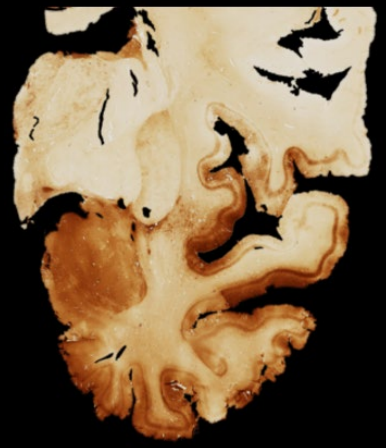
the injured brain, *the injured mind*.

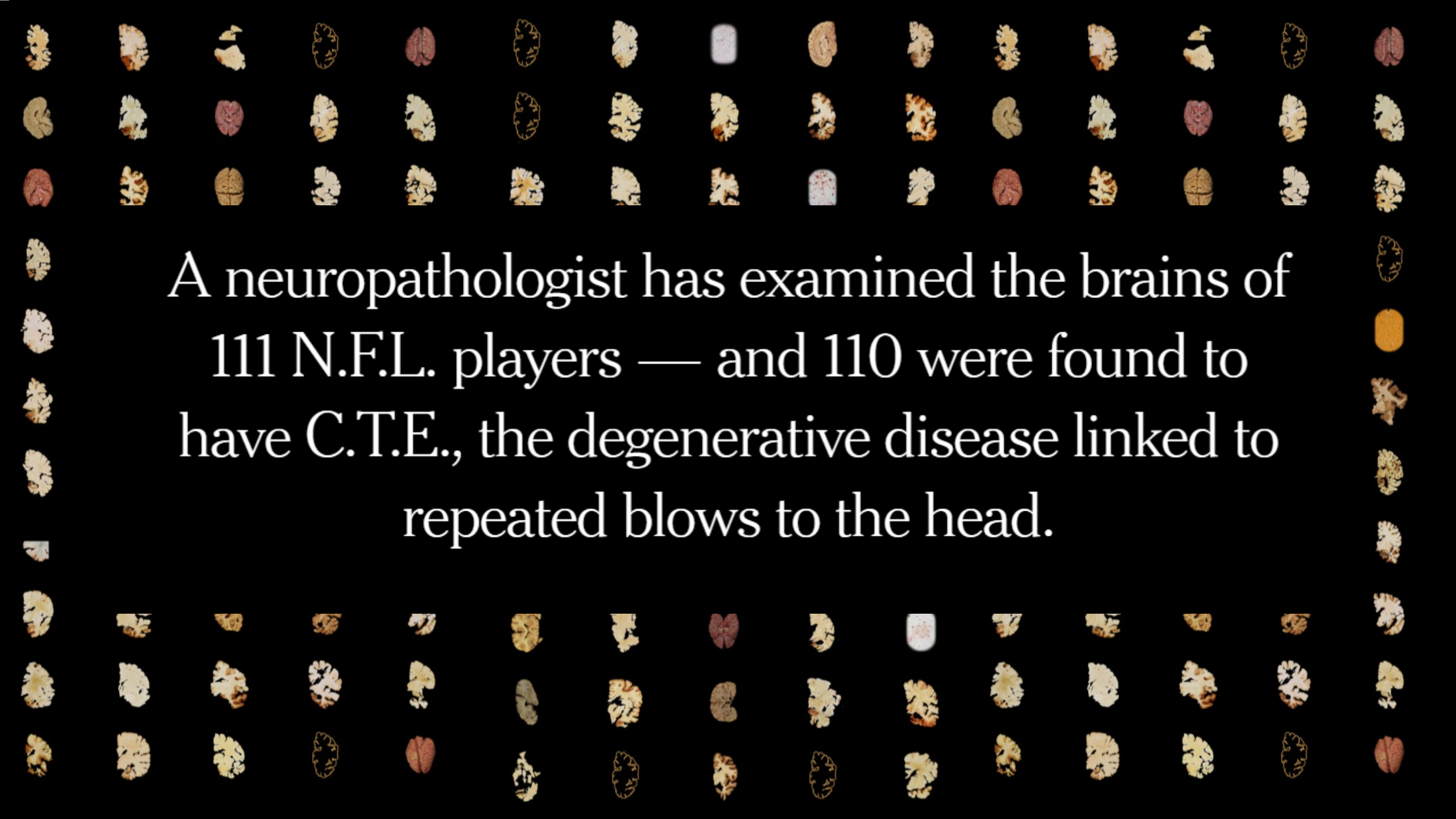
mary et boyle, ph.d.
department of cognitive science
ucsd

