



DR COREY CUNNINGHAM

CONCUSSION *in Sport*

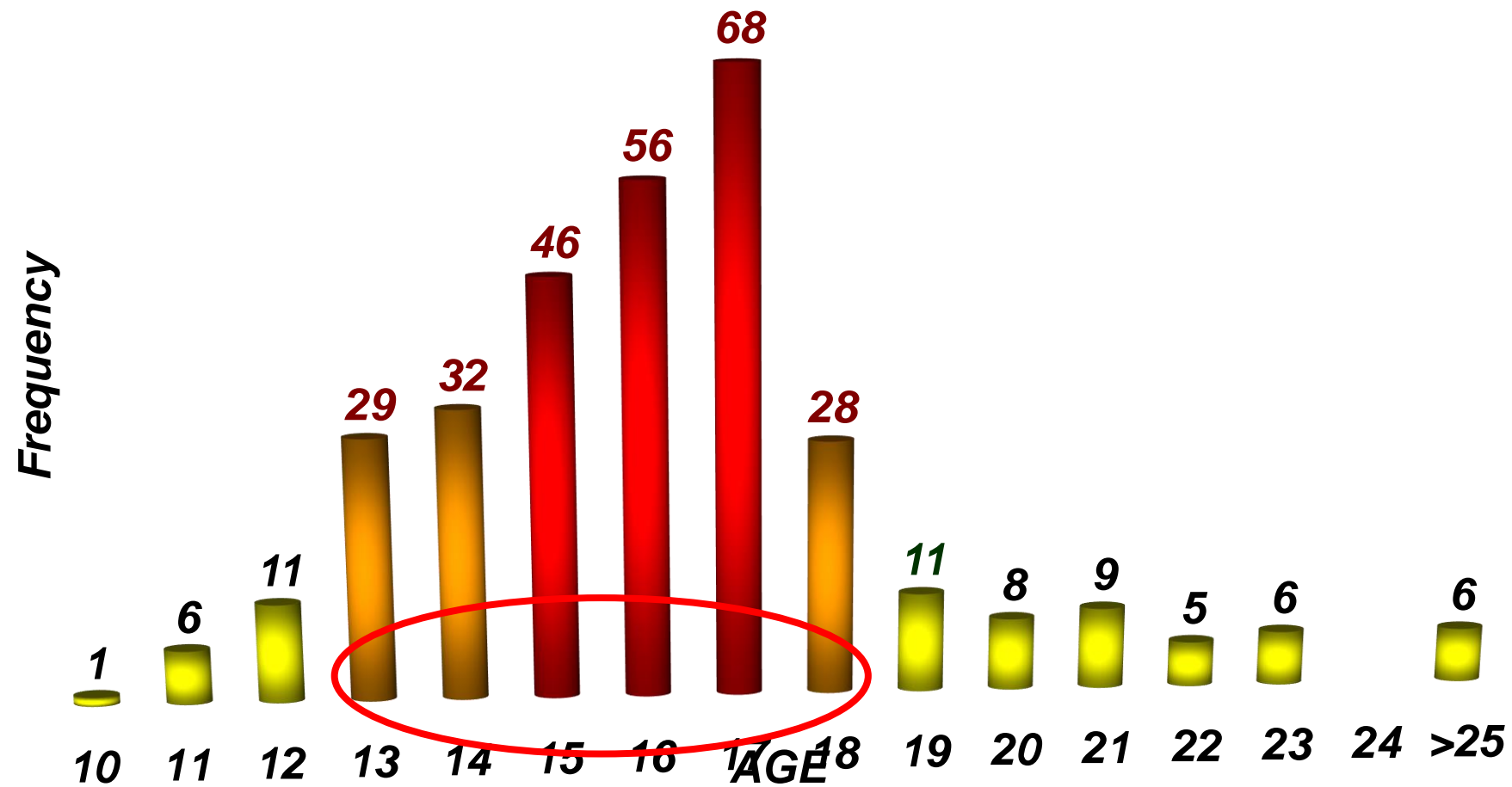
MONDAY 13 MAY | 7PM | RHODES THEATRE

Incidence across sports

No sport is immune to head injury

	Sport	/ 1000 hours exposure		Sport	/ 1000 hours exposure
1.	Horse Racing (amateur)	95.2	10.	Rugby Union (professional)	9.1
2.	Taekwondo (competition)	50	11.	Rugby Union (amateur)	5.1 – 7.9
3.	Mixed Martial Arts	48.3	12.	Aussie Rules	4.1
4.	Horse Riding (jumps)	25	13.	Rugby Union (sevens)	3.01
5.	Kick Boxing	19.3	14.	Soccer	0.5
6.	Horse Racing (flats)	17.1	15.	Basketball	0.4
7.	Boxing (professional)	13.2	16.	Wrestling	0.4
8.	Rugby League	14.4	17.	Field Hockey	0.2
9.	Rugby Union (junior)	10.1	18.	Gymnastics	0.2

Children and adolescents



SPORTS FINAL

DAILY NEWS
NEW YORK'S HOMETOWN NEWSPAPER

This is your brain on football

Despite immense pressure from the medical community and attempts to lower concussion rates, the NFL reported a staggering increase in head injuries for 2015. **SEE SPORTS**

NFL concussions up a stunning 58%
Frightening figures just 'tip of iceberg'

WHITE HOUSE: HIL HAD TOP-SECRET EMAILS PAGES 6-7

FIRST deGROIN, NOW deBACK
Amoré scratched from latest start: P. 22-23

DAILY NEWS
March 20, 2016

NFL finally admits what rest of world already knew: Football causes brain damage

WHAT TOOK SO LONG!

PAY THE FITZ
The NFL's top health guru acknowledges Monday there is a link between football and CTE. Page 14

Mark Halperin on What Obama Can Learn from Reagan
Haiti, the Aftermath: Words and Photos By James Nachtwey
Will Apple's iPad Save The Media?

TIME

THE MOST DANGEROUS GAME.

How to Fix Football
BY SEAN GREGORY

The Crisis in High Schools
BY RILEY BRIDGEMAN

TIME

HE DIED PLAYING THIS GAME.

IS FOOTBALL WORTH IT?

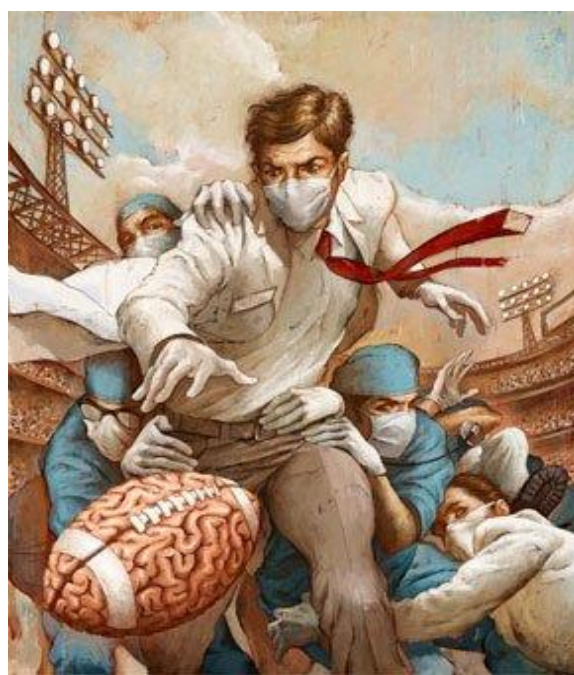
Shortly after this photo was taken, 16-year-old Chad Stover suffered a traumatic brain injury. He never got up.
BY SEAN GREGORY

WILL SMITH

BASED ON A TRUE STORY

CONCUSSION

EVEN LEGENDS NEED A HERO
CHRISTMAS



RANGERS ACE CLIFF LEE: WHY HE'LL BE THE DIFFERENCE
By TOM VERDUCCI

AUBURN QB CAM NEWTON: RACING TOWARD THE HEISMAN
By LARS ANDERSON

Sports Illustrated

CONCUSSIONS

SPECIAL REPORT
THE HITS THAT ARE CHANGING THE GAME...
By PETER KING

...AND THE HITS NO ONE IS NOTICING
By DAVID EPSTEIN

TRAGEDY HITS HOME
Ex-Marist player among injured in Brussels attack: P. 46

DAILY NEWS
March 23, 2016

BRAIN DEAD!

