

Sport-Related Concussions (mTBI)



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“There is nothing mild about a mild
Traumatic Brain Injury”

Sport Related Concussions or mTBI



What is a Concussion

The 3rd International Conference on Concussion in Sport Held in Zurich, November 2008

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

Caused by:

- direct blow to the head or body that results in an impulse being transmitted to the head



Case Study: The Relationship Between Sport-Related Concussion and Neurocognitive Performance in a Minor Hockey Player

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Participant

- 14 year old male hockey player
- Sustained a concussion 72 days after baseline
- Two reported head impacts while wearing a CSA approved helmet

What Happened

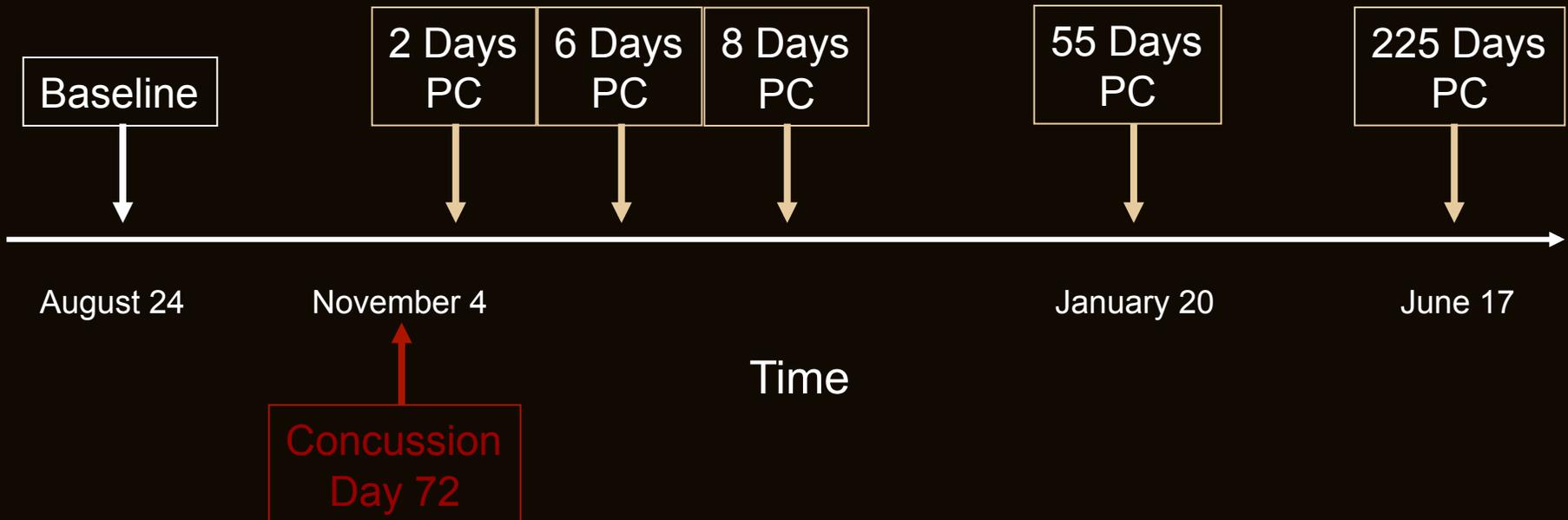
Reported Concussion & Post Concussion (PC) Description