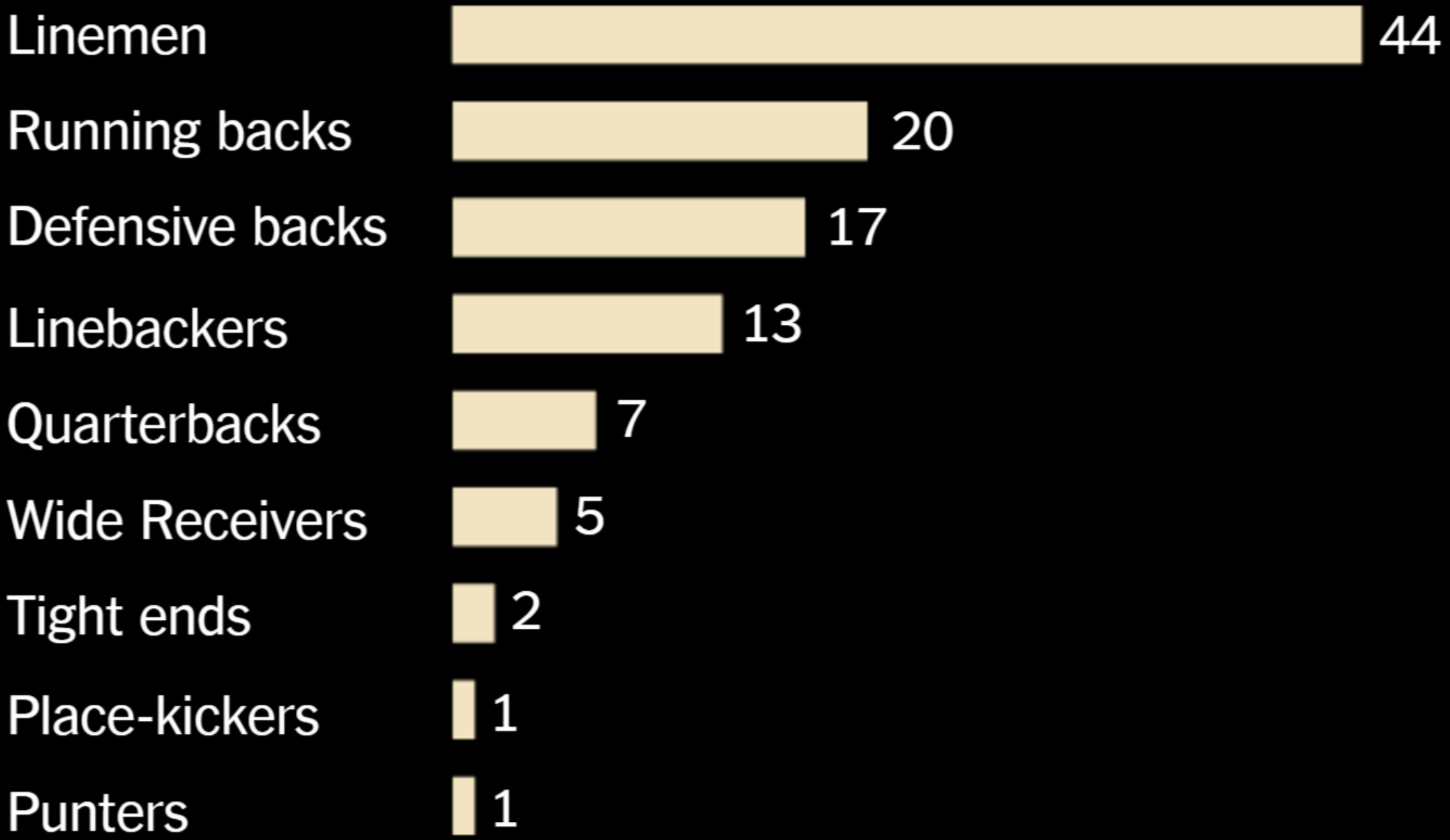
Part 2



110

N.F.L. Brains


A neuropathologist has examined the brains of 111 N.F.L. players — and 110 were found to have C.T.E., the degenerative disease linked to repeated blows to the head.


Linemen
44
Running backs
20
Defensive backs
17
Linebackers
13
Quarterbacks
7
Wide Receivers
5
Tight ends
2
Place-kickers
1
Punters
1

44

Linemen

Daniel Colchico

Pete Duranko

Tom Keating

Tom Mchale

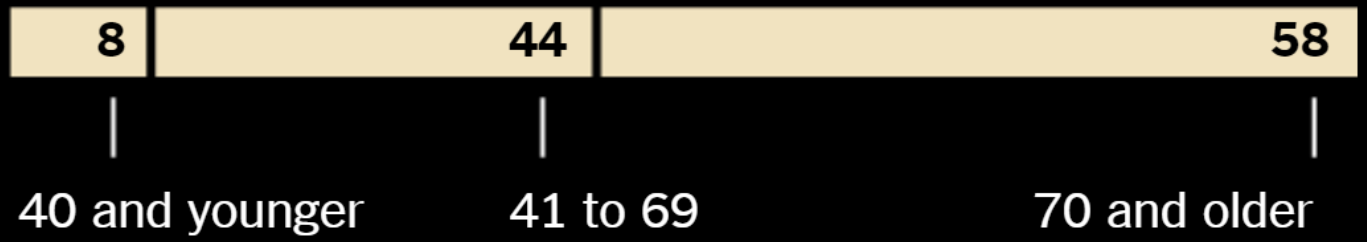
Mike Pyle

Gerry Huth

Joe O'Malley

John Wilbur

Age ranges at time of death



Dr. McKee found the disease at a level similar to that found in Seau's brain, and it was in the region of the brain that is consistent with the symptoms he was exhibiting.

Sash's mother, Barnetta Sash, said: "Now it makes sense. The part of the brain that controls impulses, decision-making and reasoning was damaged badly."

CTE confirmed

"One of the problems with CTE cases is that some of them end in suicide. The suicides are often precipitous, without warning," said neurosurgeon Julian Bailes, a co-author of the report and co-director of the NorthShore Neurological Institute in Evanston, Ill.

Gary Mihoces, USA TODAY Sports

Officially, Seau never suffered a concussion during a two-decade career with the San Diego Chargers, Miami Dolphins and New England Patriots that ended with his 2009 retirement. But Walczak, a former tight end and long snapper in the NFL, believes his friend suffered multiple undiagnosed concussions.

"Junior just didn't report head injuries," Walczak said. "I had (unreported) concussions, too, especially back when guys were allowed to tee off on the long snappers. But you just don't report them. You're a football player. You're tough. If you did report stuff like that, next thing you know you're on waivers."

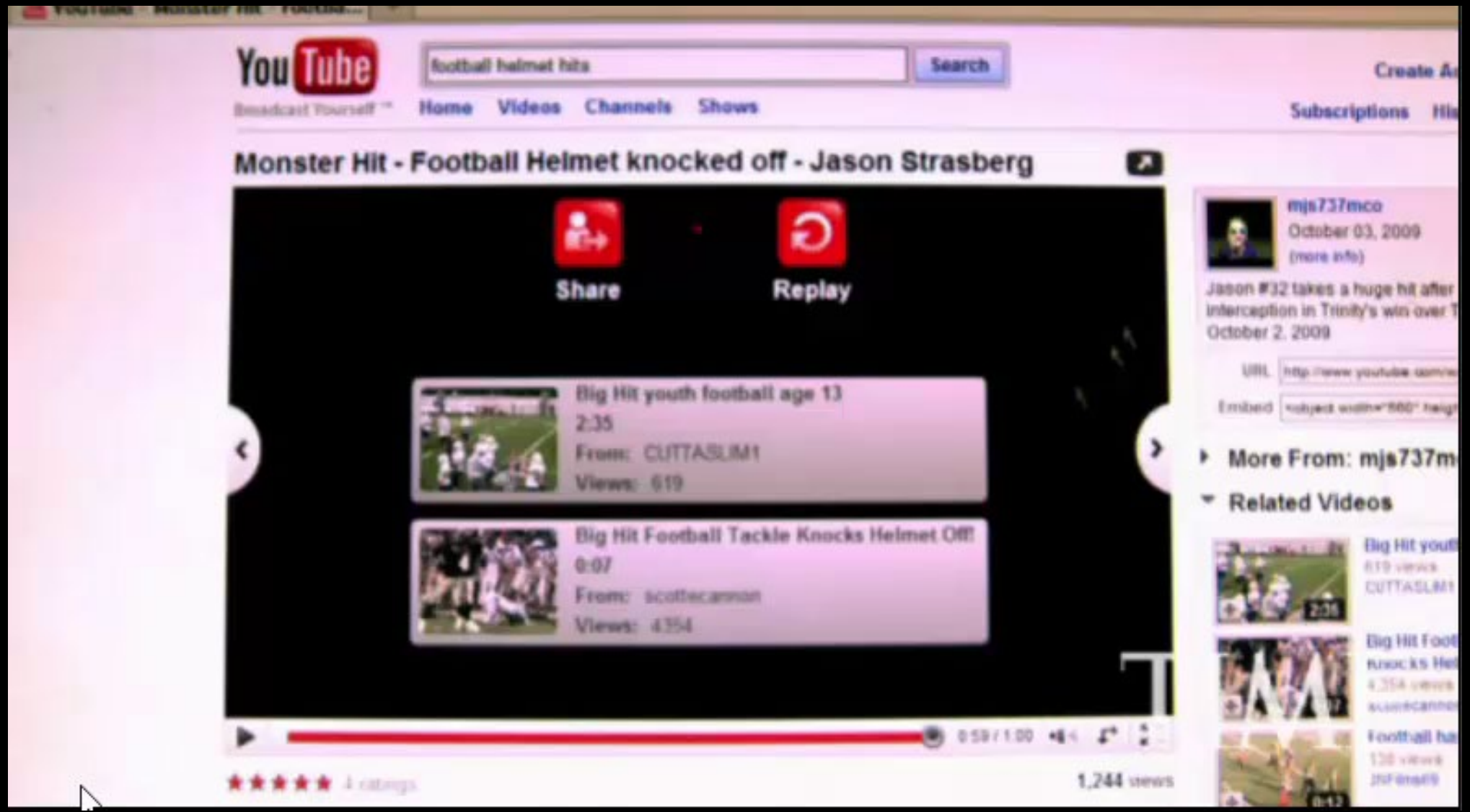
Erik Brady and Gary Mihoces, USA TODAY Sports