Despite medical proof and NFL's own admission, Jerry calls link between football & brain disease **'ABSURD'**

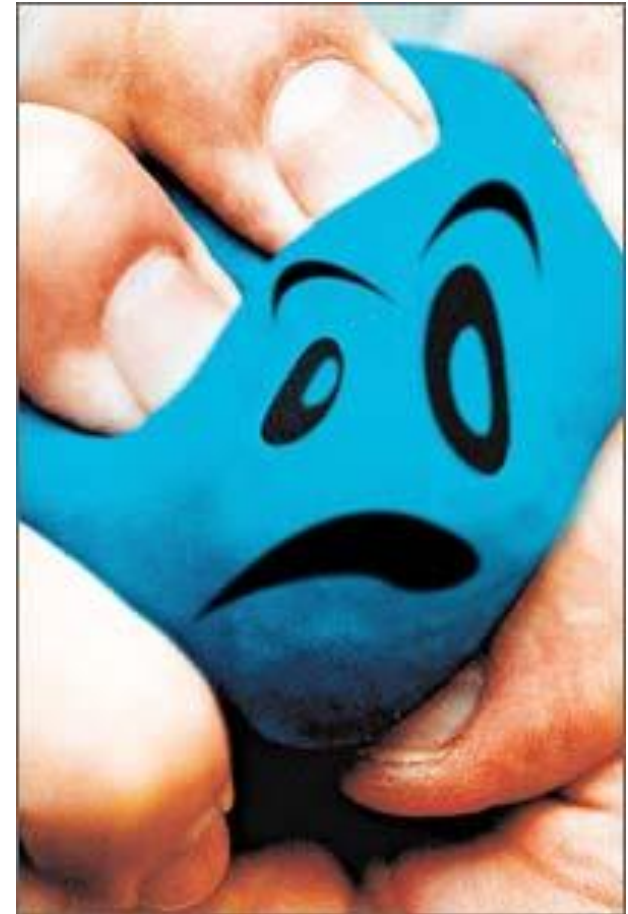
PREZ, JETER ON HAND AS MLB STORMS CUBA: PAGES 40-42

Concussion

- What is it?
- How does it happen?
- What are the symptoms and signs to look out for?
- How do we manage it?
- When is it safe to return to play?
- Are there any long term effects?

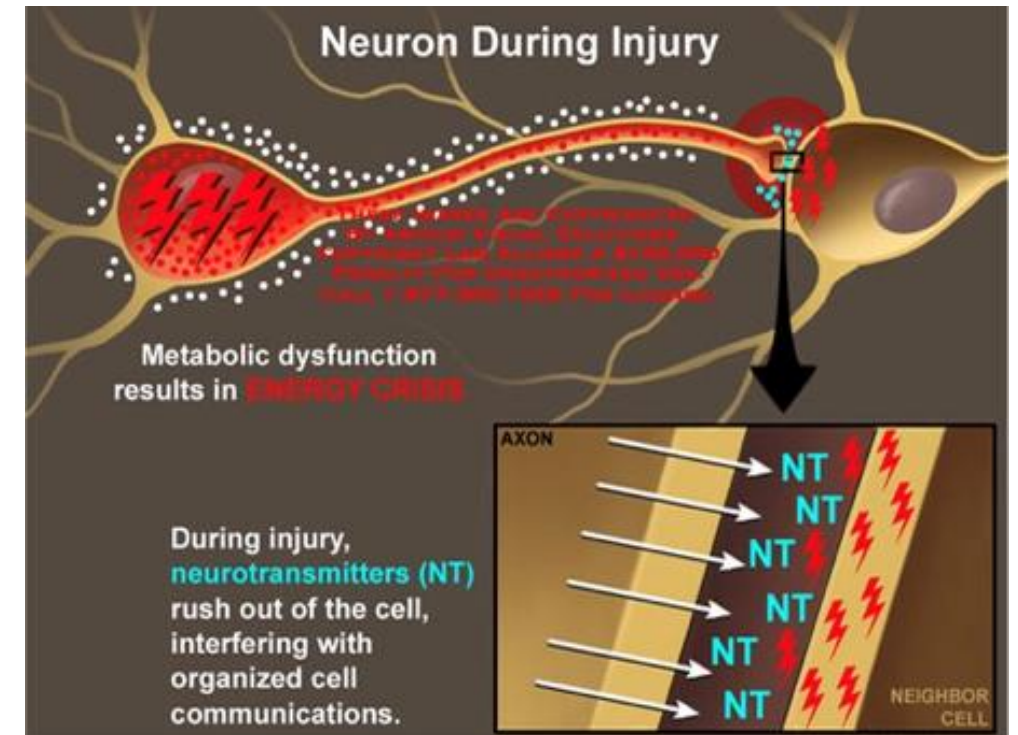
Concussion

- Consensus guidelines Berlin 2016
- Traumatic brain injury
- Induced by biomechanical forces
- Acute onset
- Transient loss of neurological function
- Functional / chemical disturbance rather than structural injury

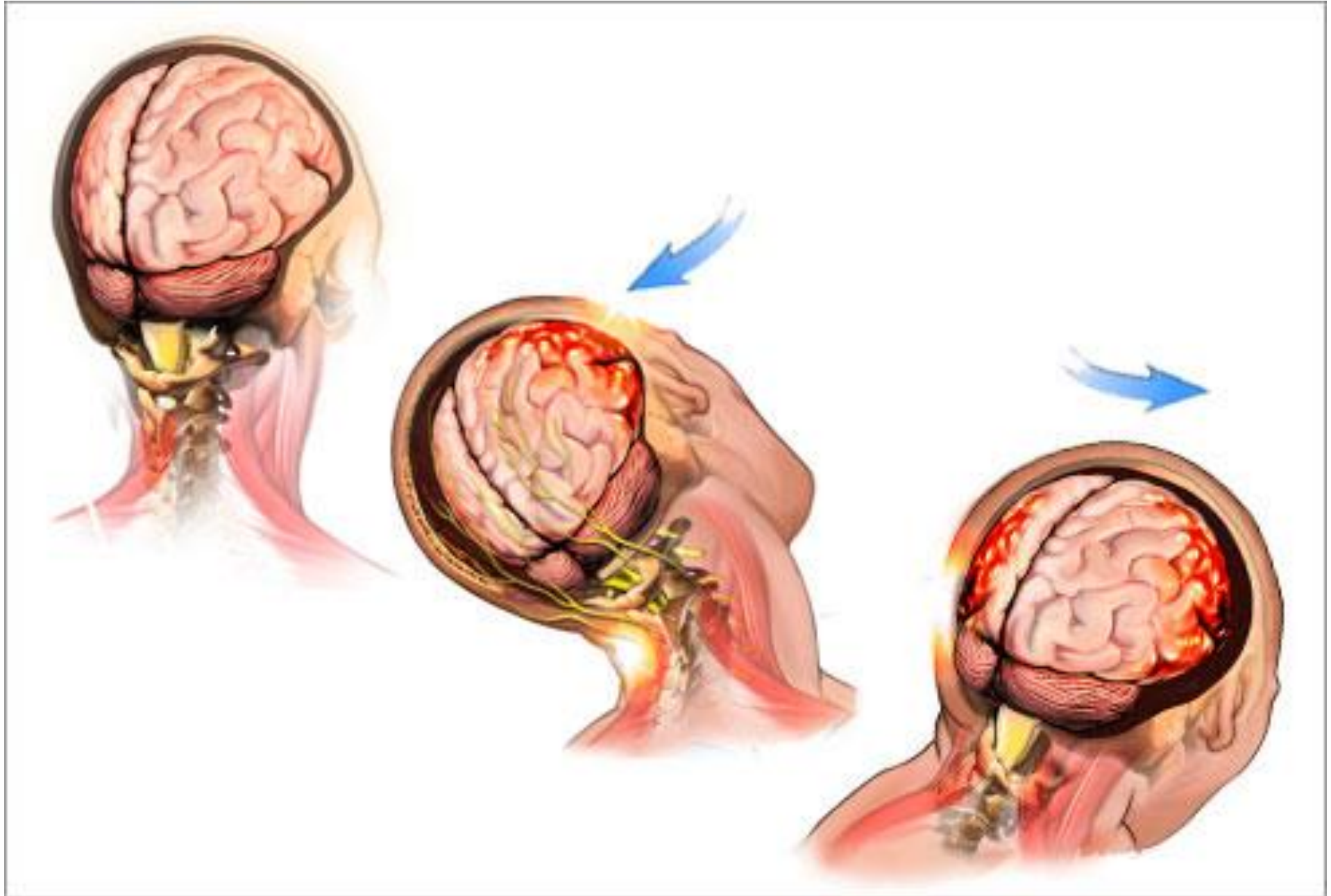


Concerns

- Can mimic intracranial injury
- Impact on learning
- Risks associated with second impact
- Increase risk of other (non head) injury
- Potential for long term neurocognitive and psychological issues



