

# CONCUSSIONS, WHEN DOES IT STOP BEING A GAME?

Steven M. Kane, MD  
Atlanta Medical Center

# The question must be asked...

- ▣ Does a 15 year old have sufficient judgment to see a dangerous situation and choose another path?



THE EPIC RED SOX FAIL OF 2012

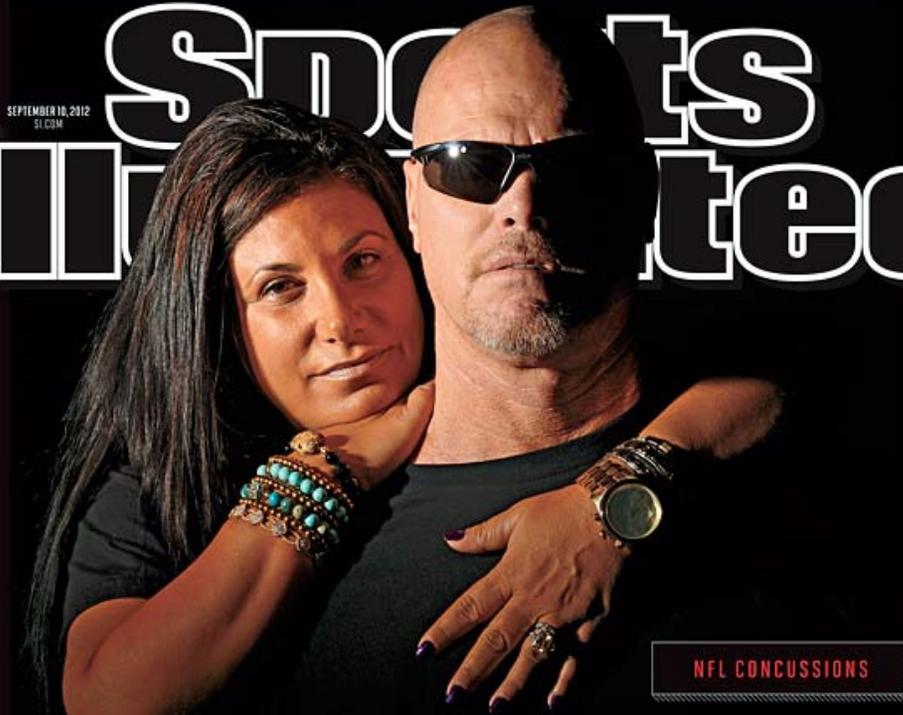
*By Tom Verducci P. 38*

WHAT MAKES A MAN KICK?

*By Lee Jenkins P. 54*

SEPTEMBER 10, 2012  
\$1.50

# SPORTS Illustrated



NFL CONCUSSIONS

## The Other Half Of the Story

One of many women caring for retired NFL players, **Laurie Navon** frequently has her picture taken with her boyfriend, **Jim McMahon**—in case he wakes up one day and no longer remembers her

*By Melissa Segura*

# Concussions

- ▣ It is estimated that 53% of high school athletes have sustained a concussion before participation in high school sports, and 36% of collegiate athletes have a history of multiple concussions
- ▣ Estimates put the incidence of mTBI from 1.6-3.8 million annually in America

# Do we want to know?

- ▣ Estimates of 40,000 (high school) and 250,000 (all football participants) concussions are suffered yearly amongst football players. A University of Northern Carolina study has shown that pro players contract Alzheimer's disease at a rate 37% higher than normal. That study, along with multiple others, reports that their average life expectancy has been shown to be less than sixty years.

**Will football even be around...?**



# \$765 million Reasons against concussion sports.

Allegations  
from the more  
than 4,500  
retired players  
who sued the  
league during  
the past few  
years



# NCAA not immune

Play CBS Sports.com's Franchise Basketball – the ultimate pro hoops simulation game.

 **EYEON**  
College Football

## Three former college football players suing NCAA over concussions

By Mike Singer | CBSsports.com

September 5, 2013 11:42 am ET

 61  60  0

Three former college football players are suing the NCAA, claiming that the institution failed to educate players and disclose the risks of concussions, and the lead attorney from the ongoing O'Bannon lawsuit is handling the class-action suit.

Chris Walker and Ben Martin, two former Tennessee players (2007-11), along with Dan Ahern, a former North Carolina State player (1972-76), filed the suit in federal court in Chattanooga, Tenn., on Wednesday.

