinsonian syndrome, and marked mental deterioration may set in, “necessitating commitment to an asylum.”
Prominent Former Athletes are Stepping Forward With Similar Symptoms

• 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

The Ted Johnson Story

Plagued by post-concussion syndrome and battling an amphetamine addiction, former Patriots linebacker Ted Johnson is a shell of his former self

“I don’t want anyone to end up like me”
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.
Part 2 - Background

1. Concussion misconceptions
2. Concussion definition
3. Symptoms
4. Mechanism of injury
5. Physiology
What is a Concussion?

• Concussion is a complex pathophysiological process affecting 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.

• A concussion typically results in short-lived neurological impairment that resolves spontaneously.

• A concussion is an “invisible injury.”
  - There is often no evidence of injury to observers
  - Sometimes the athlete isn’t aware they have a concussion
  - Coaches can’t “see” a concussion like they can a broken bone
  - A concussion doesn’t always cause the athlete classic pain

• Imaging studies (CT, MRI) are normal.

* Cantu, R
Common Concussion Misconceptions

• One must be rendered unconscious to sustain a concussion.
  – Less than 10% of concussions cause loss of consciousness

• Concussions only occur in contact sports like boxing and football.
  • Concussion can occur in all sports and activities.

• Males experience more concussions than females competing in the same sport.
  • Females suffer more diagnosed concussions than males

• Older athletes are at more risk of concussion than children.
  • The developing brain is most vulnerable and needs longer to recover

* Cantu, R
# Signs and Symptoms of Concussion

## Signs Observed by Coaches
- Appears dazed or stunned
- Confusion
- Forgetful
- Inability to recall events before hit
- Inability to recall events after hit
- Moves clumsily
- Is unsure of game, score, or opponent
- Answers questions slowly
- Loses consciousness
- Behavioral changes
- Personality changes
- Loss of consciousness
- Irritability

## Symptoms Felt by Athletes
- Headache
- Bell-ringer or ding
- Dizziness - loss of balance
- Nausea/vomiting
- Double or blurred vision
- Light sensitivity
- Noise sensitivity
- Feeling ‘sluggish’
- Foggy/drowsy
- Concentration problems
- Memory problems
- Confusion
- Seeing stars
- Nervousness
- Sleep disturbance
- Sadness

* CDC
Player Reported Symptom Duration

- The duration of concussion symptoms is often short.

Prolonged signs and symptoms indicate a more severe concussion.

- 28% of athletes have symptoms that last longer than 24 hours.
- 22% have symptoms that last between 2 and 24 hours.
- 28% have symptoms that last between 5 minutes and 2 hours.
- 22% of athletes have symptoms that last < 5 minutes.

* Delaney JS et al. (2002)
Part 3 - Long-term Consequences

1. Chronic traumatic encephalopathy
2. Depression
3. Memory impairment
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"
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
Chronic Traumatic Encephalopathy

Alzheimer’s Disease
Chronic Traumatic Encephalopathy  Alzheimer’s
Concussion Humor has Gone Mainstream...

Teammates Pretty Sure Ben Roethlisberger Can No Longer Remember Their Names

January 8, 2009 | Onion Sports

PITTSBURGH—After Ben Roethlisberger repeatedly addressed his Pittsburgh teammates as "dude," "Mac," and "you there" for an entire practice session last Monday, the quarterback's fellow Steelers concluded that the oft-concussed Pro Bowler is unable to remember their names.