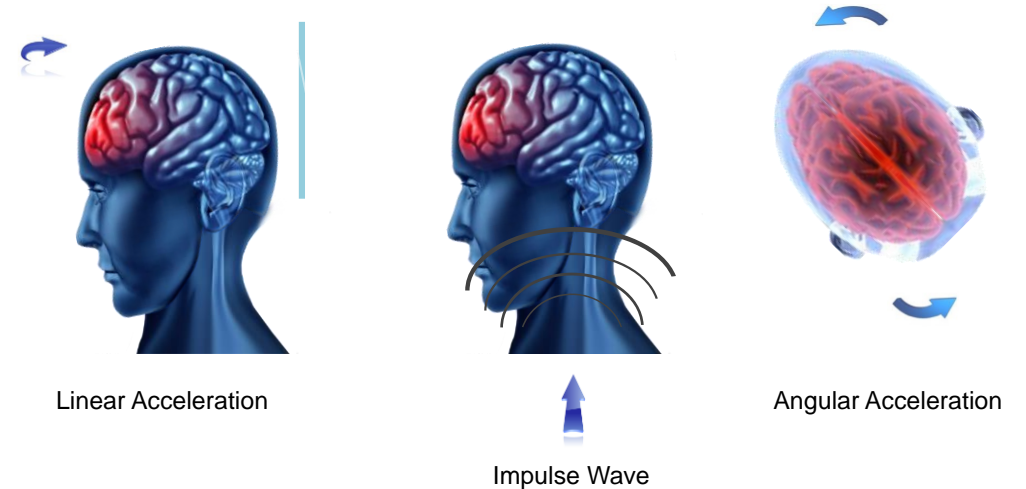
Brain inside the skull



Mechanisms of Injury

- Direct impact to head
- Force transmitted from body up to the head
- Rotational / angular force

Mechanical Impact Forces



Symptoms

SYMPTOM CLUSTER	SYMPTOM
Physical	<ul style="list-style-type: none">• Loss of consciousness (<10%)• Headache• Nausea• Vomiting• Blurred vision• Tiredness/low energy• Balance disturbance• Sensitivity to bright light• Sensitivity to loud noise
Emotional	<ul style="list-style-type: none">• Irritability• Feeling anxious• Feeling sad or depressed

SYMPTOM CLUSTER	SYMPTOM
Sleep	<ul style="list-style-type: none">• Sleeping more or less than normal• Unable to fall asleep• Daytime drowsiness
Cognitive	<ul style="list-style-type: none">• Memory loss• Memory problems• Poor concentration• Confusion• Slow thought processing

CONCUSSION RECOGNITION TOOL 5[©]

To help identify concussion in children, adolescents and adults



FIFA®

Supported by



FEI

RECOGNISE & REMOVE

Head impacts can be associated with serious and potentially fatal brain injuries. The Concussion Recognition Tool 5 (CRT5) is to be used for the identification of suspected concussion. It is not designed to diagnose concussion.

STEP 1: RED FLAGS — CALL AN AMBULANCE

If there is concern after an injury including whether ANY of the following signs are observed or complaints are reported then the player should be safely and immediately removed from play/game/activity. If no licensed healthcare professional is available, call an ambulance for urgent medical assessment:

- Neck pain or tenderness
- Double vision
- Weakness or tingling/burning in arms or legs
- Severe or increasing headache
- Seizure or convulsion
- Loss of consciousness
- Deteriorating conscious state
- Vomiting
- Increasingly restless, agitated or combative

Remember:

- In all cases, the basic principles of first aid (danger, response, airway, breathing, circulation) should be followed.
- Assessment for a spinal cord injury is critical.
- Do not attempt to move the player (other than required for airway support) unless trained to do so.
- Do not remove a helmet or any other equipment unless trained to do so safely.

If there are no Red Flags, identification of possible concussion should proceed to the following steps:

STEP 2: OBSERVABLE SIGNS

Visual clues that suggest possible concussion include:

- Lying motionless on the playing surface
- Slow to get up after a direct or indirect hit to the head
- Disorientation or confusion, or an inability to respond appropriately to questions
- Blank or vacant look
- Balance, gait difficulties, motor incoordination, stumbling, slow laboured movements
- Facial injury after head trauma

© Concussion in Sport Group 2017

STEP 3: SYMPTOMS

- Headache
- "Pressure in head"
- Balance problems
- Nausea or vomiting
- Drowsiness
- Dizziness
- Blurred vision
- Sensitivity to light
- Sensitivity to noise
- Fatigue or low energy
- "Don't feel right"
- More emotional
- More Irritable
- Sadness
- Nervous or anxious
- Neck Pain
- Difficulty concentrating
- Difficulty remembering
- Feeling slowed down
- Feeling like "in a fog"

STEP 4: MEMORY ASSESSMENT

(IN ATHLETES OLDER THAN 12 YEARS)

Failure to answer any of these questions (modified appropriately for each sport) correctly may suggest a concussion:

- "What venue are we at today?"
- "Which half is it now?"
- "Who scored last in this game?"
- "What team did you play last week/game?"
- "Did your team win the last game?"

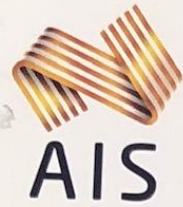
Athletes with suspected concussion should:

- Not be left alone initially (at least for the first 1-2 hours).
- Not drink alcohol.
- Not use recreational/ prescription drugs.
- Not be sent home by themselves. They need to be with a responsible adult.
- Not drive a motor vehicle until cleared to do so by a healthcare professional.

The CRT5 may be freely copied in its current form for distribution to individuals, teams, groups and organisations. Any revision and any reproduction in a digital form requires approval by the Concussion in Sport Group. It should not be altered in any way, rebranded or sold for commercial gain.

ANY ATHLETE WITH A SUSPECTED CONCUSSION SHOULD BE IMMEDIATELY REMOVED FROM PRACTICE OR PLAY AND SHOULD NOT RETURN TO ACTIVITY UNTIL ASSESSED MEDICALLY, EVEN IF THE SYMPTOMS RESOLVE

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CONCUSSION IN SPORT AUSTRALIA POSITION STATEMENT

An initiative of the Australian Institute of Sport,
Australian Medical Association, Australasian
College of Sport and Exercise Physicians
and Sports Medicine Australia

Dr Lisa Elkington, Dr Silvia Manzanero and Dr David Hughes
Australian Institute of Sport

Updated October 2018



CONCUSSION POLICY

RUGBY AUSTRALIA



CONCUSSION REFERRAL & RETURN FORM

This Concussion Referral & Return Form MUST be completed as specified by *Rugby Australia Concussion Procedure*.

NOTE: THIS IS A LEGAL DOCUMENT AND UPON COMPLETION (Sections 1-3) MUST BE PROVIDED TO THE COMPETITION MANAGER BEFORE A PLAYER RETURNS TO FULL CONTACT TRAINING AND PLAYING.