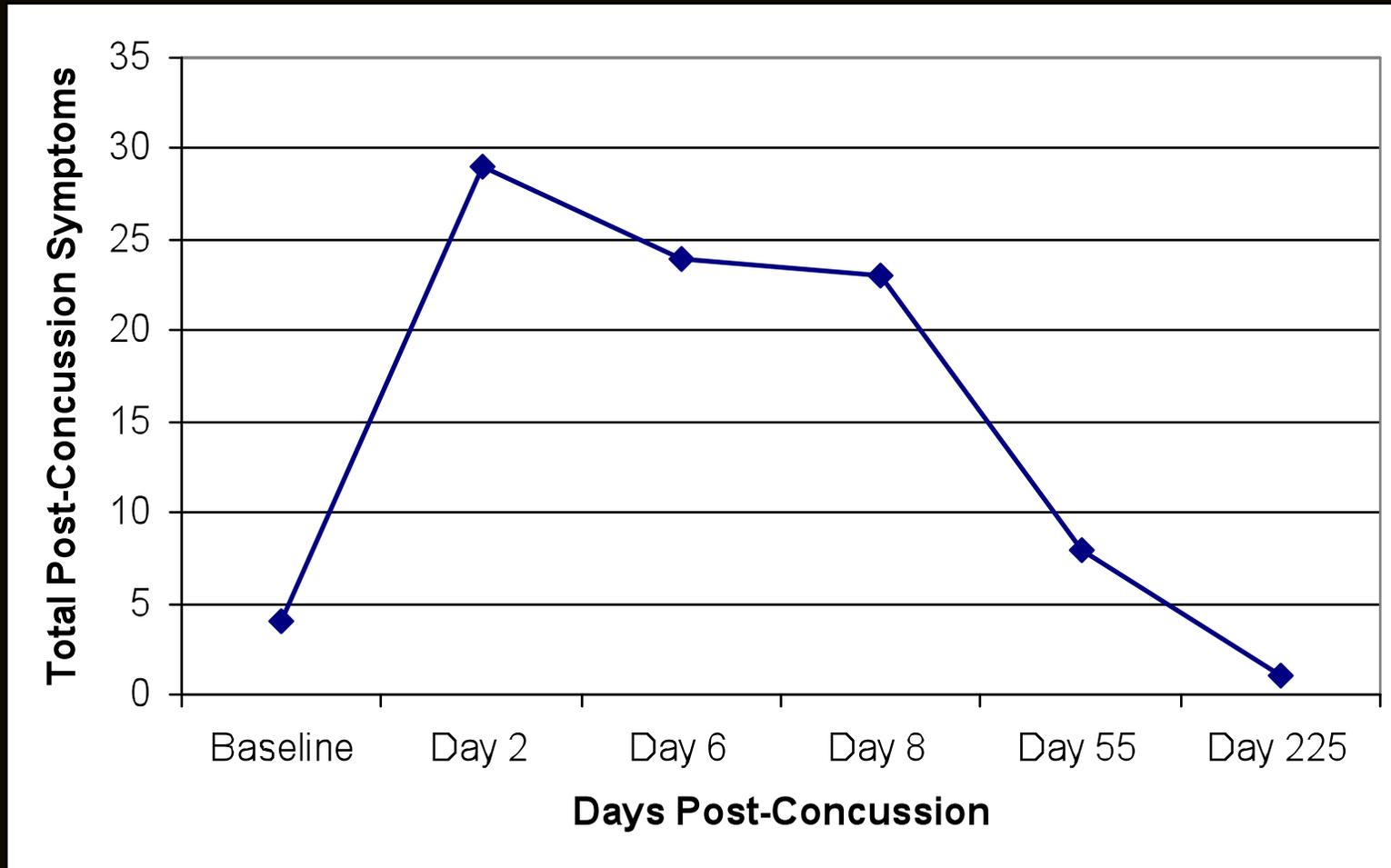
Neurocognitive Tests

- **ImPACT**
 - Immediate Post Concussion Assessment and Cognitive Test (Verbal & Visual Memory, Reaction Time, Processing Speed, Impulse Control)
- **Conners' Continuous Performance Test II (CCPT – II)**
 - Attention and impulsivity
- **Attention Network Test**
 - Alerting, Orienting, & Executive Control

Testing Schedule



Post Concussion Symptoms



Conclusions

- Post concussion increase in post concussion symptoms and decrease in visual memory (ImPACT).
 - resolves gradually by day 55
- Impulsivity and executive function of attention alterations persist beyond 55 days post concussion (CCPT II & ANT). (Soviero & McAuliffe; 2006; Halterman et al., 2005)
- Some neurocognitive function may still be affected following mTBI in youth even though post concussion symptoms have been resolved.
- Two other cases (14 year old girls)
 - Similar results (~40 days post concussion)

Contact Info

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Extras

Quick Notes

- No evidence that the helmet / mouth guard use reduces risk of concussion (Benson et al. 2011; Roberts, 2011)
- Approximately 90% of athletes with mTBI are not rendered unconsciousness (Bailes, 2009)
- Sport-Related Concussions are under reported (Guskiewicz, 2004)
- Conventional Neuroimaging (CT Scan) is normal in concussive injury (McCroory, 2009)