"I walked up to him in the locker room and said, 'Hey Ben,' and he responded, 'Hey...brother,'" said a teammate who spoke on the condition of continued anonymity. "He only used a first name once, and that was when he was talking to Troy Polamalu. And he kept calling him Randy." When asked if he would be ready for Sunday's game, Roethlisberger said that as the third-string goalie, there is only so much he could do.
Chronic Traumatic Encephalopathy

- Athletes began their sport at young ages
  11-20 years; mean 16 years

- Played for varying lengths of time
  14-23 years; mean 18.4 years

- First symptoms of CTE
  Age 25-76 years; mean 43.1 years
Chronic Traumatic Encephalopathy

- Interval between retirement and onset of symptoms:
  0-37 years, mean 8 years
  1/3 were symptomatic at time of retirement from sport
  1/2 were symptomatic within 4 years of stopping play

- Interval between onset of symptoms and death:
  2-46 years, mean 17.5 years

- Age at death:
  23-91 years, mean 54.8 years
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

“I read that story about dementia in former NFL players. Maybe we should reconsider this.”
Prominent Former Athletes are Stepping Forward With Similar Symptoms

Ted Johnson Story

• 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.
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
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
Part 4 – Epidemiology

1. Incidence of reported concussions
2. Incidence of unreported concussions
3. Reporting habits
4. Athletes at greatest risk
Preventing Negative Outcomes for Athletes

A strategy to improve neurological outcomes for athletes must address both concussions and overall brain trauma.

**PCS**

**Concussions**
- Reporting
- Diagnosis
- Management

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

**CTE**

**Risk Management**
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>
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<tbody>
<tr>
<td>Langburt et al (2001)</td>
<td>High School</td>
<td>47.2 %</td>
<td>3</td>
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<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>
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</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
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.
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.

A study found that even though quarterbacks suffer the least cumulative trauma (other than kickers), they suffer the most diagnosed concussions in football.
One study found that linebackers suffer the most cumulative trauma to their head per game (collisions x average force per collision).

This discrepancy illustrates that we still don’t know:
- What positions receive more concussions in any sport
- If the number of concussions is the most important contributor to risk of long-term neurological problems

* McNeely et al. (2005)
Head Impact Data

Head Impacts During High School Football: A Biomechanical Assessment

<table>
<thead>
<tr>
<th>Position</th>
<th>Impacts</th>
<th>Per Session</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lineman</td>
<td>736</td>
<td></td>
</tr>
<tr>
<td>Skill</td>
<td>431</td>
<td>16 hits</td>
</tr>
</tbody>
</table>

- 271 hits (1.4%) exceeded 70 g’s, one proposed concussion threshold

<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>

- HS athletes sustain greater more trauma to the brain than college athletes. Theories include:
  - Poor training on proper technique
  - Weaker body requires reliance on using head as battering ram
  - Weaker necks

Steven P. Broglio, PhD
Other Reasons Athletes Don’t Report Concussions

• **Decision Tree** - Experience shows that athletes are often able to play through a concussion if they choose to ignore their symptoms. Those who live by a “if you can walk you can play” mantra are less inclined to report symptoms.

• **Fear** - Athletes also list the following reasons for withholding information.
  – Fear of losing starting position or playing time
  – Fear of being perceived as “not tough”
  – Fear of punishment from - or being mocked by - their coaches

• **Injury Culture** - Coaches need to recognize how the injury culture they create will affect athlete reporting.
  – Coaches who have “must practice to play” should consider creating a separate and unique rule for concussions.
Part 5 – Response

1. Initial response
2. Grading concussions
3. Return-to-game guidelines
4. Return-to-play (RTP) guidelines
5. Emergency treatment
Normal Neuron Function

- Dendrites
- Nerve cell body
- Axon
- Synapse
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**

Massive release of neurotransmitters interferes with cell communications

Nerve cell is extremely **vulnerable** in this condition, and further injury or stress may cause **cell death or serious cell damage**.
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
**Concussion Grading - Part 1**

- Historically, concussions have been “graded” based on the symptoms present during and after the time of injury.