The suit alleges that the NCAA didn't do enough to assess, treat and prevent brain trauma following concussions. The plaintiffs are seeking an NCAA-funded medical monitoring program for former football players.

"Plaintiffs and the members of the Class have no adequate remedy at law in that monetary damages alone cannot compensate them for the increased risks of long-term physical and

# Ridell Vs. Ridolfi



- ▣ A jury in Colorado said Ridolfi is entitled to **\$11.5 million in damages** for his injuries, and that Riddell is 27 percent responsible, so Riddell will have to pay \$3.1 million of the damages. The rest of the damages are largely symbolic, as those damages were awarded against Ridolfi's coaches, who have immunity as government employees and will not have to pay the damages.

# Concussions

Sport	Division	No. of Concussions	National Estimates†	Rates per 1000 Athlete-Exposures			Overall Rate Comparison Collegiate Versus High School		
				Practice	Competition	Overall	Rate Ratio	95% Confidence Interval	P Value
Football	High school	201	55 007	0.21	1.55	0.47	N/A‡	N/A	N/A
	Collegiate	245	—	0.39	3.02	0.61	1.31	1.09, 1.58	<.01
Boys' soccer	High school	33	20 929	0.04	0.59	0.22	N/A	N/A	N/A
	Collegiate	42	—	0.24	1.38	0.49	2.26	1.43, 3.57	<.01
Girls' soccer	High school	51	29 167	0.09	0.97	0.36	N/A	N/A	N/A
	Collegiate	57	—	0.25	1.80	0.63	1.76	1.21, 2.57	<.01
Volleyball	High school	6	2568	0.05	0.05	0.05	N/A	N/A	N/A
	Collegiate	14	—	0.21	0.13	0.18	3.63	1.39, 9.44	<.01
Boys' basketball	High school	16	3823	0.06	0.11	0.07	N/A	N/A	N/A
	Collegiate	33	—	0.22	0.45	0.27	3.65	2.01, 6.63	<.01
Girls' basketball	High school	40	12 923	0.06	0.60	0.21	N/A	N/A	N/A
	Collegiate	49	—	0.31	0.85	0.43	1.98	1.31, 3.01	<.01
Wrestling	High school	30	5935	0.13	0.32	0.18	N/A	N/A	N/A
	Collegiate	15	—	0.35	1.00	0.42	2.34	1.26, 4.34	.01
Baseball	High school	9	1991	0.03	0.08	0.05	N/A	N/A	N/A
	Collegiate	12	—	0.03	0.23	0.09	1.88	0.79, 4.46	.22
Softball	High school	10	3558	0.09	0.04	0.07	N/A	N/A	N/A
	Collegiate	15	—	0.07	0.37	0.19	2.61	1.17, 5.82	.03
Boys' sports total	High school	289	87 685	0.13	0.61	0.25	N/A	N/A	N/A
	Collegiate	347	—	0.30	1.26	0.45	1.78	1.52, 2.08	<.01
Girls' sports total	High school	107	48 216	0.07	0.42	0.18	N/A	N/A	N/A
	Collegiate	135	—	0.23	0.74	0.38	2.04	1.59, 2.64	<.01
Overall total	High school	396	135 901	0.11	0.53	0.23	N/A	N/A	N/A
	Collegiate	482	—	0.28	1.02	0.43	1.86	1.63, 2.12	<.01

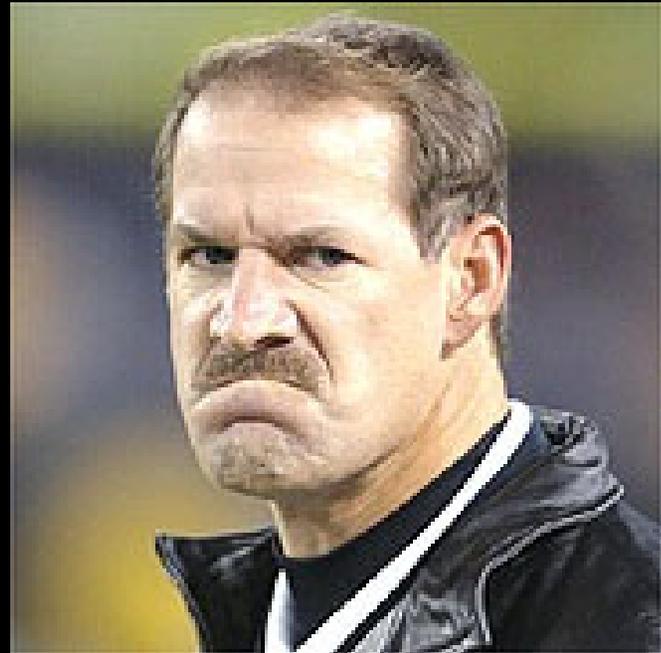
\*Collegiate data for the 2005–2006 school year were provided by the National Collegiate Athletic Association Injury Surveillance System.