FAILURE TO COMPLETE ANY SECTION OF THIS FORM WILL RESULT IN THE PLAYER BEING EXCLUDED INDEFINATELY FROM FULL CONTACT TRAINING AND PLAYING

SECTION 1 - PLAYER DETAILS *(please print clearly)*

TEAM OFFICIAL TO COMPLETE (Manager, Coach or First Aid / Medical Officer) BEFORE PRESENTING TO MEDICAL DOCTOR REVIEWING THE PLAYER

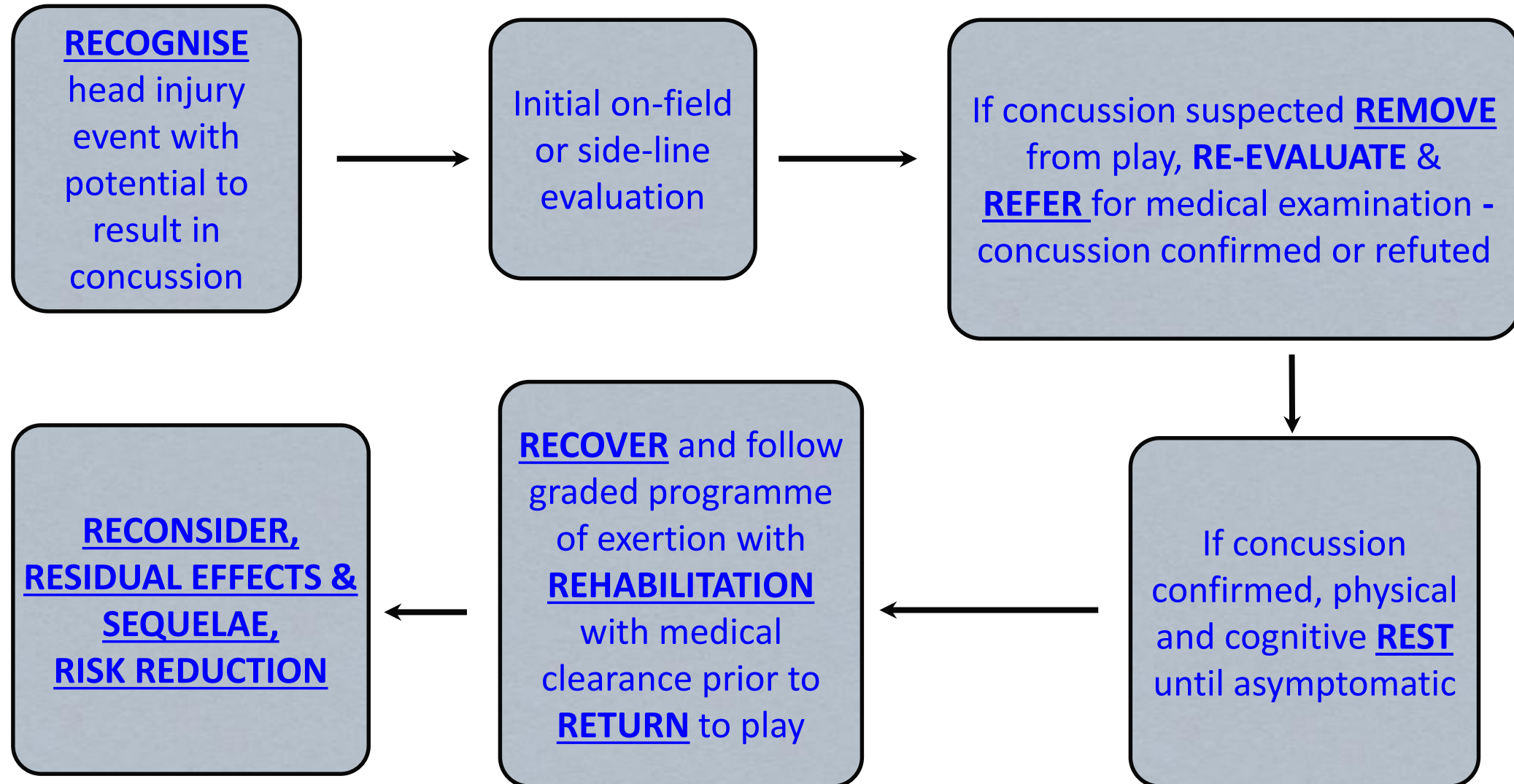
Name of player:	Date of Birth:
Club/School:	Competition/State:

Dear Doctor,

This rugby player has presented to you today because they were injured on (day & date of injury) _____ in a (game or training session) _____ and suffered a potential head injury or concussion.

The Injury involved: (select one option)	Direct head blow or knock	<input type="checkbox"/>
	Indirect injury to the head e.g. whiplash injury	<input type="checkbox"/>
	No specific injury observed	<input type="checkbox"/>

Principles of concussion management – the 11R's



Barker concussion program

- Commenced 2016
- Continues to evolve and improve
- Medical and Physio
- Coaches and staff
- Parents

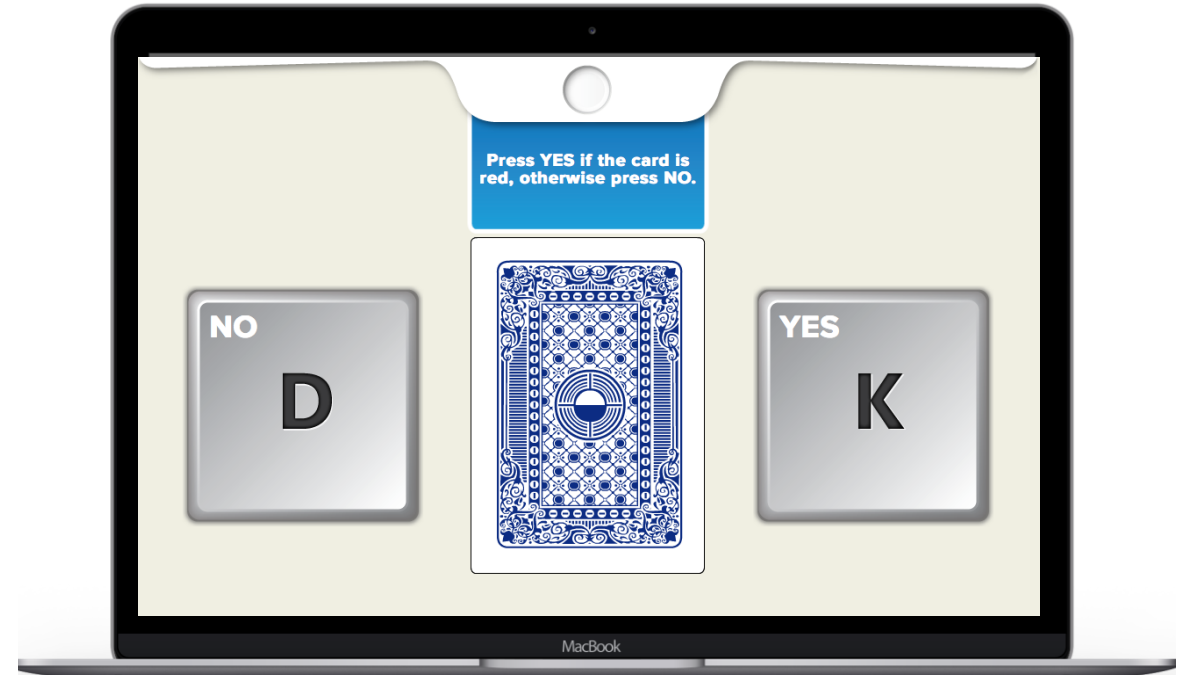


Headsmart (Cogstate)

2016 – 290 students

2017 – 1192 students (Year 7-12)

2018 – 1200 students



Baseline Test Report

This is not a Medical Diagnosis. After Injury reports should be interpreted only by a qualified Medical Provider and are intended solely to give the Provider additional information about an athlete's cognitive function.



Athlete Information

Name: _____
Birth Year: _____
Age: _____
Gender: Male
Dominant Hand: Right
Test Date: 12 May 2019
Test Time: 09:12 PM
Test Duration: 551 seconds
Expiration Date*: 10 May 2020

Test ID: _____

*While acceptable Baseline test results will be compared to After Injury tests, new Baseline tests are strongly recommended every year.

Integrity Checks

Processing Accuracy > 80% (95%) ✓
Attention Accuracy > 80% (82%) ✓
Learning Accuracy > 53% (55%) ✓
W. Memory Accuracy > 53% (94%) ✓
Processing Speed < Attention Speed ✓
Processing Speed < W. Memory Speed ✓

Note: This is not a Medical Diagnosis. After Injury reports should be interpreted only by a qualified Medical Provider and are intended solely to give the Provider additional information about an athlete's cognitive function. "Acceptable" means only that a Baseline score on a particular test is statistically within normal ranges. It does not guarantee that the Computerized Cognitive Assessment Tool (CCAT) results are an accurate measure of a particular athlete's cognitive function. Many factors can influence the quality and validity of CCAT results, including low motivation, distractions during test taking, emotional distress, lack of sleep, etc. A Baseline test should be repeated if it is suspected that such factors may have impaired the testing process.