Seau brain disease sends alarms among players, critics

Word came Thursday that Seau had a degenerative brain disease when he shot himself in the chest last May. Most shocking was that it was hardly a shock at all. His is merely the latest of dozens of cases of former pro football players who died with signs of chronic traumatic encephalopathy (CTE) and the third by suicide in recent times.

"**On initial examination the brain looked normal but under the microscope, with the use of special staining techniques, abnormalities were found that were consistent**" with a form of CTE, NIH said in a statement. It added that a small region of Seau's left frontal lobe showed scarring consistent with a small, old, traumatic brain injury.

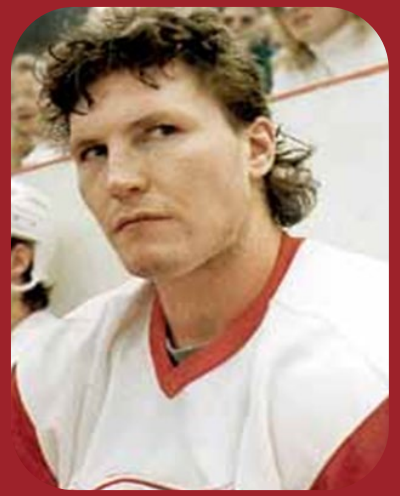
Erik Brady and Gary Mihoces, USA TODAY Sports



http://www.time.com/time/video/player/0,32068,64253995001_1957921,00.html

Chris Benoit

Reggie Fleming



Bob Probert

Wrestling

Ice Hockey

“Women report more severe symptoms and longer recovery times than men following brain injuries in sports”

Repeatedly heading a soccer ball exacts a toll on an athlete's brain.

The study authors found that female amateur soccer players who frequently head balls showed more white matter brain alterations than their male counterparts. The study included 49 women and 49 men, ages 18 to 50, and examined MRI imaging of players' brains. Each female player was compared to a male player of a similar age and with other similar characteristics including frequency of heading exposure.

https://www.npr.org/sections/health-shots/2018/07/31/634263471/heading-may-be-riskier-for-women-soccer-players-than-men

MRI-defined White Matter Microstructural Alteration Associated with Soccer Heading Is More Extensive in Women than Men

*Todd G. Rubin, MS** • *Eva Catenaccio, MD** • *Roman Fleysher, PhD* • *Liane E. Hunter, MS* • *Naomi Lubin, BA* • *Walter F. Stewart, PhD* • *Mimi Kim, ScD* • *Richard B. Lipton, MD* • *Michael L. Lipton, MD, PhD*

From the Gruss Magnetic Resonance Research Center, Department of Radiology (T.G.R., R.F., L.E.H., N.L., M.L.L.), Departments of Epidemiology and Population Health (M.K., R.B.L.), Neurology (R.B.L.), and Psychiatry and Behavioral Sciences (M.L.L.), and the Dominick P. Purpura Department of Neuroscience (T.G.R., M.L.L.), Albert Einstein College of Medicine, 1300 Morris Park Ave, Bronx, NY 10461; Departments of Radiology (M.L.L.) and Neurology (R.B.L.), Montefiore Medical Center, Bronx, NY; Department of Pediatrics, Johns Hopkins University, Baltimore, Md (E.C.); and Sutter Health, Walnut Creek, Calif (W.F.S.). Received January 29, 2018; revision requested April 13; final revision received May 2; accepted May 22. **Address correspondence to** M.L.L. (e-mail: *michael.lipton@einstein.yu.edu*).

Supported by the National Institutes of Health, National Institute of Neurologic Disorders and Stroke (R01 NS082432), and a grant from the Dana Foundation David Mahoney Neuroimaging Program.

*T.G.R. and E.C. contributed equally to this work.

Conflicts of interest are listed at the end of this article.

Radiology 2018; 289:478–486 • https://doi.org/10.1148/radiol.2018180217 • Content code: NR

Purpose: To examine the role of sex in abnormal white matter microstructure after soccer heading as identified by using the diffusion-tensor imaging (DTI) metric fractional anisotropy (FA).

Materials and Methods: In this prospective cross-sectional study, 98 individuals who were enrolled in a larger prospective study of amateur soccer players (from 2013 to 2016) were matched 1:1 for age and history of soccer heading in the prior 12 months. Among the subjects, 49 men (mean age, 25.7 years; range, 18–50 years) and 49 women (mean age, 25.8 years; range, 18–50 years)

