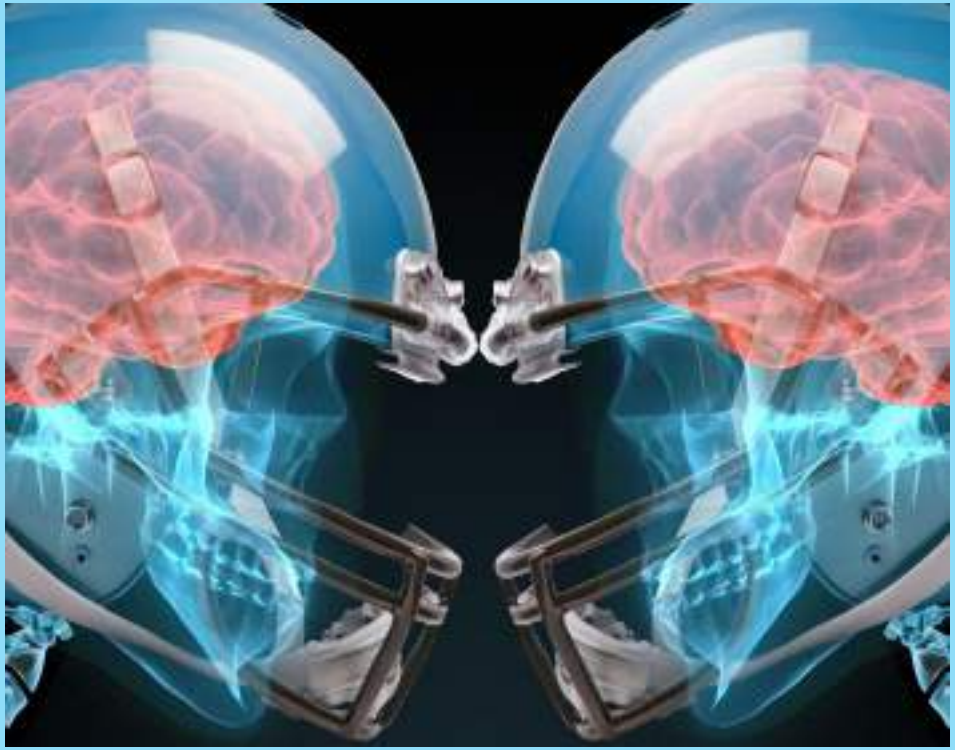


Sports EYEllustrated: Keep your Head in the Game!

Vittorio Mena O.D., M.S.

On behalf of Vision Expo, we sincerely thank you for being with us this year.

Vision Expo Has Gone Green!

We have eliminated all paper session evaluation forms. Please be sure to complete your electronic session evaluations online when you login to request your CE Letter for each course you attended! Your feedback is important to us as our Conference Advisory Board considers content and speakers for future meetings to provide you with the best education possible.