Test Results

Task	Score	Acceptable
12 May 2019		
● Processing Speed	103.2	✓
Speed ¹	296 ms	
Accuracy ²	94.9%	
Hits ³	37	
Misses ⁴	2	
Anticipations ⁴	2	
▲ Attention	102.1	✓
Speed ¹	481 ms	
Accuracy ²	81.6%	
Hits ³	31	
Misses ⁴	7	
Anticipations ⁴	1	
◆ Learning	87.8	✓
Speed ¹	1017 ms	
Accuracy ²	55.4%	
Hits ³	46	
Misses ⁴	37	
Anticipations ⁴	1	
■ Working Memory Speed	92.3	✓
Speed ¹	851 ms	
□ Working Memory Accuracy	101.6	✓
Accuracy ²	93.9%	
Hits ³	31	
Misses ⁴	2	
Anticipations ⁴	0	

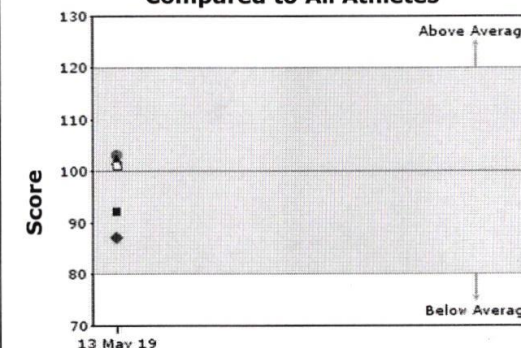
1. A higher value indicates a slower response
2. A higher value indicates a better response
3. A higher value indicates a better performance
4. A higher value indicates a poorer performance
5. Threshold is 1.65 standard deviations computed from age-based within-subject standard deviation

Note: Cognitive test results are standardized around a mean of 100 with a standard deviation of 10. All data is compared to age-matched normative baseline.

Explanation

Acceptable Baseline. Please send a copy of these results to your qualified Medical Provider for their records. A new Baseline test is recommended every year.

Compared to All Athletes



Warning: Taking this test will not prevent head injury. For more information on test reports and their meaning, visit concussion.cogstate.com. **Traumatic brain injury and concussion are very serious medical conditions. If it is suspected that an athlete may have sustained such an injury, they should immediately seek the care of a qualified Medical Provider. Only a qualified Medical Provider can safely make a decision on whether an athlete has sustained a traumatic brain injury or concussion or whether an athlete is ready to return to sports or school.** This report's sole purpose is to give qualified Medical Providers additional information about an athlete's cognitive function. Test data and results are to be interpreted by qualified Medical Providers and are never a substitute for their expert medical judgment. This report does not provide a medical diagnosis and return to play decisions must consider all clinical signs and symptoms, history of concussion, and the results of any other investigations undertaken (eg, MRI or CT scans). Many factors can influence the quality and validity of CCAT test results, including low motivation, distractions during test taking, emotional distress, lack of sleep, etc. A Baseline or After Injury test should be repeated if it is suspected that such factors may have impaired the testing process.

Questions? If you have questions regarding this test, please feel free to contact us customerservice@cogstate.com. You can also call us at 1.877.399.2966 between 8 am and 8 pm CST. Please be advised that our customer service representatives are not authorized nor able to provide medical counsel or advice of any kind. Such issues should be discussed with a qualified Medical Provider.

Baseline Test Report

This is not a Medical Diagnosis. After Injury reports should be interpreted only by a qualified Medical Provider and are intended solely to give the Provider additional information about an athlete's cognitive function.



Athlete Information

Name:
Birth Year:
Age:
Gender: Male
Dominant Hand: Right
Test Date: 03 May 2019
Test Time: 06:15 PM
Test Duration: 695 seconds
Expiration Date*: 1 May 2020

Test ID:

*While acceptable Baseline test results will be compared to After Injury tests, new Baseline tests are strongly recommended every year.

Integrity Checks

Processing Accuracy > 80% (51%) ✗
Attention Accuracy > 80% (57%) ✗
Learning Accuracy > 53% (66%) ✓
W. Memory Accuracy > 53% (59%) ✓
Processing Speed < Attention Speed ✓
Processing Speed < W. Memory Speed ✓

Note: This is not a Medical Diagnosis. After Injury reports should be interpreted only by a qualified Medical Provider and are intended solely to give the Provider additional information about an athlete's cognitive function. "Acceptable" means only that a Baseline score on a particular test is statistically within normal ranges. It does not guarantee that the Computerized Cognitive Assessment Tool (CCAT) results are an accurate measure of a particular athlete's cognitive function. Many factors can influence the quality and validity of CCAT results, including low motivation, distractions during test taking, emotional distress, lack of sleep, etc. A Baseline test should be repeated if it is suspected that such factors may have impaired the testing process.

Test Results

Task	Score	Acceptable
3 May 2019		
● Processing Speed	76.6	✗
Speed ¹	559 ms	
Accuracy ²	50.6%	
Hits ³	45	
Misses ⁴	44	
Anticipations ⁴	29	
▲ Attention	88.9	✗
Speed ¹	661 ms	
Accuracy ²	56.7%	
Hits ³	34	
Misses ⁴	26	
Anticipations ⁴	7	
◆ Learning	96.3	✓
Speed ¹	1021 ms	
Accuracy ²	65.9%	
Hits ³	56	
Misses ⁴	29	
Anticipations ⁴	3	
■ Working Memory Speed	86.5	✓
Speed ¹	1004 ms	
□ Working Memory Accuracy	75.4	✗
Accuracy ²	59.3%	
Hits ³	32	
Misses ⁴	22	
Anticipations ⁴	1	

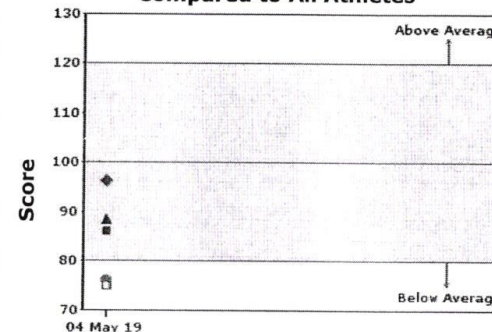
1. A higher value indicates a slower response
2. A higher value indicates a better response
3. A higher value indicates a better performance
4. A higher value indicates a poorer performance
5. Threshold is 1.65 standard deviations computed from age-based within-subject standard deviation

Note: Cognitive test results are standardised around a mean of 100 with a standard deviation of 10. All data is compared to age-matched normative baseline.

Explanation

The accuracy of responses need to be better. Please try again.

