


Taking a Closer Look at Sport Concussions


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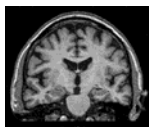
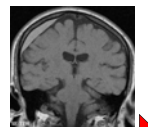
Overview


- What is concussion?
- What are the acute effects?
- Are there long term effects?



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Overview: What is concussion?



mild Traumatic Brain Injury
Functional Change

severe Traumatic Brain Injury
Structural Change


“A complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces.”

1. A direct or indirect blow
2. Rapid onset of impairment with spontaneous resolution
3. Acute clinical symptoms reflect a functional disturbance
4. Clinical symptoms may or may not involve loss of consciousness.
5. Normal structural neuroimaging studies

McCrory, *Clin J Spts Med*, 2009

Overview

- Soccer is unique with the intentional and direct use of the head for ball control
- Most common causes of soccer related concussion:
 - 1) 59% collisions related to heading
 - 2) 30% collisions unrelated to heading (Powell, 1999)
- Intentional heading does not result in concussion



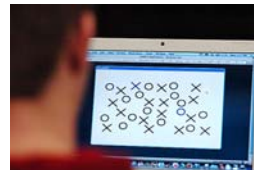
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Sport	% of All Injuries: Practices	IR (per 1000 AE): Practices	% of All Injuries: Games	IR (per 1000 AE): Games
Volleyball	2.0	0.06	4.7	0.15
Baseball	1.6	0.03	3.3	0.19
Softball	2.8	0.07	6.0	0.25
Basketball: Men's	3.0	0.12	3.6	0.32
Gymnastics	2.3	0.14	2.6	0.40
Basketball: Women's	3.7	0.15	6.5	0.50
Field Hockey	3.4	0.09	9.4	0.52
Lacrosse: Women's	4.6	0.15	9.8	0.70
Soccer: Men's	1.8	0.08	5.8	1.08
Lacrosse: Men's	3.6	0.12	8.6	1.08
Wrestling	2.5	0.14	4.8	1.27
Soccer: Women's	2.2	0.12	8.6	1.42
Ice Hockey: Men's	5.3	0.10	9.0	1.47
Football	5.6	0.54	6.8	2.34
Ice Hockey: Women's	13.2	0.33	21.6	2.72

J Athl Train, 2007

Acute Effects of Concussion

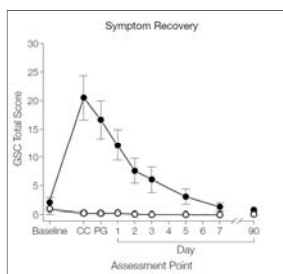
- Variable injury response mandates a multifaceted assessment (Guskiewicz 2004, McCrory 2009)
 - Self-report symptoms (Piland 2003, 2006)
 - Balance (Guskiewicz 1996, 2001)
 - Sensory Organization Test
 - Balance Error Scoring System
 - Cognitive Function (McCrory 2003)
 - Pencil and paper battery
 - Computerized assessments



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Concussion Recovery – Symptoms

- Headache -85% of injuries
- Dizziness – 68% of injuries
- Confusion – 60% of injuries
- Disoriented – 58% of injuries
- Blurred Vision – 36% of injuries
- Amnesia – 28% of injuries
- Loss of consciousness- 10% of injuries

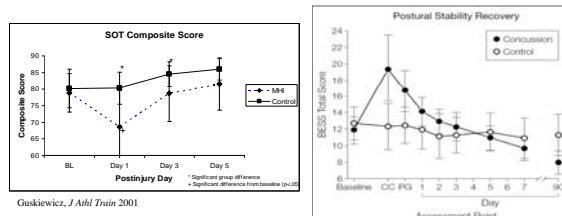


• Resolution within 5-7 days



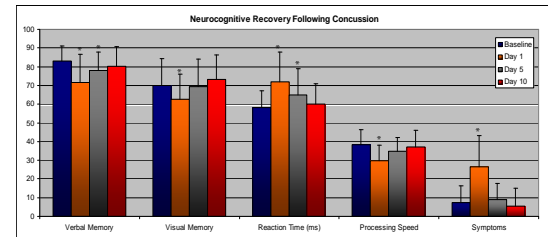
Concussion Recovery – Balance

- Resolution within 3-5 days



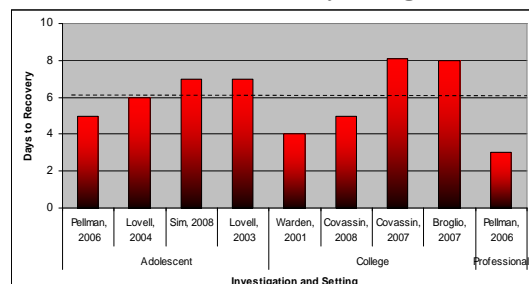
Concussion Recovery – Cognitive

- Resolution within ~5 days



Iverson, Brain Injury, 2006

Concussion Recovery - Cognitive



Ellemberg, J Neurotrauma, 2009

Concussion Recovery – fMRI Imaging

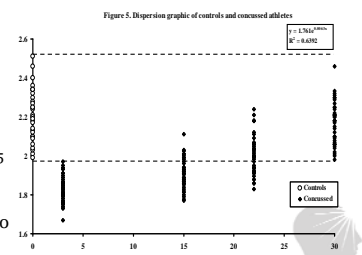
- 8 collegiate football athletes
 - 4 concussed
 - 4 controls
- 1 week post-injury
 - No difference in functional cognitive performance
 - Digit Span, addition and subtraction tasks
 - Significant fMRI BOLD signal
- Concussed athletes recruit additional resources to moderate cognitive load