VISION EXPO

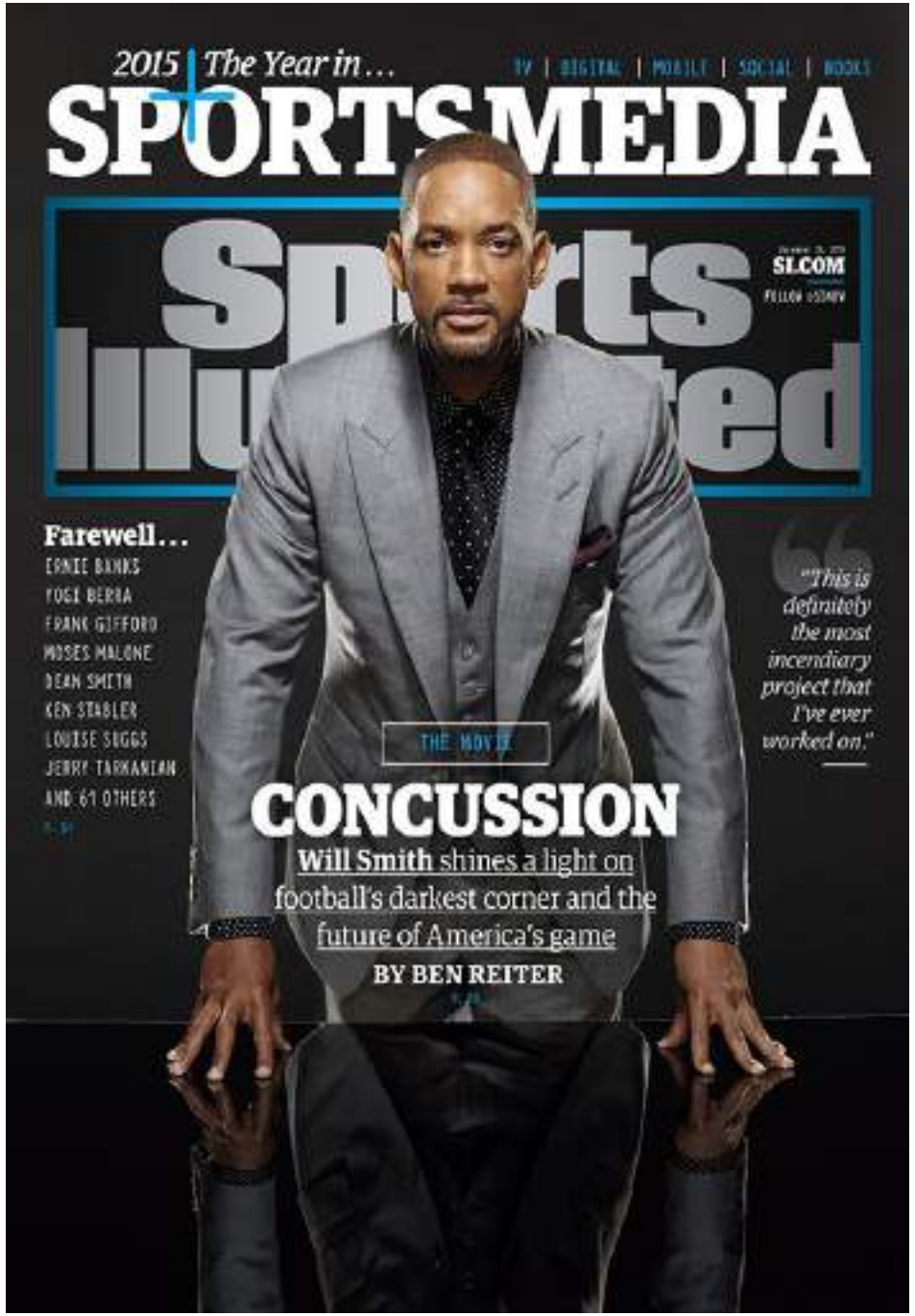
Dr. Vittorio Mena Industry Disclosures

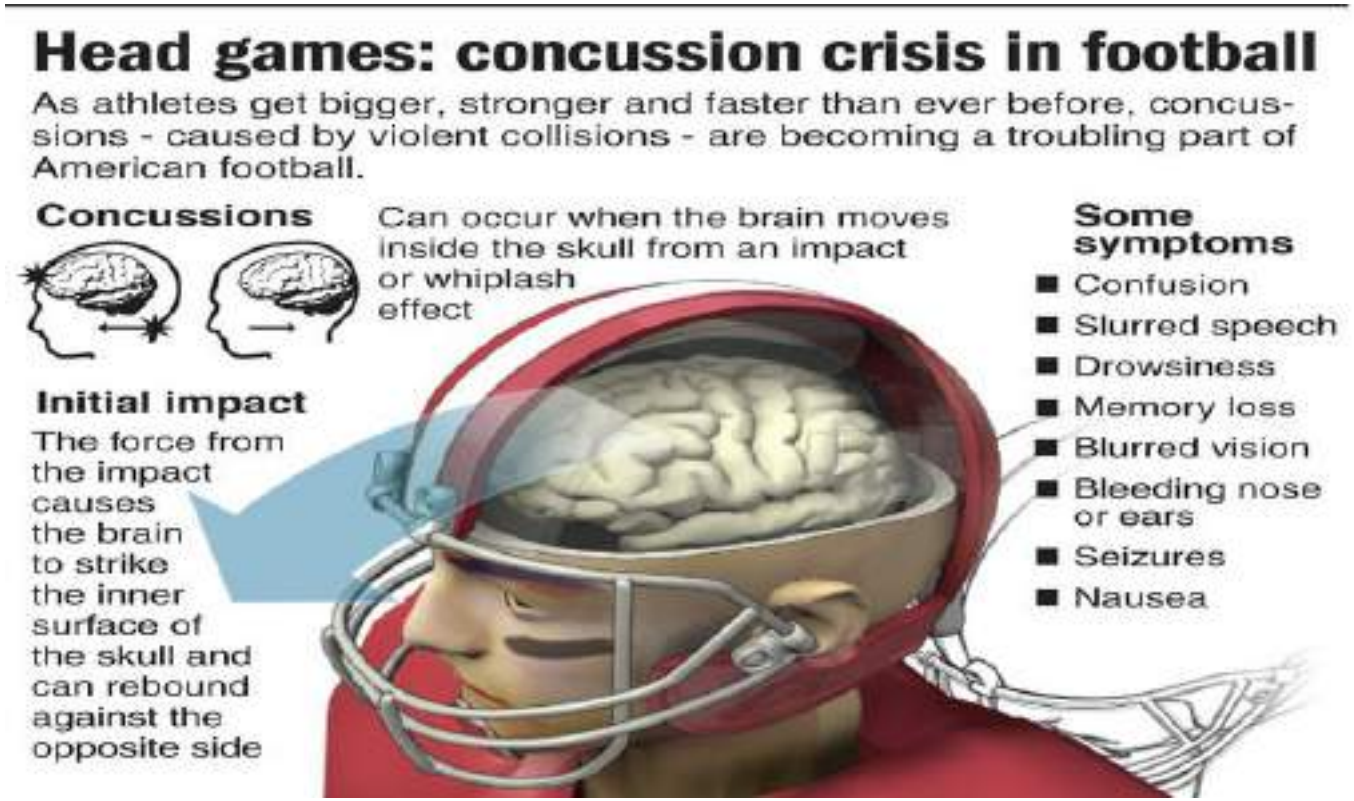
Sports Vision Background

- 2013: AOSA National Liaison Sports Vision Section
- 2014-2016: Examined players/coaches/staff NY Giants
- 2017-Present: Director Sports Vision (Optical Academy)
  - Also work with NYC Dept. of Ed and Health
- 2018: Special Olympics Opening Eyes Clinical Director
  - New Jersey, Pennsylvania, Seattle, Orlando
- 2019: NJSOP Young O.D. of the Year
- 2020: Public Service Award: Salus University
- 2021: AOA Sports & Performance Vision Section
- Mentors/Colleagues:
  - Dr. Stephen Morris (University of Miami)
  - Dr. Paul Berman (NJ Devils & NJ Nets; Global Senior Advisor)
  - Dr. Fraser Horn (Nike, Dean of Pacific University)
  - Dr. Keith Smithson (Washington Wizards, Nationals, D.C. United)
  - Dr. Fred Edmunds (NY Mets, XTREMESIGHT)
  - Dr. David Kirschen (Boston Red Sox, U.S. Olympic Teams)
  - Dr. Michael Galloway (T.E.I. & Special Olympics)
  - Dr./Lt.Col. Richard Baird (U.S. Airforce)

Dr. Amanda Nanasy

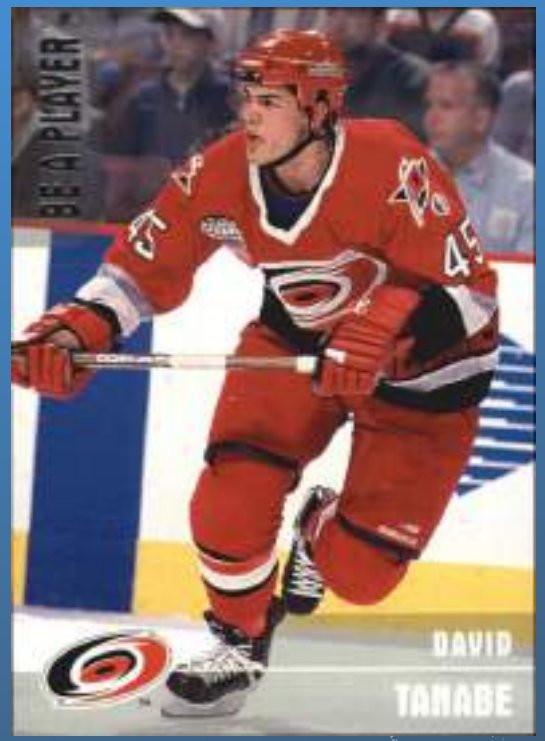
American Optometric Association
Sports Vision Section





"Pro Football is like nuclear warfare. There are no winners only survivors"
– Frank Gifford (NY Giants)

Concussion Stats/Facts



- CDC reported 1.6-3.8 million concussions occur annually due to sports or other recreational activities ($60 Billion)
  - 5.8% Collegiate athletes
  - 8.9% High school athletes
- CNN reported 71% increase concussion rate in youths since 2010
- BCBS reported 10-19 yr olds are 5x more likely to be diagnosed with a concussion
- 90% of sports related concussions occur without losing consciousness
- Vision was the 3rd most reported symptom behind headaches and dizziness
- Athletes with history of concussion are up to 8x more likely to suffer another
- 67% of the neural connections within the brain are involved with some aspect of vision:
  - After TBI over 20 different visual skills can be affected!
    - Accommodative dysfunction = 21%-47%
- David Tanabe: 1st Carolina Hurricane (NHL) forced to retire because of a concussion

GAME FACE

According to the American Optometric Association's 2014 American Eye-Q® survey,

ONLY ABOUT 21 PERCENT OF ADULTS

wear protective eyewear during sports, and only 46 percent of parents make their children wear eye protection. Get in the game about the importance of protective eyewear in sports.