†National estimates for the National Collegiate Athletic Association data were not available.

‡Indicates not applicable.

# How long does the concussion last?

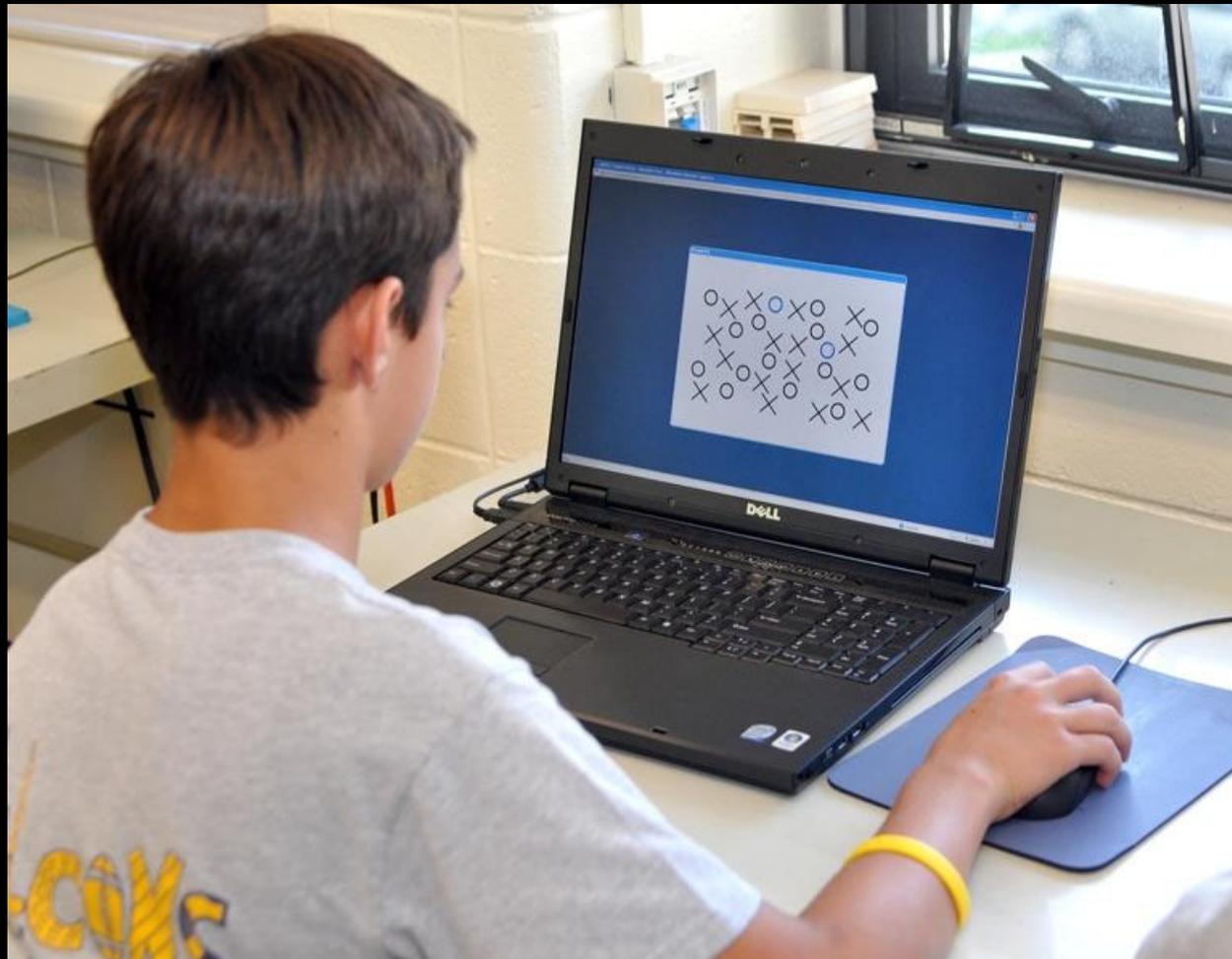
- ▣ “In 10 to 20 percent of individuals, concussive symptoms persist for a number of weeks, months, or even years,”



# Risk for Recurrent Concussion

- ▣ Return to play within 10 days from first concussion.
- ▣ Quarterback
- ▣ Return prior to achieving baseline neurocognitive function.
- ▣ Return to play with persistent symptoms.