MALE ↘ FEMALE ↘

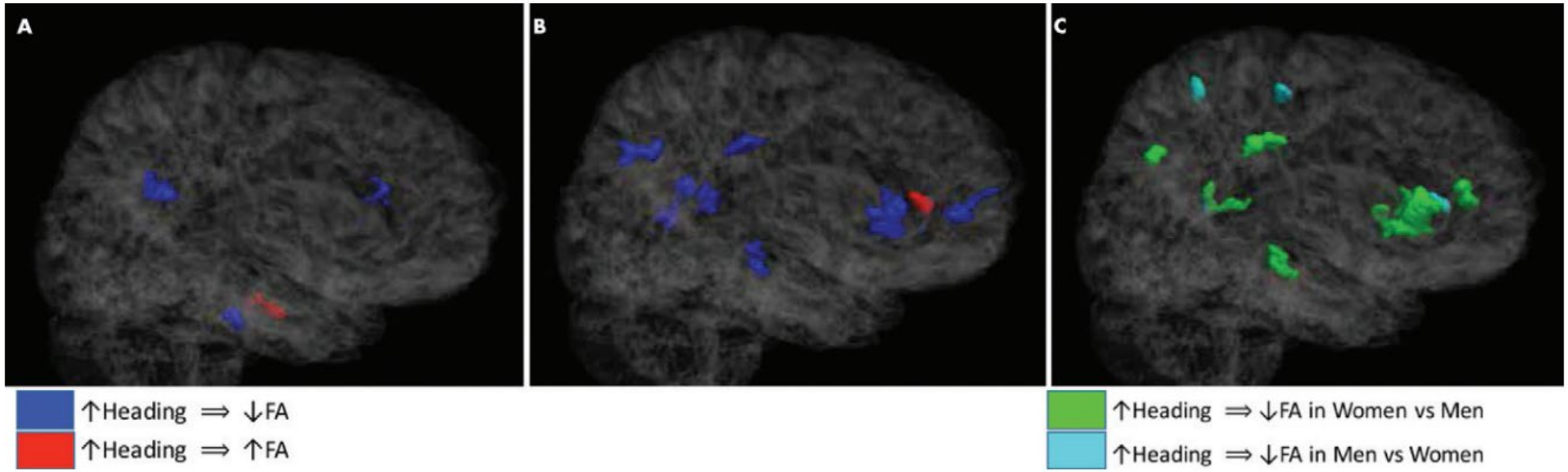


Figure 2: *A, B,* Three-dimensional semitransparent images of the Johns Hopkins University template brain oriented facing the right hemisphere in, *A,* male, and, *B,* female soccer players demonstrate that lower fractional anisotropy (FA) is associated with heading more extensively in women than in men. Fewer regions of significant association of FA with heading are detected in men than in women. *C,* Image shows that significant differences in association of heading and FA between men and women are predominantly co-located with areas where women, but not men, show significant association of heading and FA.

https://pubs.rsna.org/doi/pdf/10.1148/radiol.2018180217

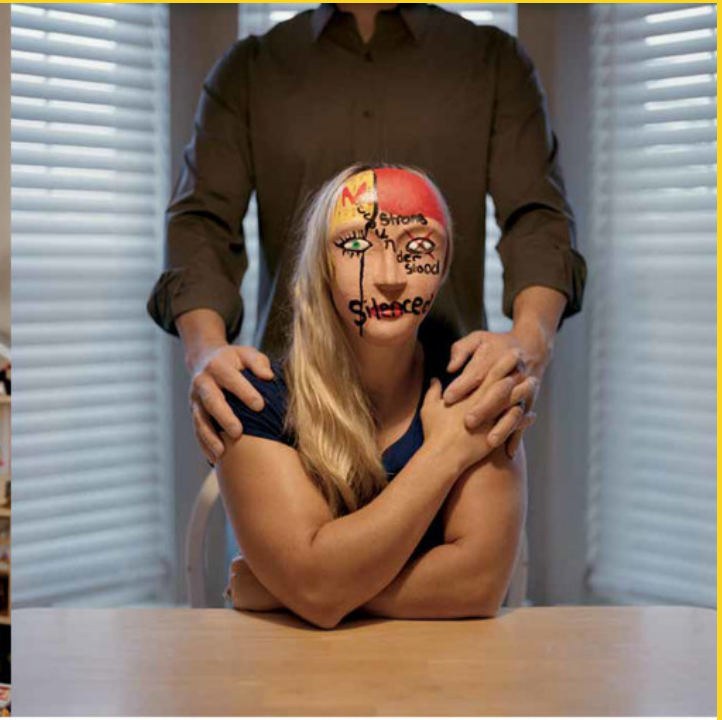
It isn't about concussions!

One should look at the sub-concussive injuries.

The injuries that the athlete does not think is a problem.

It is those injuries which might have long term problems!

https://www.npr.org/sections/health-shots/2018/07/31/634263471/heading-may-be-riskier-for-women-soccer-players-than-men



Marine Gunnery Sgt. Aaron Tam (Ret.)
Iraq 2004-05, 2007-08

"Detonation happened, and I was right there in the blast seat. I got blown up. And all this medical study—nobody ever thought that they [blast events] were very harmful, and so we didn't log them, which we should because all blast forces are cumulative to the body. On a grade number for me, it would probably be 300-plus explosions… I'm not going to not play with my children. I'm not going to let my injuries stop them from having a good life."

PHOTOGRAPHED WITH HIS WIFE, ANGELA, AND THEIR TWO CHILDREN

Marine Gunnery Sgt. Tiffany H.
Iraq 2007-08, Afghanistan 2010-11

Tiffany H., as she prefers to be known, was "blown up" while helping women in a remote Afghan village earn additional income for their families. Memory loss, balance difficulties, and anxiety are among her many symptoms. The blinded eye and sealed lips on her mask are common symbols used by blast-injured soldiers.

https://www.nationalgeographic.com/healing-soldiers/blast-force.html

BLAST FORCE

The Invisible War on the Brain

Brain trauma from blast force is the signature injury of the Iraq and Afghanistan campaigns, afflicting hundreds of thousands of U.S. combat personnel. Although unseen, the damage strikes deeply into a soldier's mind and psyche.

Marines on patrol in Afghanistan in 2009 noticed a motorcyclist pass by, and moments later an IED exploded. "It's like being kicked by a horse, a horse with a foot that could cover your entire body," said one survivor of an IED attack. PETER VAN AGTMAEL, MAGNUM PHOTOS

https://www.nationalgeographic.com/healing-soldiers/blast-force.html

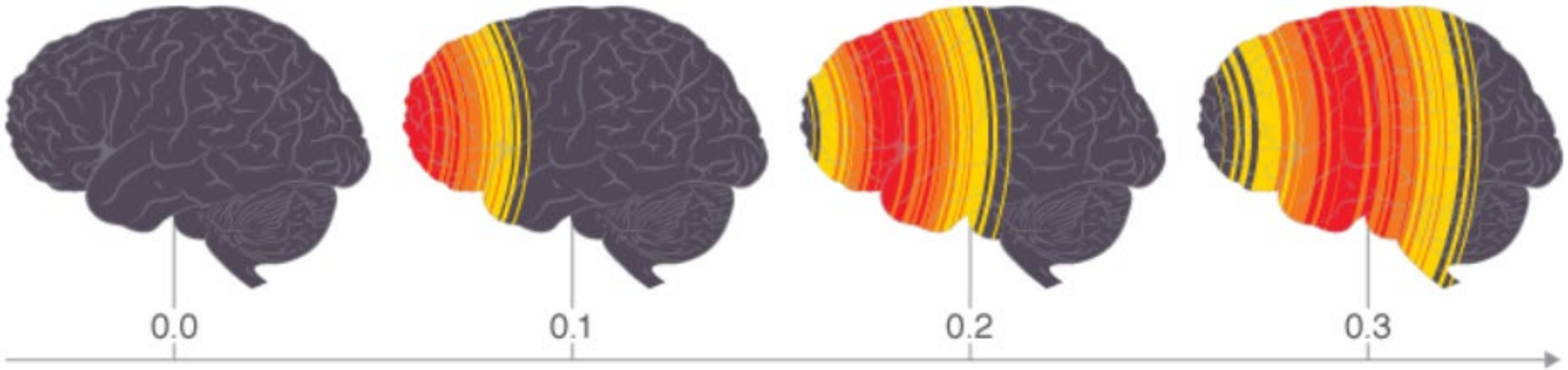
The shock wave from a distant explosion "felt like it lifted my innards and put them back down."