<table>
<thead>
<tr>
<th>Severity</th>
<th>Symptoms</th>
</tr>
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</table>
| Grade 1  | No loss of consciousness  
Post-traumatic amnesia lasts <30 minutes  
Post-concussion signs/symptoms last <30 minutes |
| Grade 2  | Loss of consciousness less than one minute  
Post-traumatic amnesia >30 minutes and <24 hours  
Post-concussion signs/symptoms last >30 min and <7 days |
| Grade 3  | Loss of consciousness greater than one minute  
Post-traumatic amnesia >24 hours  
Post-concussion signs/symptoms last >7 days |

Concussion Grading - Part Two

• However, the latest consensus statement (Zurich 2008) advises that concussions *should not be graded at the time of injury*, as there is little evidence to support that immediate symptoms (LOC, amnesia, balance deficits) correlate with recovery time.

• Instead, concussion severity is best measured by how long signs and symptoms of a concussion remain.

• SLI advises that concussions not be graded, yet coaches keep in mind that more severe immediate symptoms usually indicate a more severe concussion.
Return-to-Play Guidelines

- After an athlete suffers a concussion, only a *medical professional* (athletic trainer, doctor, etc.) should clear them to return to play.
- Coaches SHOULD NOT make return-to-play decisions.
- For educational purposes, the following is a background on methods medical professionals use to determine when it is safe for an athlete to return-to-play.

<table>
<thead>
<tr>
<th>Severity</th>
<th>1&lt;sup&gt;st&lt;/sup&gt; Concussion</th>
<th>2&lt;sup&gt;nd&lt;/sup&gt; Concussion</th>
<th>3&lt;sup&gt;rd&lt;/sup&gt; Concussion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 1</td>
<td>May return-to-play if asymptomatic for &gt; 1 week</td>
<td>Return to play in 2 weeks when asymptomatic for 1 week</td>
<td>Terminate season; may return to play next season if asymptomatic</td>
</tr>
<tr>
<td>Grade 2</td>
<td>May return-to-play if asymptomatic for &gt; 1 week</td>
<td>Minimum of 1 month; may then return-to-play if asymptomatic for &gt; 1 week</td>
<td>Terminate season; may return to play next season if asymptomatic</td>
</tr>
<tr>
<td>Grade 3</td>
<td>Minimum of 1 month; may then return-to-play if asymptomatic for &gt; 1 week</td>
<td>Terminate season; may return to play next season if asymptomatic</td>
<td></td>
</tr>
</tbody>
</table>
Sideline/ Acute Evaluation of Concussion - Tests

• Multiple sideline/acute evaluation of concussion tests are available.

• SLI does not encourage coaches to master and administer these tests. Appropriate use includes the following:
  – The SAC is intended as a standardized means of objectively documenting the presence and severity of neurocognitive impairment associated with concussion, thereby immediately providing additional information to athletic trainers and other medical personnel responsible for clinical decision making in care of athletes.*

• Popular tests include
  – Sport Concussion Assessment Tool (SCAT)
    ▪ Available on SLI website
  – Standardized Assessment of Concussion (SAC)
    ▪ Available on the Web
  – Acute Concussion Evaluation (ACE)
    ▪ Available on the Web

• Most tests cover:
  – Signs
  – Symptoms
  – Memory
  – Cognition
  – Neurologic evaluation

* Standardized Assessment of Concussion (SAC) Manual Overview
When to Return to the Same Game

• Historically, some experts have advocated allowing athletes to return to the same game if symptoms clear within 15 minutes.

• However, recent research indicates it may never be safe to return high school aged athletes and below to the same game.

• SLI and the 2008 “Zurich Guidelines” recommend never returning youth athletes to the same game.
  – The younger the athlete, the longer he or she should be held out for the same concussion.

When in doubt, sit them out!
Differential Response to Concussion - Age

• Even though you often see professional athletes return to the same game after a concussion, do not think the same rules apply to your youth athletes.

• Medical research indicates that the younger the brain:
  - The longer it takes for the athlete to recover
  - The greater the risk of Second Impact Syndrome
  - The more damage the concussion can cause

• Among the potential reasons -
  - The immature brain is approximately 60 times more sensitive to glutamate-mediated N-methyl-D-aspartate excitotoxic brain injury.
Inappropriate Concussion Care Example

Don’t let this be you!