# ImPACT



# Is every player at risk for sub-concussive trauma and it's long term effects?

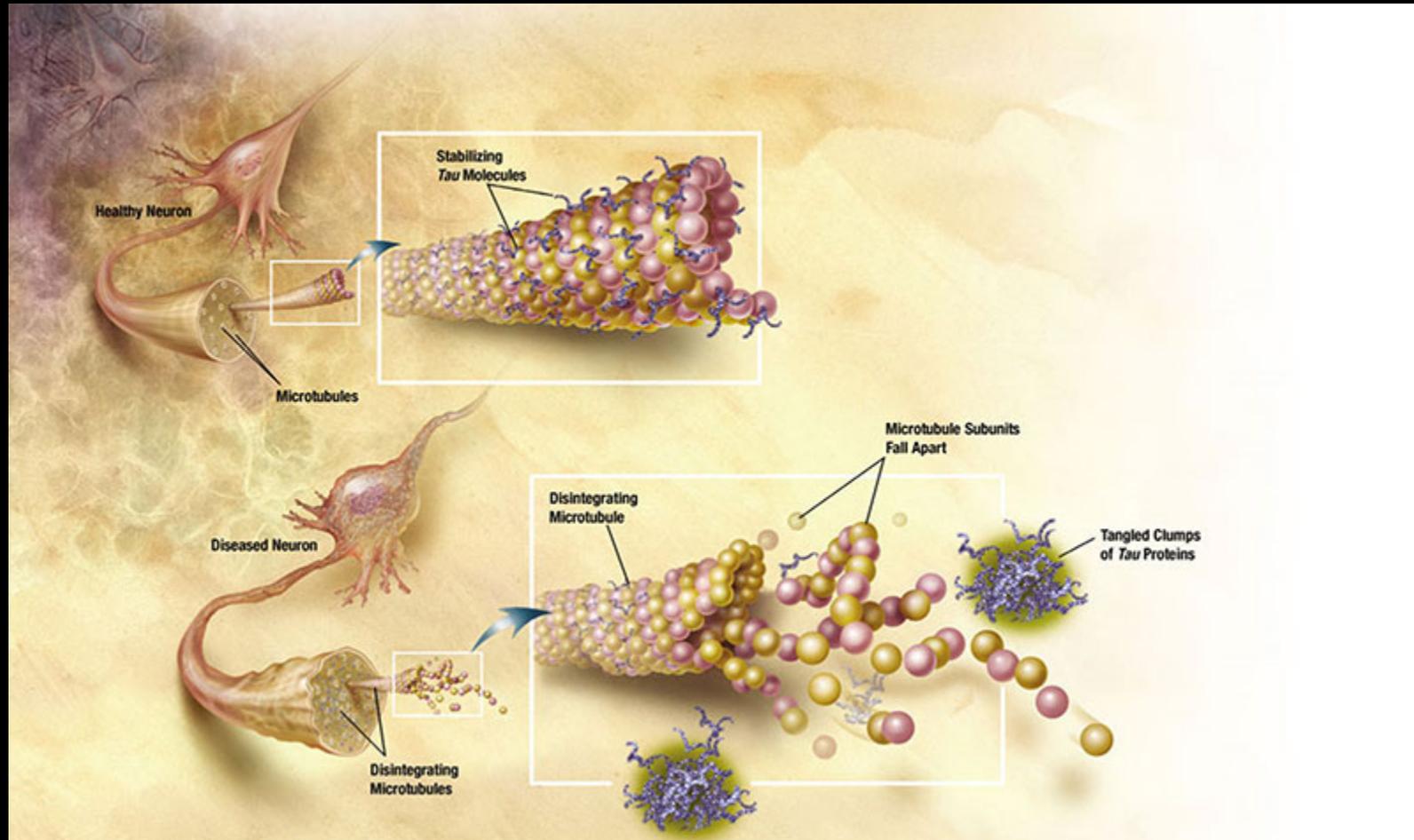
- ▣ Each football season results in **800 to a 1200 sub-concussive** traumas to the head.
- ▣ BU now says that **it isn't the concussion it's the repeated hits.**