—Kevin Parker

https://www.nationalgeographic.com/healing-soldiers/blast-force.html

Blast in the Brain

Studies show that the key mechanical factors associated with brain injury are an increase in intracranial pressure and the brain's motion relative to the skull. The blast wave, or overpressure, affects the brain immediately upon impact with the skull. Pressure in the brain returns to normal after only a few milliseconds, but brain motion can occur for hundreds of milliseconds after impact.

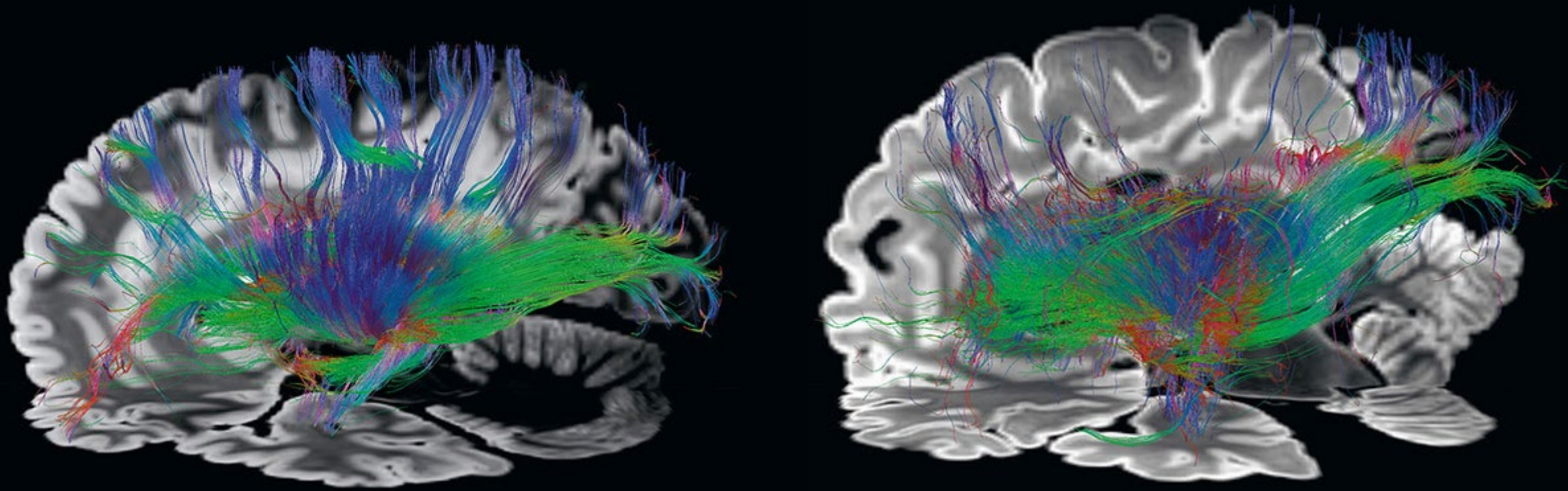


BLAST WAVE TRANSMISSION

in milliseconds

JASON TREAT, NGM STAFF. SOURCE: ANDREW MERKLE, JOHNS HOPKINS UNIVERSITY APPLIED PHYSICS LABORATORY

https://www.nationalgeographic.com/healing-soldiers/blast-force.html



IMAGES *(LEFT)* COURTESY BRIAN L. EDLOW, MASSACHUSETTS GENERAL HOSPITAL;
(*RIGHT*) *JOURNAL OF NEUROPATHOLOGY AND EXPERIMENTAL NEUROLOGY*

https://www.nationalgeographic.com/healing-soldiers/blast-force.html

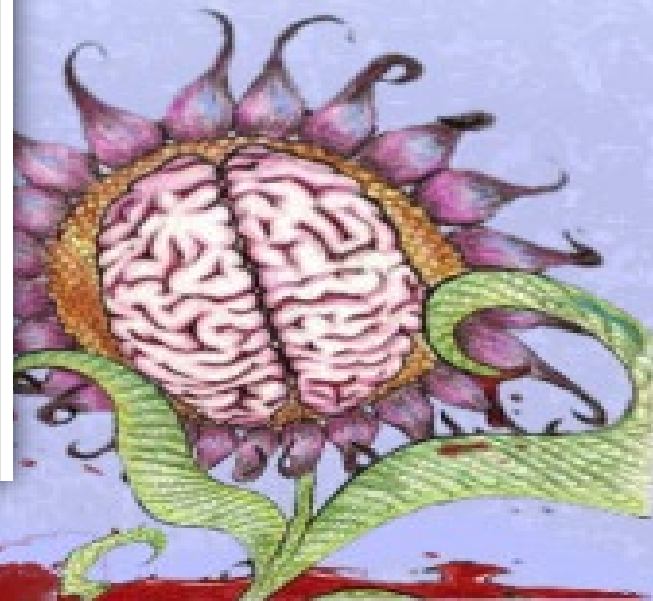
With Focus on Youth Safety, a Sport Considers Changes

David Duprey/Associated Press

The Sabres' Jason Pominville was concussed after a blindside hit against the glass on Oct. 11. A Mayo Clinic conference will discuss steps to prevent such injuries.

By JEFF Z. KLEIN
Published: October 17, 2010

http://www.nytimes.com/2010/10/18/sports/hockey/18hockey.html



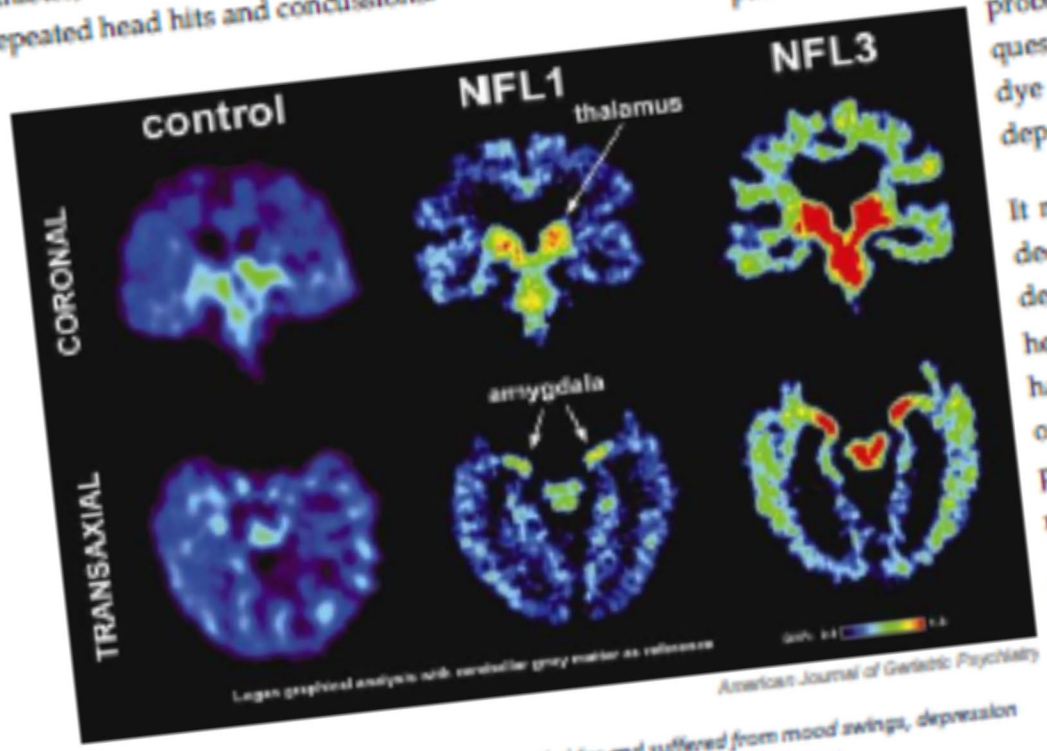
PET Scan May Reveal C.T.E. Signs, Study Says