San Antonio Express-News, 2006

Q & A With (HS Football Player - Name Withheld)

Reporter: How are you feeling after the concussion?

Athlete: Fine. I knew I was going back in the game. Before I was put back in, I told the coaches that I might not remember anything else, but I remember what my duties are on the field.
Emergency Room Guidelines

• Most concussions do not require a trip to the emergency room. However, some do, both immediately and in the days following the injury.

• Problems can arise over the first 24-48 hours. Athletes should not be left alone and must go to a hospital at once if they:
  - Have a headache that gets worse
  - Are very drowsy or can’t be awakened
  - Can’t recognize people or places
  - Have repeated vomiting
  - Behave unusually or seem confused; are very irritable
  - Have seizures
  - Have weak or numb arms or legs
  - Are unsteady on feet
  - Have slurred speech
  - Lose consciousness

* Summary and Agreement Statement of the Second International Symposium on Concussion in Sport, Prague 2004
Part 6 – Management

1. Neurometabolic cascade
2. Post-concussion syndrome
3. Second Impact Syndrome
4. Duration of symptoms
5. Gender
6. Return-to-play tests/Stepwise RTP
Proper concussion management is complicated and involves many pieces that fit together like a puzzle.
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.

* Giza and Hovda (2000)
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.
Second-Impact Syndrome

- **Second Impact Syndrome** occurs when an athlete, who has already sustained a head injury, sustains a second head injury before symptoms have cleared from the first injury.

  - This second blow to the head, sometimes minor, can result in a loss of auto regulation of the brain's blood supply. Loss of autoregulation leads to brain swelling. This results in increased intracranial pressure and leads to hemorrhage of the brain.

  - The average time from second impact to brainstem failure is quite rapid, taking two to five minutes. 50% of SIS sufferers die, and the survivors rarely recover fully.

**Young Players, Serious Injuries**

- September 16, 2007 - At least 50 high school or younger football players in more than 20 states since 1997 have been killed or have sustained serious head injuries on the field, according to research by The New York Times.

Second Impact Syndrome - Case Study

The Event

• 5-foot-1-inch high school freshman fullback Jake S. had just finished a play on the field. He was able to return to the huddle but then collapsed as he was leaving the huddle and slipped into a coma.
• He died a few days later.

A Concussion the Week Before?

• **Prior Game** - "He went out for a halfback pass. As soon as he caught the ball, he got hit. It caught him more in the face mask than in the head. It tweaked his neck a little bit. He came out for a few plays. He went back in and finished the game."

• **Friends Knew** - Friends told authorities that Jake complained of headaches the week before the tragedy. His father said it didn't appear as if he had any symptoms of a concussion after the last game.

*The Denver Post*
Duration of “Window of Vulnerability”

• The duration of the “window of vulnerability” is unknown and varies from athlete to athlete.

• Some computerized neuropsych testing shows that by measuring cognitive function, it may be unsafe for about half of high school athletes to return for at least a week. Some athletes may take weeks or months.

<table>
<thead>
<tr>
<th>Time since concussion</th>
<th>Percent of athletes who have not returned to normal cognitive function*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 week</td>
<td>More than 50%</td>
</tr>
<tr>
<td>2 weeks</td>
<td>~25%</td>
</tr>
<tr>
<td>3 weeks</td>
<td>10 to 20%</td>
</tr>
</tbody>
</table>

Concussions are like snowflakes - No two are the same

*Estimates based on multiple sources
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.
Return-to-Play Tests

• Sideline/acute assessments of concussion
  – SCAT, SAC, ACE

• Balance testing
  – Balance Error Scoring System (BESS)

• Computerized neuropsychological tests
  – Headminder Concussion Resolution Index (CRI)
  – ImPACT
  – CogSport Concussion Sentinel
  – Automated Neuropsychological Assessment Metrics (ANAM)
Stepwise Return-to-Play

- Once the player is out, the simplest return to play guideline involves step-wise RTP