Compared to All Athletes

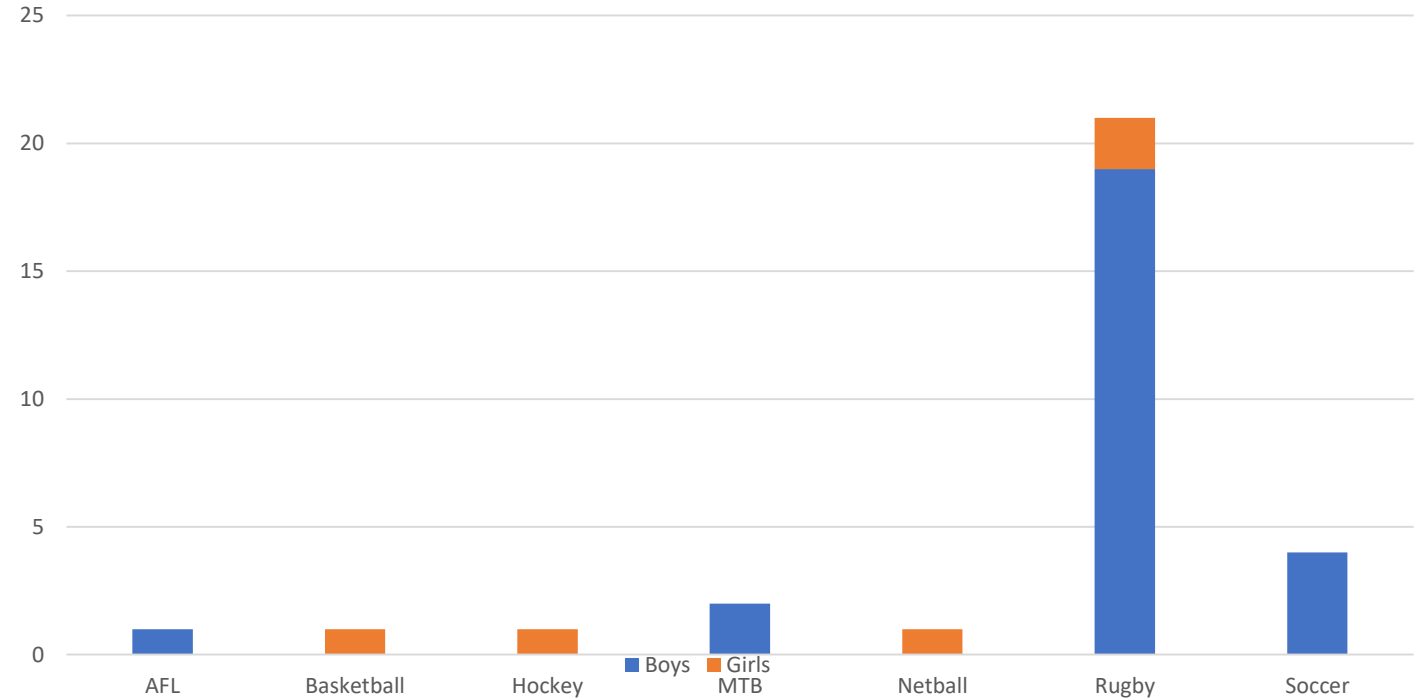


Warning: Taking this test will not prevent head injury. For more information on test reports and their meaning, visit concussion.cogstate.com. **Traumatic brain injury and concussion are very serious medical conditions. If it is suspected that an athlete may have sustained such an injury, they should immediately seek the care of a qualified Medical Provider. Only a qualified Medical Provider can safely make a decision on whether an athlete has sustained a traumatic brain injury or concussion or whether an athlete is ready to return to sports or school.** This report's sole purpose is to give qualified Medical Providers additional information about an athlete's cognitive function. Test data and results are to be interpreted by qualified Medical Providers and are never a substitute for their expert medical judgment. This report does not provide a medical diagnosis and return to play decisions must consider all clinical signs and symptoms, history of concussion, and the results of any other investigations undertaken (eg, MRI or CT scans). Many factors can influence the quality and validity of CCAT test results, including low motivation, distractions during test taking, emotional distress, lack of sleep, etc. A Baseline or After Injury test should be repeated if it is suspected that such factors may have impaired the testing process.

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Concussion by Sport Barker College 2018

- Winter sports dominate



Decision making

- Recognise and Remove from play
- Monitor
- Review post match and mid week
- Medical follow up



Game day – Home or hospital?

- Medical assessment
- Stable
- No driving
- Rest
- Panadol OK
- Prolonged LOC
- Increasing headache
- Vomiting
- Deteriorating symptoms, signs
- Children, any concerns

Rest and treatment/rehabilitation following sport-related concussion: a systematic review

Kathryn J Schneider,¹ John J Leddy,² Kevin M Guskiewicz,³ Tad Seifert,⁴ Michael McCrea,⁵ Noah D Silverberg,⁶ Nina Feddermann-Demont,^{7,8} Grant L Iverson,⁹ Alix Hayden,¹⁰ Michael Makdissi^{11,12}

- A brief period (24–48 hours) of cognitive and physical rest is appropriate for most patients.
- Following this, patients should be encouraged to gradually increase activity.
- The exact amount and duration of rest are not yet well defined and require further investigation.
- The data support interventions including cervical and vestibular rehabilitation and multifaceted collaborative care.
- Closely monitored subsymptom threshold, submaximal exercise may be of benefit.

Management

- Rest
 - Screen time, school, exams, exercise, training
- Brain rehab
- Medical review
- Graded Return to training / Play



Follow up assessment

- SCAT 5
 - Symptoms
 - Cognitive processing
 - Memory
 - Concentration
 - Balance
- Computer-based testing
 - Cogstate
 - Compare with baseline

3

STEP 3: COGNITIVE SCREENING
Standardised Assessment of Concussion (SAC)⁴

ORIENTATION

What month is it?	0	1
What is the date today?	0	1
What is the day of the week?	0	1
What year is it?	0	1
What time is it right now? (within 1 hour)	0	1
Orientation score	of 5	

IMMEDIATE MEMORY

The Immediate Memory component can be completed using the traditional 5-word per trial list or optionally using 10-words per trial to minimise any ceiling effect. All 3 trials must be administered irrespective of the number correct on the first trial. Administer at the rate of one word per second.

Please choose EITHER the 5 or 10 word list groups and circle the specific word list chosen for this test.

I am going to test your memory. I will read you a list of words and when I am done, repeat back as many words as you can remember, in any order. For Trials 2 & 3: I am going to repeat the same list again. Repeat back as many words as you can remember in any order, even if you said the word before.

List	Alternate 5 word lists					Score (of 5)		
						Trial 1	Trial 2	Trial 3
A	Finger	Penny	Blanket	Lemon	Insect			
B	Candle	Paper	Sugar	Sandwich	Wagon			
C	Baby	Monkey	Perfume	Sunset	Iron			
D	Elbow	Apple	Carpet	Saddle	Bubble			
E	Jacket	Arrow	Pepper	Cotton	Movie			
F	Dollar	Honey	Mirror	Saddle	Anchor			
Immediate Memory Score						of 15		
Time that last trial was completed								

List	Alternate 10 word lists					Score (of 10)		
						Trial 1	Trial 2	Trial 3
G	Finger	Penny	Blanket	Lemon	Insect			
	Candle	Paper	Sugar	Sandwich	Wagon			
H	Baby	Monkey	Perfume	Sunset	Iron			
	Elbow	Apple	Carpet	Saddle	Bubble			
I	Jacket	Arrow	Pepper	Cotton	Movie			
	Dollar	Honey	Mirror	Saddle	Anchor			
Immediate Memory Score						of 30		
Time that last trial was completed								

Name: _____

DOB: _____

Address: _____

ID number: _____

Examiner: _____

Date: _____

CONCENTRATION

DIGITS BACKWARDS

Please circle the Digit list chosen (A, B, C, D, E, F). Administer at the rate of one digit per second reading DOWN the selected column.

I am going to read a string of numbers and when I am done, you repeat them back to me in reverse order of how I read them to you. For example, if I say 7-1-9, you would say 9-1-7.

Concentration Number Lists (circle one)					
List A	List B	List C			
4-9-3	5-2-6	1-4-2	Y	N	0
6-2-9	4-1-5	6-5-8	Y	N	1
3-8-1-4	1-7-9-5	6-8-3-1	Y	N	0
3-2-7-9	4-9-6-8	3-4-8-1	Y	N	1
6-2-9-7-1	4-8-5-2-7	4-9-1-5-3	Y	N	0
1-5-2-8-6	6-1-8-4-3	6-8-2-5-1	Y	N	1
7-1-8-4-6-2	8-3-1-9-6-4	3-7-6-5-1-9	Y	N	0
5-3-9-1-4-8	7-2-4-8-5-6	9-2-6-5-1-4	Y	N	1
List D	List E	List F			
7-8-2	3-8-2	2-7-1	Y	N	0
9-2-6	5-1-8	4-7-9	Y	N	1
4-1-8-3	2-7-9-3	1-6-8-3	Y	N	0
9-7-2-3	2-1-6-9	3-9-2-4	Y	N	1
1-7-9-2-6	4-1-8-6-9	2-4-7-5-8	Y	N	0
4-1-7-5-2	9-4-1-7-5	8-3-9-6-4	Y	N	1
2-6-4-8-1-7	6-9-7-3-8-2	5-8-6-2-4-9	Y	N	0
8-4-1-9-3-5	4-2-7-9-3-8	3-1-7-8-2-6	Y	N	1
Digits Score:			of 4		

MONTHS IN REVERSE ORDER

Now tell me the months of the year in reverse order. Start with the last month and go backward. So you'll say December, November. Go ahead.

Dec - Nov - Oct - Sept - Aug - Jul - Jun - May - Apr - Mar - Feb - Jan	0	1
Months Score	of 1	
Concentration Total Score (Digits + Months)	of 5	

© Concussion in Sport Group 2017
Echemendia RJ, et al. Br J Sports Med 2017;51:851-858. doi:10.1136/bjsports-2017-097506SCAT5

After Injury Test Report

This is not a Medical Diagnosis. After Injury reports should be interpreted only by a qualified Medical Provider and are intended solely to give the Provider additional information about an athlete's cognitive function.