The New York Times

By Ken Belson

Published: January 22, 2013

For years, researchers have had to use tissue obtained posthumously to diagnose chronic traumatic encephalopathy, or C.T.E., the degenerative brain disease that has bedeviled athletes, soldiers and others who have sustained repeated head hits and concussions.



American Journal of Geriatric Psychiatry

Five retired N.F.L. players who were 45 years and older and suffered from mood swings, depression and cognitive problems were given PET, or positron emission tomography, scans.

retired players was consistent with those found in the autopsies of players who had C.T.E.

But the size of the group was tiny. Far larger and more in-depth studies will be needed before PET scans may be used to identify the tau pathology in patients who are not already experiencing cognitive problems. Some doctors also questioned the accuracy of the dye used to identify tau deposits in the brain.

It may take years and perhaps decades for doctors to determine how much of a role head hits and brain trauma have in patients with C.T.E., as opposed to genetic predisposition and health maladies like heart disease.

But the study is a first step toward the possibility of using PET scans to develop strategies to prevent the onset of the disease and provide treatment for those who have it.

what about one season of contact sports in college?

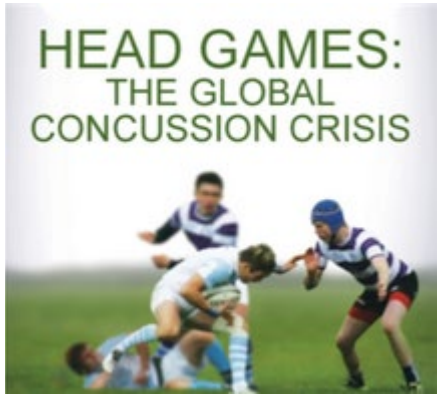
Cognitive effects of one season of head impacts in a cohort of collegiate contact sport athletes

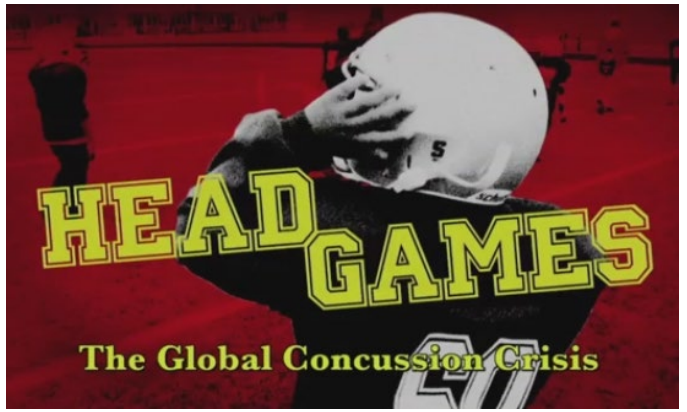
T.W. McAllister, MD
L.A. Flashman, PhD
A. Maerlender, PhD
R.M. Greenwald, PhD
J.G. Beckwith, MS
T.D. Tosteson, ScD
J.J. Crisco, PhD
P.G. Brolinson, DO
S.M. Duma, PhD
A.-C. Duhaime, MD
M.R. Grove, MS
J.H. Turco, MD

Conclusion:

Repetitive head impacts over the course of a single season may negatively impact learning in some collegiate athletes. Further work is needed to assess whether such effects are short term or persistent.

Neurology 2012;78:1777–1784





https://rent.headgamesthefilm.com/Home/Index

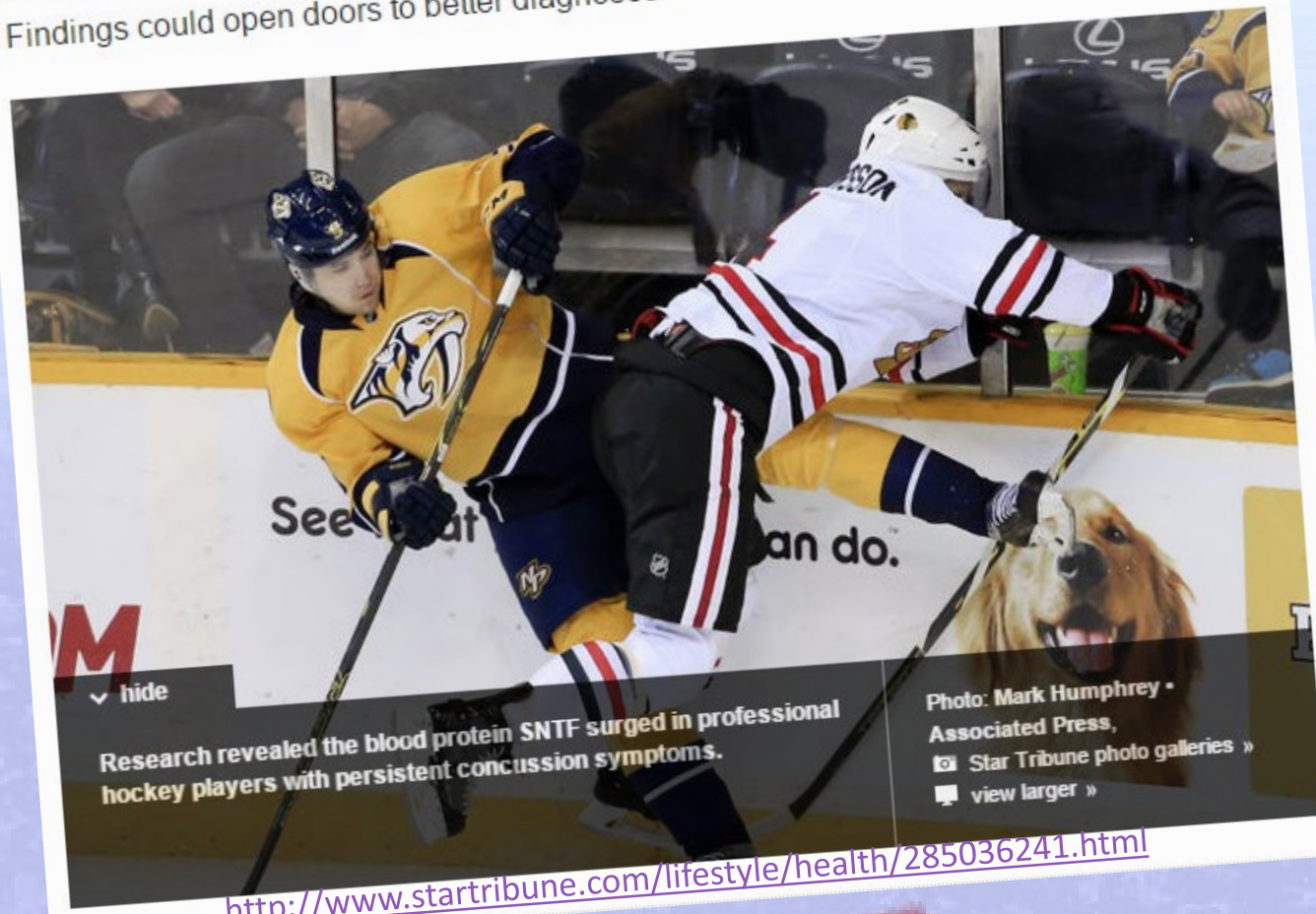
http://vitals.nbcnews.com/_news/2013/01/22/16646308-game-change-brain-scans-offer-new-view-of-nfl-concussions?lite