Jantzen, Am J Neuroradiol 2004

Concussion Recovery – MRS Imaging

- Cerebral metabolism evaluation
 - 40 athletes
 - 30 controls
 - Days 3, 15, 22, and 30
 - Clinical recovery between days 3 and 15
- Elevated cerebral metabolism until day 30



Vagnozzi et al, Brain, 2010

Long Term Effects: Soccer Heading and Cognitive Function

- Soccer Athletes (N=91)
- Non-Soccer Athletes (N=96)
- Student Controls (N=53)

Test	Soccer athletes (N=91)	Non-soccer athletes (N=96)	Student controls (N=53)	Group difference P value
Scholastic Aptitude Test	1132.30 ± 163.30	1148.82 ± 82	1190.82 ± 145.27	0.543
Hopkins Verbal Learning Test (Immediate memory recall)	29.90 ± 3.73 (N=86)	26.54 ± 5.14 (N=95)	29.20 ± 3.78 (N=53)	0.072
Memory recognition	11.82 ± 0.83 (N=96)	11.57 ± 0.74 (N=95)	11.68 ± 0.70 (N=53)	0.680
Walker Digit Span Test	9.83 ± 1.51 (N=90)	9.88 ± 1.60 (N=95)	9.75 ± 1.53 (N=53)	0.542
Digits forward	8.20 ± 2.06 (N=90)	8.11 ± 2.21 (N=95)	7.60 ± 2.29 (N=53)	0.266
Digits backward	8.20 ± 2.06 (N=90)	8.11 ± 2.21 (N=95)	7.60 ± 2.29 (N=53)	0.266
Stroop Test (page 1)	53.28 ± 10.50 (N=30)	52.16 ± 9.05 (N=30)	53.58 ± 8.29 (N=53)	0.498
Trail Making Test (part B)	49.11 ± 18.23 (N=43)	51.64 ± 14.09 (N=70)	50.53 ± 14.61 (N=53)	0.410
Controlled Oral Word Association Test	37.50 ± 8.13 (N=30)	39.82 ± 10.19 (N=30)	39.28 ± 9.12 (N=53)	0.732
Symbol Digit Modality Test	40.54 ± 9.26 (N=30)	40.43 ± 9.24 (N=30)	42.35 ± 11.15 (N=53)	0.259

* Higher scores represent better performance on all tests except Trail Making Test (part B). Not all subjects took all tests because test battery changed over the years. The number of subjects is given for each test result.

Guskiewicz, *Am J Sport Med*, 2002

Long Term Effects: Concussion and Cognitive Function

IMPACT
n=235; 20-41.8 yrs

Concussion Resolution Index
n=264; 20-11.4 yrs

Broglio, *Br J Sports Med*, 2006

Concussion and Cognitive Function

	0 Concussions	1+ Concussions
n	44	46
Age (Years)	19.41 ± 1.28	20.04 ± 1.17
Height (m)	1.72 ± 0.09	1.76 ± 0.07
Weight (kg)	77.72 ± 12.05	80.84 ± 12.42
Mean # Concussions	--	1.65 ± 0.97
Time From Last Injury (yrs)	--	3.21 ± 2.90

- Tasks
 - Clinical assessment – ImPACT
 - Equal performance between groups
 - Novelty Oddball Task with ERPs

Broglio, *J Neurotrauma*, 2009

Concussion and Cognitive Function

www.alltoxic.edu

Concussion and Gait

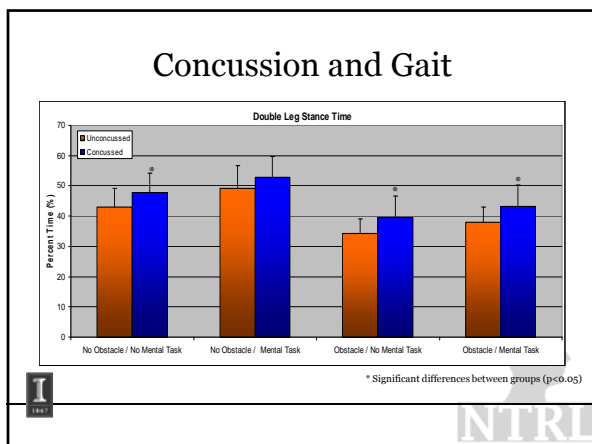
	Concussed (n=28)	Non-Concussed (n=40)
Male	17	20
Female	11	20
Age (yrs)	21.0	20.7
Height (cm)	173.6	169.2
Weight (kg)	78.1	72.0
Previous # Concussion	2.0	--
Time from Injury (yrs)	6.3	--

- Tasks
 - Walk(3.6m) with and without (.5m) obstacles
 - Brooks Mental Task while walking and seated
 - Equal performance between groups

Martini et al, *Archives Phys Med*, in press

Concussion and Gait

* Significant differences between groups (p<0.05)



Headbands

- Do not appear to work in reducing ball impact force. (Withnall, *Brit J Sport Med*, 2005)
- May be effective in reducing concussions
 - ~50% reduction (Delaney *Brit J Sport Med*, 2008)

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What does it all mean?

- Rapid identification and treatment
- Progressive return
 - to sport and school
- Keep playing!

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Thank You

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