Athlete Information

Name: _____
Birth Year: 2001
Age: 18
Gender: Male
Dominant Hand: Right
Test Date: 15 Apr 2019
Test Time: 02:30 PM
Test Duration: 436 seconds
Baseline Date: 17 Mar 2019

Test ID: 30003

Integrity Checks

Processing Accuracy > 80% (100%) ✓
Attention Accuracy > 80% (91%) ✓
Learning Accuracy > 53% (71%) ✓
W. Memory Accuracy > 53% (97%) ✓
Processing Speed < Attention Speed ✓
Processing Speed < W. Memory Speed ✓

Note: This is not a Medical Diagnosis. After Injury reports should be interpreted only by a qualified Medical Provider and are intended solely to give the Provider additional information about an athlete's cognitive function. "Acceptable" means only that a Baseline score on a particular test is statistically within normal ranges. It does not guarantee that the Computerized Cognitive Assessment Tool (CCAT) results are an accurate measure of a particular athlete's cognitive function. Many factors can influence the quality and validity of CCAT results, including low motivation, distractions during test taking, emotional distress, lack of sleep, etc. A Baseline test should be repeated if it is suspected that such factors may have impaired the testing process.

Test Results

Task	Baseline Score 17 Mar 2019	After Injury Score 15 Apr 2019	Significant Decline ⁵	Acceptable
Processing Speed	107.1	107.5		✓
Speed ¹	270 ms	267 ms		
Accuracy ²	97.3%	100%		
Hits ³	36	35		
Misses ⁴	1	0		
Anticipations ⁴	1	0		
Attention	108.4	106.0	No 2.4 (N<9.1)	✓
Speed ¹	414 ms	440 ms		
Accuracy ²	93.8%	90.9%		
Hits ³	30	30		
Misses ⁴	2	3		
Anticipations ⁴	0	0		
Learning	102.5	101.4	No 1.1 (N<11.4)	✓
Speed ¹	923 ms	597 ms		
Accuracy ²	72.5%	71.3%		
Hits ³	58	57		
Misses ⁴	22	23		
Anticipations ⁴	0	0		
Working Memory Speed	109.6	111.6		✓
Speed ¹	519 ms	489 ms		
Working Memory Accuracy	106.1	106.1		✓
Accuracy ²	96.9%	96.9%		
Hits ³	31	31		
Misses ⁴	1	1		
Anticipations ⁴	0	0		

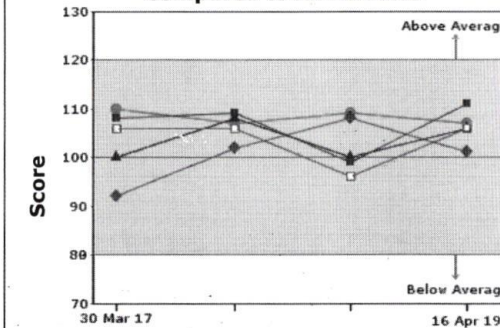
1. A higher value indicates a slower response
2. A higher value indicates a better response
3. A higher value indicates a better performance
4. A higher value indicates a poorer performance
5. Threshold is 1.65 standard deviations computed from age-based within-subject standard deviation

Note: Cognitive test results are standardised around a mean of 100 with a standard deviation of 10. All data is compared to age-matched normative baseline.

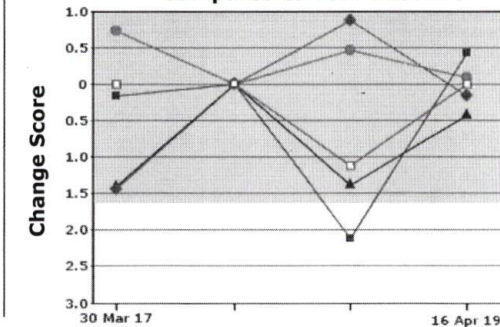
Explanation

All tasks were performed within an acceptable margin of the previous Baseline performance.

Compared to All Athletes



Compared to Your Baseline



Warning: Taking this test will not prevent head injury. For more information on test reports and their meaning, visit concussion.cogstate.com. **Traumatic brain injury and concussion are very serious medical conditions. If it is suspected that an athlete may have sustained such an injury, they should immediately seek the care of a qualified Medical Provider. Only a qualified Medical Provider can safely make a decision on whether an athlete has sustained a traumatic brain injury or concussion or whether an athlete is ready to return to sports or school.** This report's sole purpose is to give qualified Medical Providers additional information about an athlete's cognitive function. Test data and results are to be interpreted by qualified Medical Providers and are never a substitute for their expert medical judgment. This report does not provide a medical diagnosis and return to play decisions must consider all clinical signs and symptoms, history of concussion, and the results of any other investigations undertaken (eg, MRI or CT scans). Many factors can influence the quality and validity of CCAT test results, including low motivation, distractions during test taking, emotional distress, lack of sleep, etc. A Baseline or After Injury test should be repeated if it is suspected that such factors may have impaired the testing process.

Questions? If you have questions regarding this test, please feel free to contact us customerservice@cogstate.com. You can also call us at 1.877.399.2966 between 8 am and 8 pm CST. Please be advised that our customer service representatives are not authorized nor able to provide medical counsel or advice of any kind. Such issues should be discussed with a qualified Medical Provider.

What is the physiological time to recovery after concussion? A systematic review

Joshua Kamins,^{1,2} Erin Bigler,³ Tracey Covassin,⁴ Luke Henry,⁵ Simon Kemp,⁶ John J Leddy,⁷ Andrew Mayer,⁸ Michael McCrea,⁹ Mayumi Prins,¹⁰ Kathryn J Schneider,¹¹ Tamara C Valovich McLeod,¹² Roger Zemek,¹³ Christopher C Giza^{1,2,14}

- Due to differences in modalities, time course, study design and outcomes, it is not possible to define a single ‘physiological time window’ for SRC recovery.
- Multiple studies suggest physiological dysfunction may outlast current clinical measures of recovery, supporting a buffer zone of gradually increasing activity before full contact risk.
- Future studies need to use generalisable populations, longitudinal designs following to physiological and clinical recovery and careful correlation of neurobiological modalities with clinical measures.

What is the difference in concussion management in children as compared with adults? A systematic review

Gavin A Davis,¹ Vicki Anderson,¹ Franz E Babl,¹ Gerard A Gioia,² Christopher C Giza,³ William Meehan,⁴ Rosemarie Scolaro Moser,⁵ Laura Purcell,⁶ Philip Schatz,⁷ Kathryn J Schneider,⁸ Michael Takagi,¹ Keith Owen Yeates,⁹ Roger Zemek¹⁰

- All schools be encouraged to have a concussion policy and should offer appropriate academic accommodations and support to students recovering from SRC;
- children and adolescents should not RTS until they have successfully returned to school, however early introduction of symptom-limited physical activity is appropriate.

Concussion Rehab, Return to play

- Symptom free by tuesday clinic
- 1 week off training
- 1 week GRTP
 - Includes non contact training
- 1 week full training
- RTP no earlier than 19 days



Approach to investigation and treatment of persistent symptoms following sport-related concussion: a systematic review

Michael Makdissi,^{1,2,3} Kathryn J Schneider,^{4,5,6} Nina Feddermann-Demont,^{7,8}
Kevin M Guskiewicz,⁹ Sidney Hinds,¹⁰ John J Leddy,¹¹ Michael McCrea,¹²
Michael Turner,^{13,14} Karen M Johnston¹⁵

- ‘Persistent symptoms’ > 10-14 days in adults; > 4 weeks in children.
- A detailed multimodal clinical assessment is required to identify specific primary and secondary processes, and treatment should target specific pathologies identified.
- There is preliminary evidence supporting the use of symptom-limited aerobic exercise, targeted physical therapy and a collaborative approach that includes cognitive behavioural therapy.
- Management of patients with persistent symptoms is challenging and should occur in a multidisciplinary collaborative setting, with healthcare providers with experience in SRC.