Game change: Brain scans offer new view of NFL concussions

Blood test shows promise in diagnosing concussions

Article by: MARIE MCCULLOUGH , Philadelphia Inquirer | Updated: December 7, 2014 - 8:19 PM

Findings could open doors to better diagnoses.



hide

Research revealed the blood protein SNTF surged in professional hockey players with persistent concussion symptoms.

Photo: Mark Humphrey • Associated Press,

Star Tribune photo galleries »

view larger »

http://www.startribune.com/lifestyle/health/285036241.html

Blood Test for Concussion Symptoms?

Serum SNTF Increases in Concussed Professional Ice Hockey Players

And Relates to the Severity of Post-Concussion Symptoms

Robert Siman, PhD, Pashtun Shahim, MD*, Yelverton Tegner, MD**, Kaj Blennow, MD PhD*,

Henrik Zetterberg, MD PhD*#, Douglas H. Smith, MD

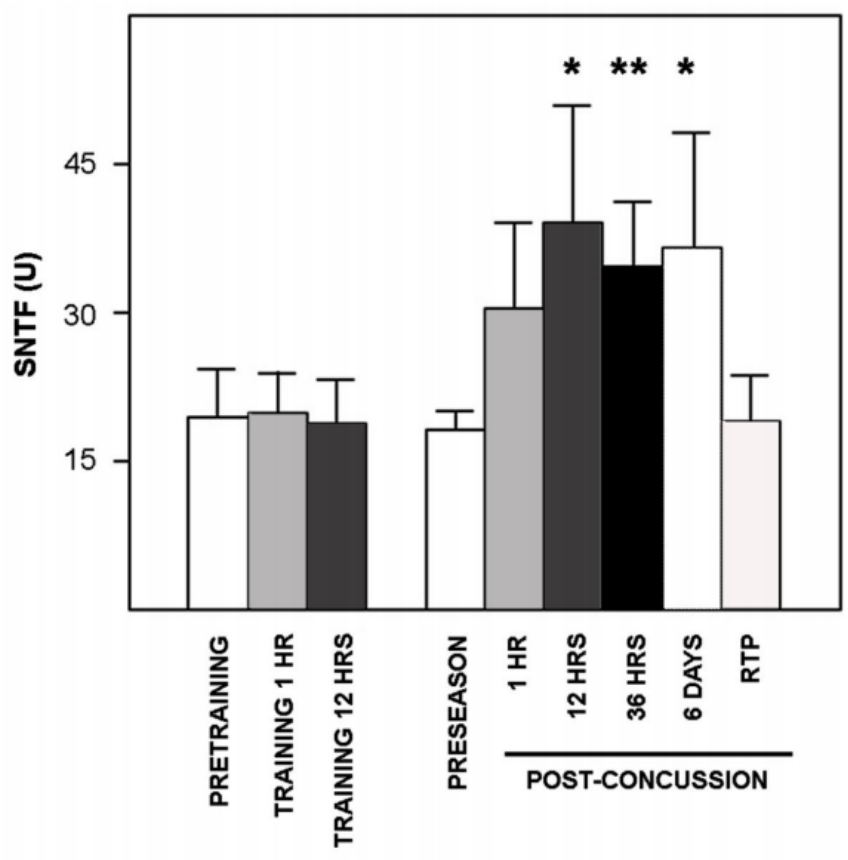


Figure 1. Sustained increase in serum SNTF concentrations in professional ice hockey players after concussion but not concussion-free training. SNTF levels were measured in serum during the preseason (n=45) or serially after an in game concussion (n=28), or before and after a training game (n=17). The mean serum SNTF levels (+/- S.E.M.) were elevated at 1,12,36, and 144 hours post-concussion compared with the mean preseason baseline concentration, and the increases at the latter three time points were statistically significant (two-tailed t-test; *$p<0.03$; **$p<0.002$). At the time of return to play (RTP) after a period of rest, SNTF levels returned to their preseason baseline. In contrast to the pronounced effects of concussion, SNTF was unchanged 1 or 12 hours after concussion-free training ($p>0.87$).

frontiers in NEUROLOGY

ORIGINAL RESEARCH ARTICLE
published: 18 November 2013
doi: 10.3389/fneur.2013.00190

Evidence that the blood biomarker SNTF predicts brain imaging changes and persistent cognitive dysfunction in mild TBI patients

Robert Siman[1]*, Nicholas Giovannone[1], Gerri Hanten[2], Elisabeth A. Wilde[2,3,4,5], Stephen R. McCauley[2,4,6], Jill V. Hunter[2,3,7], Xiaoqi Li[2], Harvey S. Levin[2,4,5,6] and Douglas H. Smith[1]

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Although mild traumatic brain injury (mTBI), or concussion, is not typically associated with abnormalities on computed tomography (CT), it nevertheless causes persistent cognitive dysfunction for many patients. Consequently, new prognostic methods for mTBI are needed to identify at risk cases, especially at an early and potentially treatable stage. Here, we quantified plasma levels of the neurodegeneration biomarker calpain-cleaved αII-spectrin N-terminal fragment (SNTF) from 38 participants with CT-negative mTBI, orthopedic injury (OI), and normal uninjured controls (UCs) (age range 12–30 years), and compared them with findings from diffusion tensor imaging (DTI) and long-term cognitive assessment. SNTF levels were at least twice the lower limit of detection in 7 of 17 mTBI cases and in 3 of 13 OI cases, but in none of the UCs. An elevation in plasma SNTF corresponded with significant differences in fractional anisotropy and the apparent diffusion coefficient in the corpus callosum and uncinate fasciculus measured by DTI. Furthermore, increased plasma SNTF on the day of injury correlated significantly with cognitive impairment that persisted for at least 3 months, both across all study participants and also among the mTBI cases by themselves. The elevation in plasma SNTF in the subset of OI cases, accompanied by corresponding white matter and cognitive abnormalities, raises the possibility of identifying undiagnosed cases of mTBI. These data suggest that the blood level of SNTF on the day of a CT-negative mTBI may identify a subset of patients at risk of white matter damage and persistent disability. SNTF could have prognostic and diagnostic utilities in the assessment and treatment of mTBI.