More than **600,000** eye injuries related to sports/recreation occur yearly. This is about **15 percent** of the 2.5 million eye injuries in the United States yearly.

1 in 18 college athletes will sustain an **eye injury** each season. This increases to **1 in 10** **for basketball players.**

Protective eyewear is made of **ultra-strong polycarbonate**, which is **10 times** more impact-resistant than other plastics.

More than **90 percent** of all eye injuries can be prevented with use of **appropriate eyewear.**

Baseball is the leading cause of eye injuries in **children under age 14.**

The National Eye Institute classifies **baseball/softball, basketball, boxing, hockey, lacrosse, paintball and racquet sports** as **"high risk"** for eye injury.

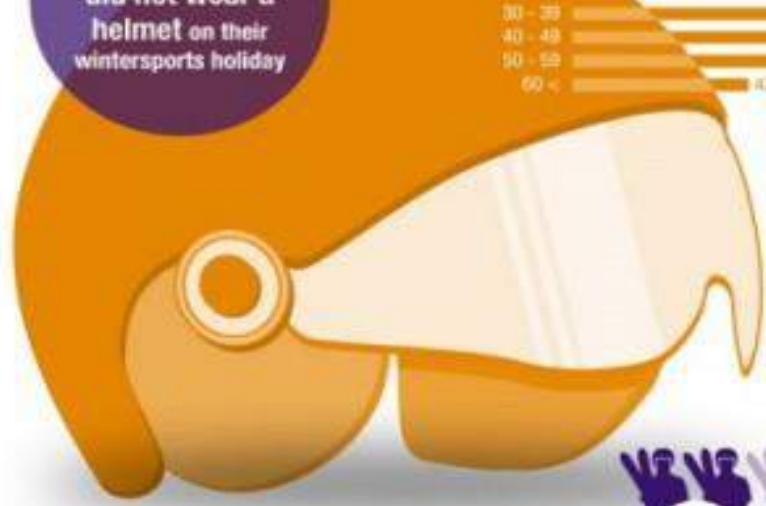
Basketball is the leading cause of eye injuries among **15- to 24-year-olds.**

Most eye injuries among **children ages 11 to 14** occur while **playing sports.**

To find a doctor of optometry near you, visit **aoa.org.**

AMERICAN OPTOMETRIC ASSOCIATION

Source: Coalition to Prevent Sports Eye Injuries, National Eye Institute



65.8% of skiers and snowboarders have had an injury on the slopes

Two thirds of skiers who have been injured and were wearing a helmet believe that their helmets prevented a more serious injuries.

I don't wear a helmet, because...

29% Uncomfortable **24%** Reduced Vision

73% Never Worn One

29% Low Risk **26%** I Ski/Snowboard Carefully

23% Inconvenient to pack **12%** Dislike the way they look **5%** Too expensive

10-15% Head injury

The general head injury rate for wintersports across Europe and North America of all snowsport injuries.

Head injuries between men and women

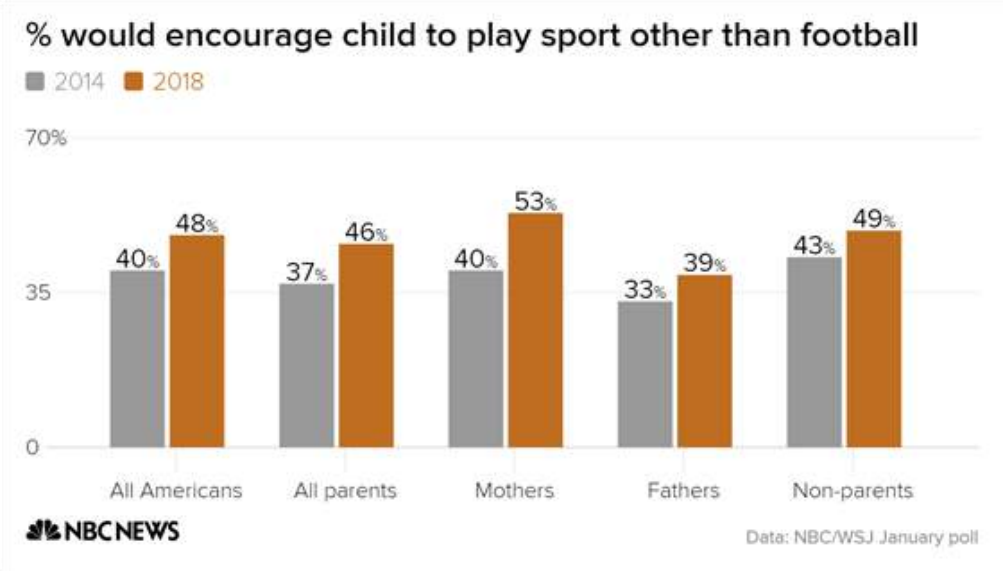
The proportion of cases of concussion among hospital visits for snowsports in the EU from 2002 to 2008