Prolonged concussion symptoms

- Unpredictable
- Headache, poor concentration, vestibular
 - School, exercise, music
- Uncertain duration
- Further scans, investigation
- Low intensity exercise





Sports Concussion and Chronic Traumatic Encephalopathy

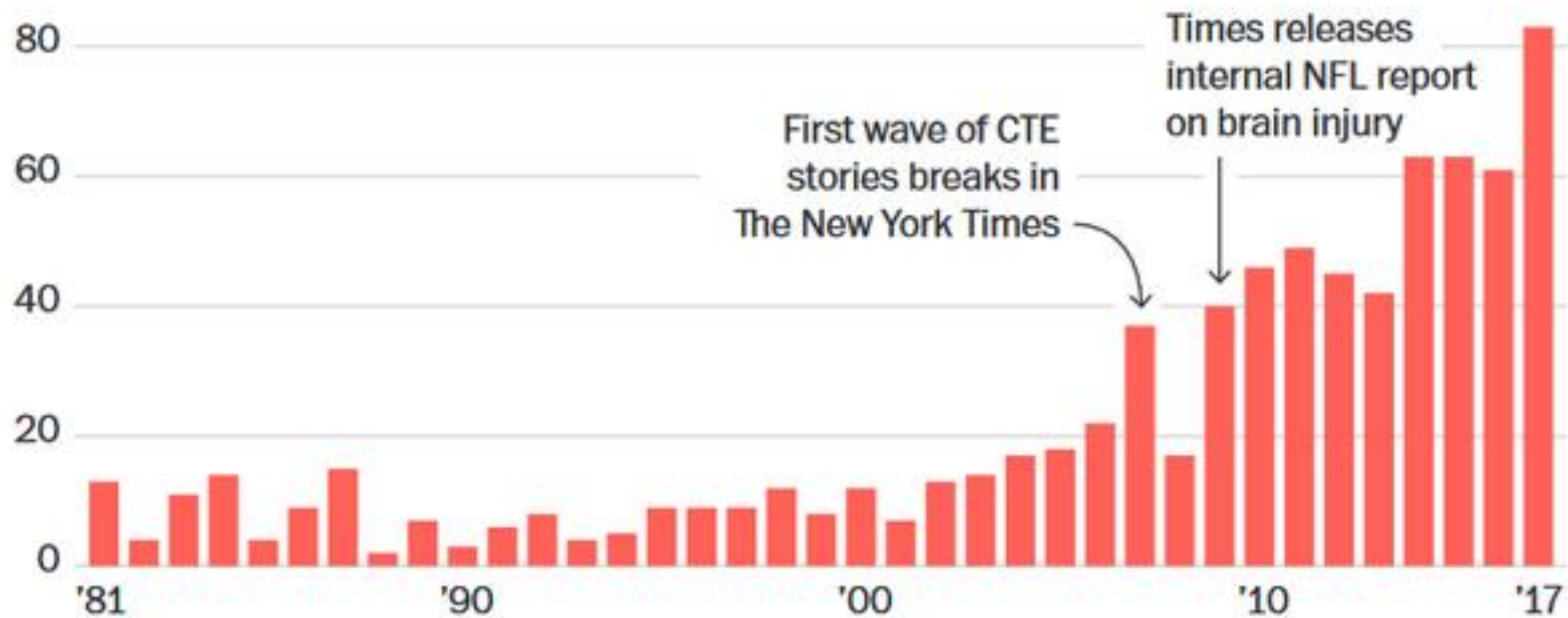
As long as people play sports, there will be concussions...are there long term effects?

Headlines travel fast

Science takes time

Late-breaking headlines

Number of articles containing “brain damage” or “brain injury” and “football” published in The Washington Post and The New York Times



Sources: LexisNexis (stories); Pro Football Reference (ages)

THE WASHINGTON POST



76 of 79 Deceased NFL Players Found to Have Brain Disease

September 30, 2014, 2:57 pm ET by Jason M. Breslow [Follow @jbreslow](#)

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As the NFL nears an end to its long-running legal battle over concussions, new data from the nation's largest brain bank focused on traumatic brain injury has found

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Game of Life and Death: As concerns about CTE grow and players suffer from deadly disease, future of football looks bleak

Brain disease affects 99% of NFL players in study

© 25 July 2017 US & Canada

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The donated brains of college and high school players were also studied

A study of American football players' brains has found that 99% of professional NFL athletes tested had a disease associated with head injuries.

The report published on Tuesday in the Journal of the American Medical Association studied 202 deceased players - 111 of them from the NFL.

All but one former National Football League player were found to have chronic traumatic encephalopathy (CTE).

The study is the largest of its kind yet conducted, its authors say.

The invisible plague of concussion

Dr. Ann McKee, director of Boston University's CTE Center, which led the study

Review

The Need to Separate Chronic Traumatic Encephalopathy Neuropathology from Clinical Features

Grant L. Iverson^{a,*}, C. Dirk Keene^b, George Perry^c and Rudolph J. Castellani^d

^a*Department of Physical Medicine and Rehabilitation, Harvard Medical School, Spaulding Rehabilitation Hospital, MassGeneral Hospital for Children™ Sports Concussion Program, and Home Base, A Red Sox Foundation and Massachusetts General Hospital Program, Boston, MA, USA*

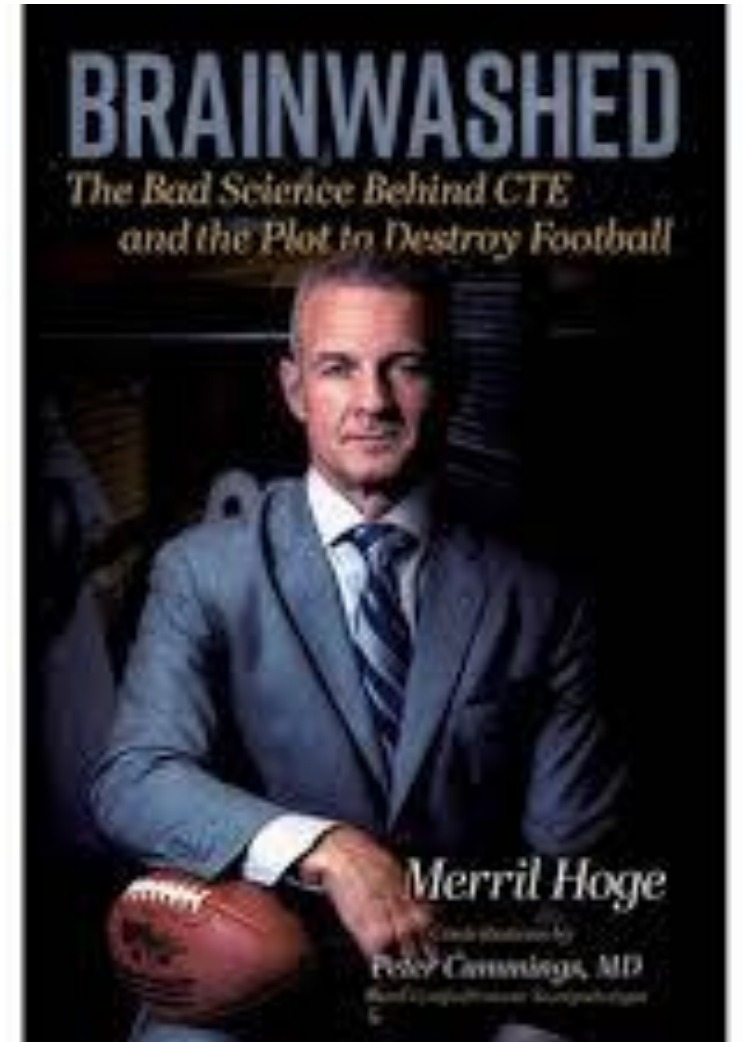
^b*Department of Pathology, Division of Neuropathology, University of Washington School of Medicine, Seattle, WA, USA*

^c*College of Sciences, University of Texas, San Antonio, San Antonio, TX, USA*

^d*Center for Neuropathology, Western Michigan University Homer Stryker MD School of Medicine, Kalamazoo, MI, USA*

Chronic Traumatic Encephalopathy

- Narrative dominated by one research group in Boston
- Multiple co-factors – vascular, genetic, drug and alcohol use, psychological...
- Some patients with CTE have never played sport or had a concussion
- While we are not sure we must manage all suspected concussions conservatively.



Concussion – key messages

- A brain injury ranging from mild.....severe
- Know and recognise the symptoms, remove from play and do not return on the same day
- Not all head injuries = concussion, but all head injuries require assessment and monitoring
- Rehab requires symptom resolution..... medical review ... graded return to training..... and then play at 3 weeks +
- Guidelines exist for player welfare



Questions