- When returning athletes to play, they should follow a stepwise symptom-limited program, with stages of progression. For example:
  - rest until asymptomatic (physical and mental rest)
  - light aerobic exercise (e.g. stationary cycle)
  - sport-specific exercise
  - non-contact training drills (start light resistance training)
  - full contact training after medical clearance
  - return to competition (game play)

- There should be approximately 24 hours (or longer) for each stage and the athlete should return to stage 1 if symptoms recur. Resistance training should only be added in the later stages. **Medical clearance should be given before return to play.**
Dr. Cantu’s Guidelines - When to Return to Play

Key Guidelines

• The only established way to recover from a concussion more quickly is through **physical and mental rest**.

• The most important guideline to remember is that *no athlete should return to participation while still symptomatic – first, at rest; and then at exertion.*
  - This includes the presence of headache related to a concussive episode.

• Athlete cannot return to play until neuropsychological testing battery has returned to baseline score or higher (in applicable)

• **NEVER RETURN A PLAYER WITHOUT CLEARANCE FROM A MEDICAL PROFESSIONAL**
Part 7 – Coordination of Care

1. Athletic trainer’s role
2. Coach’s role
3. Parent’s role
4. Special considerations
Athletic Trainer’s Responsibilities After Concussion

• When athletic trainers are available, the athletic trainer should handle sideline concussion evaluation, management, and return-to-play.

Coaches Should…

• Cooperate fully with and support the athletic trainer on concussions.

• Be willing to pull players out of competition upon the athletic trainer’s request.

• Ensure that the athletic trainer is informing and coordinating care with the family and school.
Coaches’ Responsibilities After Concussion

• When athletic trainers are unavailable, coaches are responsible for concussion care.

Coaches Should…

• Remove the athlete from the game and hide his helmet (if applicable).
• Make sure someone is with the concussed athlete at all times.
• Notify parents or guardians as soon as possible regarding a possible concussion.
• Expect parents to notify school nurse, teacher, athletic trainer, principal.
• Not allow an athlete to return to practice or games without a doctor’s clearance.
• Not always blindly follow the doctor’s clearance – if an athlete appears to still be suffering symptoms, do not let them back in.

Coaches Should Not…

• Treat a concussion like a sprain, strain, or bruise.
• Make unilateral return-to-play decisions.
Coaches and Parents

Coaches Should...

- Notify parents as soon as possible regarding a possible concussion.
- Ask parents to inform the coach if the athlete suffers any symptoms at home.
- Ask that the parents coordinate care with the school - notify school nurse, teachers, athletic trainer, principal.

Informing the school is important because many student athletes have cognitive difficulties after concussion and should be on a modified or reduced schedule for classes and homework.

- Expect parents to coordinate care with a doctor.
- Anticipate that some parents, especially those who don’t understand concussions, may want a coach to return their child to play before they have recovered. Hold your ground.
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.
Part 8 – Legal Concerns
Medical/Legal Aspects of Head Injuries

- **Negligence** is major claim in a head injury case and can be brought against coaches, athletic trainers, equipment manufactures, school districts, principals, superintendents, team physicians, EMTs, league game officials, organizations, property owners, and all on the opposing team as well.
- In sports head injuries negligence is usually defined as:
  - Failure to get an athlete appropriate medical care,
  - Failure to teach the appropriate rules of the sport (ex. no spearing in football)
- Prevention is first line of defense
  - Get athletes appropriate medical care
  - Teach appropriate rules
- Coaches, athletic trainers and equipment manufacturers are most vulnerable to a lawsuit, and American society increasingly litigious

- *Cases to read as references:*
  - Passantino v. Board of Education of City of New York, 395 NYS2d 628 (1976)
  - Brooks v. Board of Education of City of New York, 205, NYS2d 777 (1960)

*Written by Tina Cantu, Esq.*
Part 9 – Prevention

1. Role of neck strength in concussion
2. Helmets
3. Strategies to prevent concussions
4. Strategies to identify concussions
Role of Neck Strength in Concussion