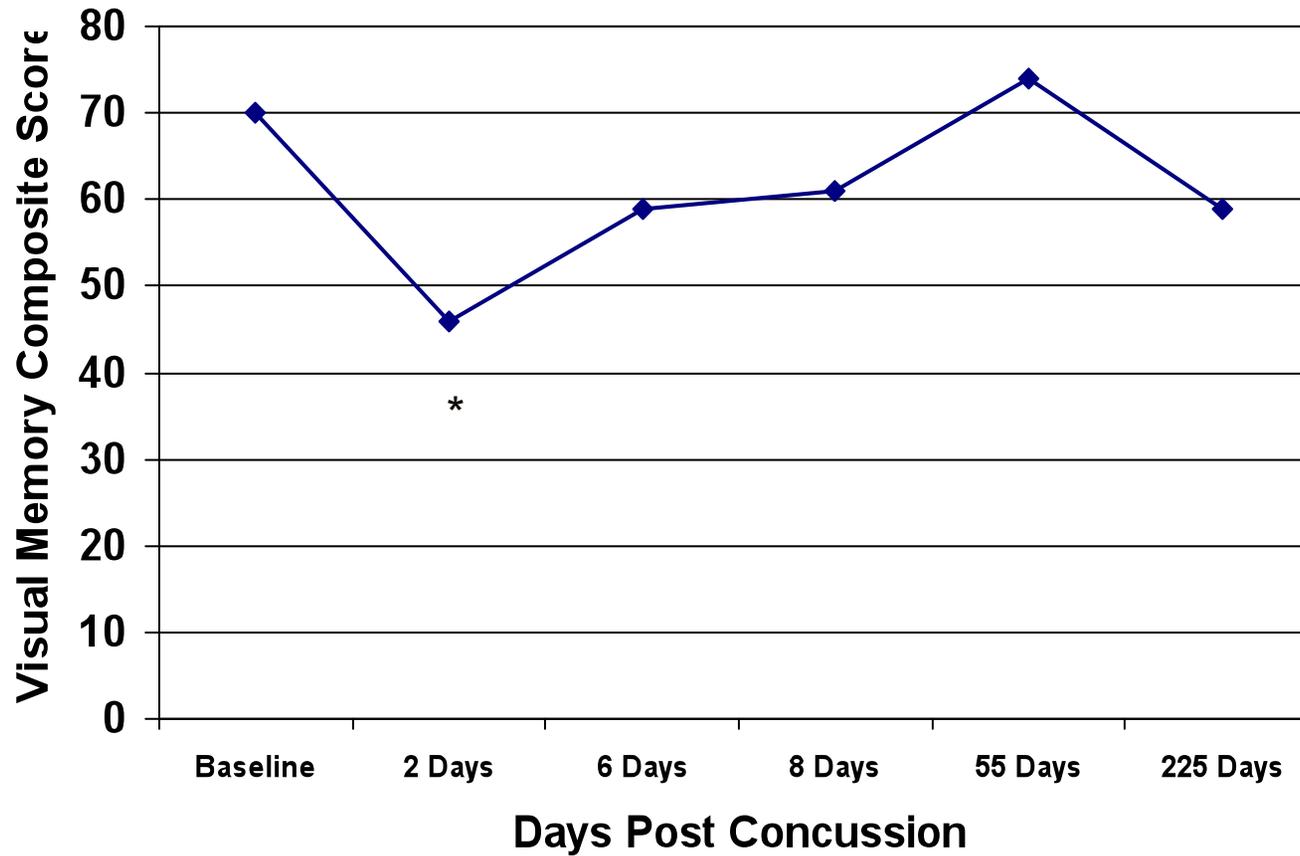
Consensus Statement on Concussion in Sport: The 3rd International Conference on Concussion in Sport Held in Zurich, November 2008

Table 1. Graduated Return-to-Play Protocol

Rehabilitation Stage	Functional Exercise at Each Stage of Rehabilitation	Objective of Each Stage
1. No activity	Complete physical and cognitive rest	Recovery
2. Light aerobic exercise	Walking, swimming, or stationary cycling, keeping intensity to <70% of maximum predicted heart rate; no resistance training	Increase heart rate
3. Sport-specific exercise	Skating drills in ice hockey, running drills in soccer; no head impact activities	Add movement
4. Non-contact training drills	Progression to more complex training drills, eg, passing drills in football and ice hockey; may start progressive resistance training	Exercise, coordination, and cognitive load
5. Full-contact practice	Following medical clearance, participate in normal training activities	Restore athlete's confidence; coaching staff assesses functional skills
6. Return to play	Normal game play	

“If in doubt sit them out”

Results – ImPACT Visual Memory



Neurocognitive Measures

- ImPACT

Test Module	Cognitive Ability Area
Word Memory	-Immediate and delayed memory for words
Design Memory	-Immediate and delayed memory for designs
X's and O's	-Attention, concentration, working memory, reaction time
Symbol Match	-Visual processing speed, learning and memory
Colour Match	-Focused attention, response inhibition, reaction time
Three Letters	-Attention, concentration, working memory, visual-motor speed
Symptom Scale Composite Score	-Rating of individual self-reported symptoms

Neurocognitive Measures

- ImPACT

Test Module	Cognitive Ability Area
Verbal Memory	Averaged percentage correct scores for Word Memory, Symbol Match memory test and Three Letters memory test
Visual Memory	Average percentage correct scores for the Design Memory and the X's and O's test
Reaction Time	Mean time in milliseconds for X's and O's test (mean counted correct reaction time), Symbol Match test (mean weighted reaction time for correct responses) and Colour Match test (mean reaction time for correct responses)
Processing Speed	X's and O's test (mean correct distracters), Symbol Match test (mean correct responses) and Three Letters memory test (number of correct responses)
Impulse Control	Average of total incorrect responses on matching tasks

Neurocognitive Measures

- Conners' CPT-II

Measure	Definition
Omissions	Number of target letters to which the participant did not respond
Commissions	Number of times the participant responded incorrectly to non-target letters
Hit Reaction Time	Average speed of correct responses in milliseconds
Hit Reaction Time Standard Error	Level of consistency in response speed (higher score denotes inconsistency in response speed)
Perseverations	Any reaction time that is less than 100 milliseconds

Key Message

1. The uniqueness of both the population and the technology used
2. The relationship found between hockey-related sustained head impacts or concussion and neurocognitive function
3. The need for more effective and stringent return-to-play guidelines for youth athletes
4. Implications for expanding the scope of practice of Occupational Therapy into the world of sport