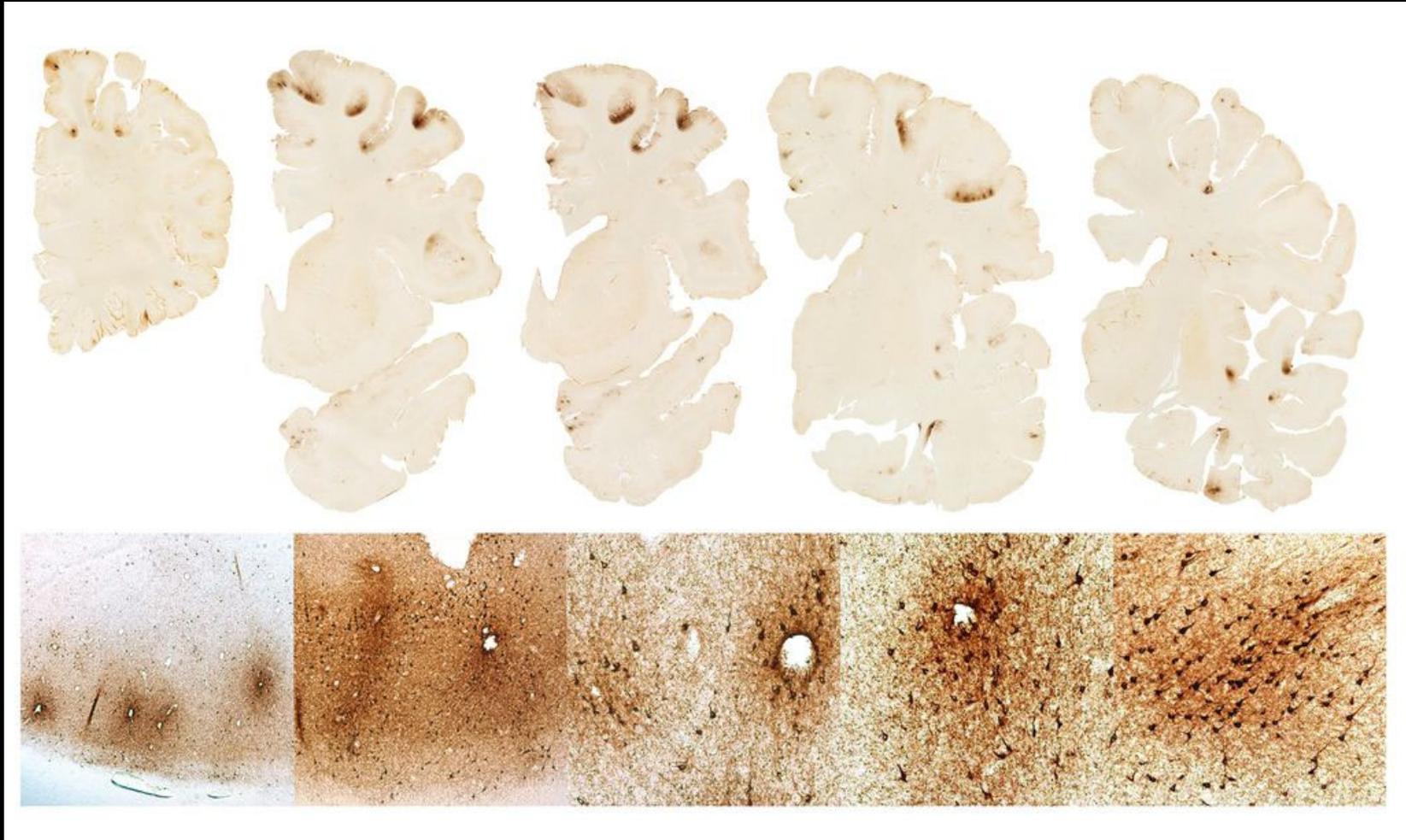
# Is this all related to concussions sub-concussive impacts?

- ▣ Depression, Suicidal Impulses, Alzheimer's Disease or the neurodegenerative condition Chronic Traumatic Encephalopathy (CTE).

# The Tau Protein



# Spots and Sulci



# Tau Protein

- ▣ It doesn't deposit in CTE pattern in Alzheimer's
- ▣ It is only found in CTE patterns with history of concussions / **multiple sub-concussive hits**
- ▣ It was found in 79/80 NFL brains donated
- ▣ It has been found in 20 year old brains with history of head trauma.
- ▣ It can be replicated in animals subjected to repetitive trauma.