Strong Neck = Lower Concussion Risk

• Studies indicate that a stronger neck can help absorb some of the force of a collision, thus reducing the force that reaches the brain
  – Head injury criterion (HIC), a force used to measure concussion risk, is proportional to
    \[
    \text{Change in Velocity}^4 \times \frac{1}{\text{Distance}^{1.5}}
    \]
  
• Therefore a small change in velocity can lead to an enormous reduction (to the power of 4) in concussion risk

• SLI recommends strengthening the neck muscles, especially the ones that resist rotation, to lower the risk of concussion

• Do not bridge!
Helmets

• Protective headgear is designed and tested by the manufacturer to meet standards created by the National Operating Committee on Standards for Athletic Equipment (NOCSAE).
  – Helmets are tested at various impact forces at multiple temperatures and impact locations on the helmet.

• Due to the imperfect nature of the testing, it is difficult to claim one helmet is always better than another. There are, however, a few guidelines that can be issued with confidence.
  – New helmets test better than older helmets
  – Proper fitting are safer. Proper fit means:
    ▪ You cannot move the helmet without moving the head (no spin)
    ▪ The helmet cannot impair vision

• One football helmet manufacturer using new technology recently performed considerably better than their competitors on the NOCSAE tests. That helmet is not yet on the market.
Other Strategies to Reduce Concussion

• Teach players to “Respect the Head.”
  - Emphasize proper technique, including:
    - NEVER MAKE INITIAL CONTACT WITH THE HEAD!
    - Crack down on and punish blindside hits to an opponent’s (or teammate’s) head
Other Strategies to Reduce Concussion (2)

- Consider reducing the amount of full contact in practice.

- Be aware of the environment (walls, goals, slick surfaces) during practice and games.
Part 10 – Education

1. Head & Neck
2. Help Each Other
3. CDC Heads Up Program
Teach Athletes to Treat Head Injuries Differently

Injured vs. hurt

Always Injured
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 1905

  • “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.”
Use the CDC’s Heads Up Program

1. Distribute CDC Fact Sheets to:
   1. Players
   2. Parents
   3. Coaches

2. “Carry the Clipboard”
   (courtesy of GG)

3. Watch CDC videos with athletes
Part 11 – Next Steps

1. Workbook
2. Online test
3. Implementation
SLI’s Minimums for a Concussion Safe(r) Program

In 2010, there is no excuse not to have:

1. **Concussion Education** - Mandatory concussion education for coaches, athletes, and parents
   1. CDC’s free *Heads Up* online certification (avail summer 2010)
   2. CDC *Heads Up* handouts for parents
   3. CDC info and videos for athletes, preseason talk from SLI or coaches

2. **Concussion Diagnosis** - “Carry the Clipboard” coaches use CDC clipboards to improve diagnosis and management of concussions

3. **Concussion Management** - Don’t let kids return to the same game, if they have a suspected concussion. Require medical professional (doctor of athletic trainer)

4. **Reduce Brain Trauma in Practice** - reevaluate practice methods to reduce brain trauma. Retire dangerous drills.

5. **Reconsider the culture of the game** - encourage kids to report concussion. Send the message that “It’s better to miss a game than the whole season.”
Accessing this Presentation

- The PDF of this presentation will be posted on your website - feel free to print out pages you find helpful
  - *books are not being distributed this year to reduce costs*
A Message From Ted Johnson

Dear Coach,

Congratulations on completing the SLI Coaches Concussion Clinic educational program. I appreciate all that sports has given me, and I am especially thankful for all the time, effort, and commitment my coaches gave at every level to teach me to be a better athlete and a better person.

Looking back, however, if I could change one thing, it is that my coaches could have known what you just learned about concussions. A lack of understanding of both the seriousness of the injury and the appropriate response, by both me and those around me, has had an extremely detrimental effect on my life and that of my family. So from the bottom of my heart, thank you for participating today.

New England Patriots 1995-2004
3-time Super Bowl Champion