Keywords: surrogate marker, concussion, calpain, DTI, spectrin, diffuse axonal injury, prognostic marker, cognitive impairment

For Ravens' John Urschel, Playing in the N.F.L. No Longer Adds Up

The New York Times

By KEN BELSONJULY 27, 2017

One of the N.F.L.'s smartest players did the math and decided to retire after just three years in the league.

The player, John Urschel, an offensive lineman for the Baltimore Ravens who received much publicity for his off-season pursuit of a doctorate in math at M.I.T., told the team on Thursday that he was hanging up his cleats at 26.

Urschel's agent, Jim Ivler, said Urschel was overwhelmed with interview requests but would not be speaking to the news media. On Twitter, Urschel wrote that "there is no big story here" and that the decision to retire was not an easy one to make, but "it was the right one for me."

He added that he planned to go back to school full-time in the fall, "to take courses that are only offered in the fall semester" and spend time with his fiancée, who is expecting their first child in December.

Urschel's decision came two days after the release of a study by researchers in Boston in which all but one of 111 brains of N.F.L. players they studied showed signs of chronic traumatic encephalopathy, a degenerative brain disease linked to repeated head hits.

The Baltimore Sun and ESPN, citing anonymous sources with the Ravens, said his retirement was related to the study.

John Urschel, who played in 13 games for the Baltimore Ravens last season, retired from the N.F.L. on Thursday at 26. Credit Matt Hazlett/Getty Images

Eugene Monroe, a fellow lineman on the Ravens that season, said he spoke with Urschel after he sustained that concussion. Urschel, he said, told him that he was unnerved that it had affected his ability to solve math problems.

"He was nervous, he was frightened about it," said Monroe, who retired last year in part because he worries about the long-term effects of repeated head hits. "For something he loves, he's been thinking about it. How could he not."

Still, Monroe said he was not surprised that Urschel returned to the field three weeks after the concussion, "football ready," as Urschel said on the HBO program, though it took him longer to recover his math skills.

"It's a real problem beyond just the hits to the head, but also the further damage that might lead to another injury," Monroe said. "Things happen even faster on the field."

Despite the severity of the concussion, Urschel said that he wanted to continue doing the two things he loved: math and football.

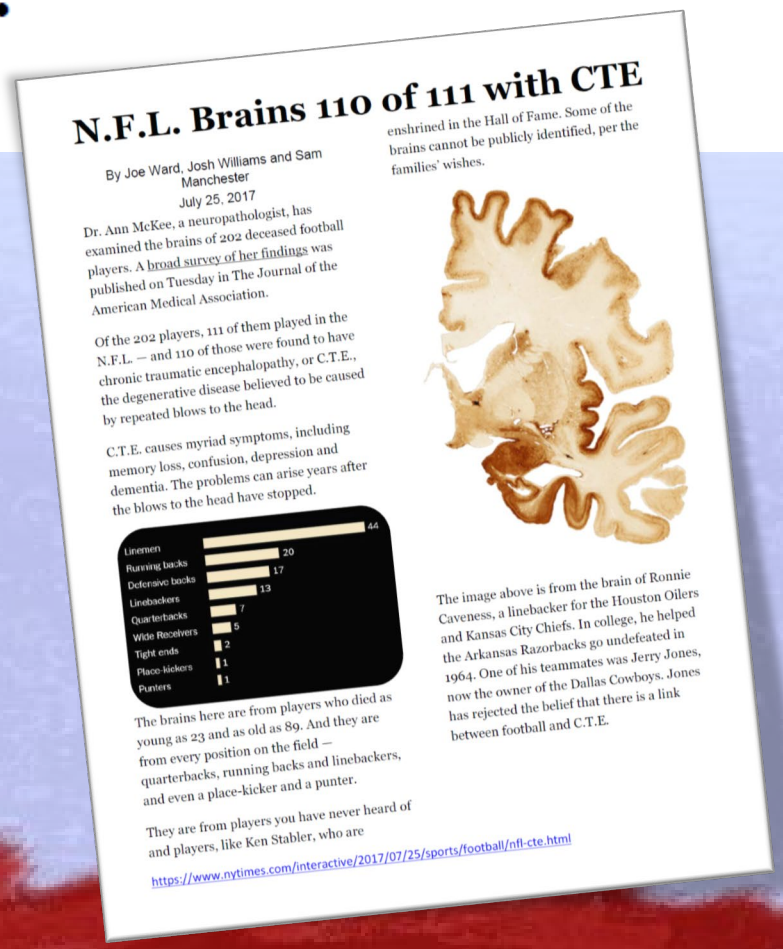
"I recognize that this is somewhat irrational," Urschel said on the segment. "But I am doing it."

Not anymore.

https://www.nytimes.com/2017/07/27/sports/football/john-urschel-baltimore-ravens-retires-nfl-cte-study.html


Concussion Coach
There's an App For That

"It is no longer debatable whether or not there is a problem in football — there is a problem," Dr. McKee said.



N.F.L. Brains 110 of 111 with CTE

By Joe Ward, Josh Williams and Sam Manchester

July 25, 2017

Dr. Ann McKee, a neuropathologist, has examined the brains of 202 deceased football players. A broad survey of her findings was published on Tuesday in The Journal of the American Medical Association.

Of the 202 players, 111 of them played in the N.F.L. — and 110 of those were found to have chronic traumatic encephalopathy, or C.T.E., the degenerative disease believed to be caused by repeated blows to the head.

C.T.E. causes myriad symptoms, including memory loss, confusion, depression and dementia. The problems can arise years after the blows to the head have stopped.

The brains here are from players who died as young as 23 and as old as 89. And they are from every position on the field — quarterbacks, running backs and linebackers, and even a place-kicker and a punter.

They are from players you have never heard of and players, like Ken Stabler, who are enshrined in the Hall of Fame. Some of the brains cannot be publicly identified, per the families' wishes.

The image above is from the brain of Ronnie Caveness, a linebacker for the Houston Oilers and Kansas City Chiefs. In college, he helped the Arkansas Razorbacks go undefeated in 1964. One of his teammates was Jerry Jones, now the owner of the Dallas Cowboys. Jones has rejected the belief that there is a link between football and C.T.E.

https://www.nytimes.com/interactive/2017/07/25/sports/football/nfl-cte.html