What can I tell my kid ?





# The Future

- ▣ Diffusion Tensor Imaging (DTI)
- ▣ Functional MRI
- ▣ Perfusion MRI
- ▣ Positron Emission Tomography (PET)
- ▣ MR Spectroscopy
- ▣ High Field Strength MRI
- ▣ **DNA risk assessment**

# Genetics?

## Genetic markers for concussion susceptibility

**ApoE E4** (Jordan et al., *JAMA*, 1997--Boxers; Kutner et al., *Neurosurgery*, 2000—NFL players; Terrell et al. and Kristman et al., 2008; Tierney et al., 2010—collegiate athletes, all in *CJSM* )

**ApoA 1** (Bazarian, 2010)

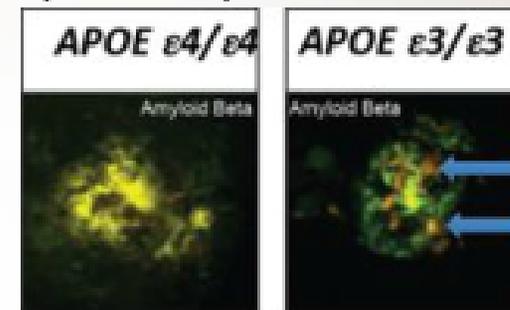
**CACNA1A calcium channel subunit gene (?---SIS)**  
(Kors et al., *Annals of Neurology*, 2001)

**Interleukin 1RN allele 2 and cerebral hemorrhage after TBI**  
(Hadjigeorgiou et al., *Neurology*, 2005)

ApoE is expressed in response to neuronal injury and repair

ApoE e3 promotes neuritic growth

ApoE e4 inhibits neuritic growth



---

ApoE e4 has been associated with poorer outcome post-TBI in most studies (severe TBI)

---

G-219 polymorphism in the ApoE promoter region 186 bp upstream of the TATA box has been associated with poorer outcome post-TBI, and for increased risk of AD and myocardial infarction

Apolipoprotein E gene variations (e.g., polymorphism) occur in the promoter (e.g., g-219t) and coding (e.g., e4) regions, which can affect ApoE expression and quality and quantity, respectively

## **ApoE e4 as a risk factor for concussion in collegiate athletes: 3 studies**

### **APOE, APOE Promoter, and Tau Genotypes and Risk for Concussion in College Athletes**

*Thomas Roland Terrell, MD, MPhil,\* Robert M. Bostick, MD, MPH,† Ruth Abramson, PhD,‡  
Dawen Xie, MD, PhD,§ William Barfield, PhD,¶ Robert Cantu, MD,||  
Michele Stanek, MSH,\*\* and Trina Ewing, MS\*\**

*Clin J Sport Med • Volume 18, Number 1, January 2008*

### **Does the Apolipoprotein ε4 Allele Predispose Varsity Athletes to Concussion? A Prospective Cohort Study**

*Vicki L. Kristman, PhD,\*†‡ Charles H. Tator, MD, PhD,‡§ Nancy Kreiger, MPH, PhD,\*\*¶  
Doug Richards, MD,||\*\* Lynda Mainwaring, PhD,|| Susan Jaglal, PhD,\*††  
George Tomlinson, PhD,\*‡‡ and Paul Comper, PhD||\*\**

*Clin J Sport Med • Volume 18, Number 4, July 2008*

### **Apolipoprotein E Genotype and Concussion in College Athletes**

*Ryan T. Tierney, PhD, ATC,\* Jamie L. Mansell, MEd,† Michael Higgins, PhD,‡  
Jane K. McDevitt, MS,\* Nieka Toone, MS,\* John P. Gaughan, PhD,§  
Anarug Mishra, PhD,¶ and Evgeny Krynetskiy, PhD¶*

*Clin J Sport Med • Volume 20, Number 6, November 2010*

# My recommendations

- ▣ Play Golf.....
- ▣ Baseline and return to baseline tests such as ImPACT
- ▣ If concussed, out one to two weeks with progressive return to play once baseline obtained.
- ▣ Guardian type helmet protectors in practice.
- ▣ Limit practices for full contact as much as possible.
- ▣ History of multiple concussions buys your son or daughter a swimming scholarship.
- ▣ Stay tuned for serum markers, diagnostic scans such as fMRI and genetic markers.

# Thanks