A 2005 Scottish survey of injuries showed that

ESPN POLL 2010

- 55.4% High School Football Players
- 33.7% Coaches
- 29.7% Athletic Trainers

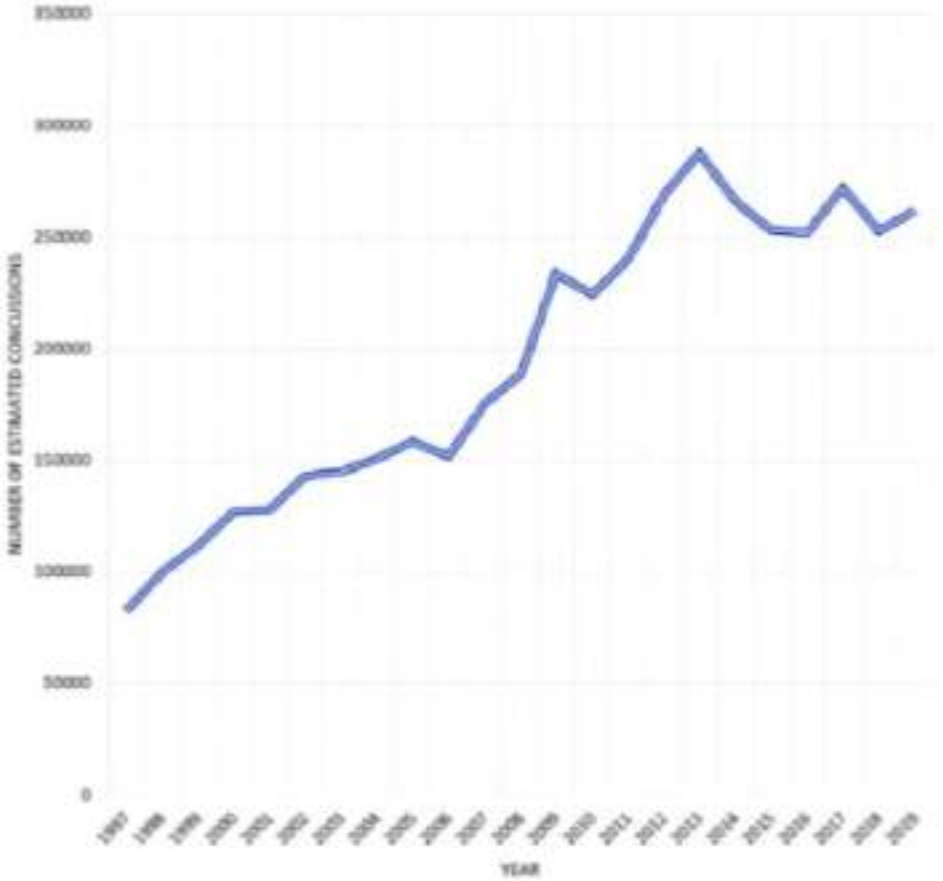
NBC NEWS POLL JAN 2018



National Awareness Concussion Day

- Optometry's Role?
- High school and Collegiate football Concussion Rates (Head & Neck)
  - High School = 5.6%
  - NCAA D3 = 5.5%
  - NCAA D2 = 4.5%
  - NCAA D1 = 4.4%
- Government Legislation: Texas, Washington, Oregon
  - 1st three states who passed concussion specific laws
  - Education for coaches on concussions
  - Return to play guidelines following TBI
  - Proper medical clearance before an athlete could return
- Washington State's Lystedt Law (May 14, 2009)
  - Mandated in all 50 states
- Problems with Legislation?
  - Many states cannot afford or provide quality care
  - Each state has different laws and clearance guidelines
- U.S. Soccer federation put a ban on headers among young athletes under 11
  - Encouraged reduced headers among 11-13 yo's during practice

Yearly concussion estimate, 1997-2019

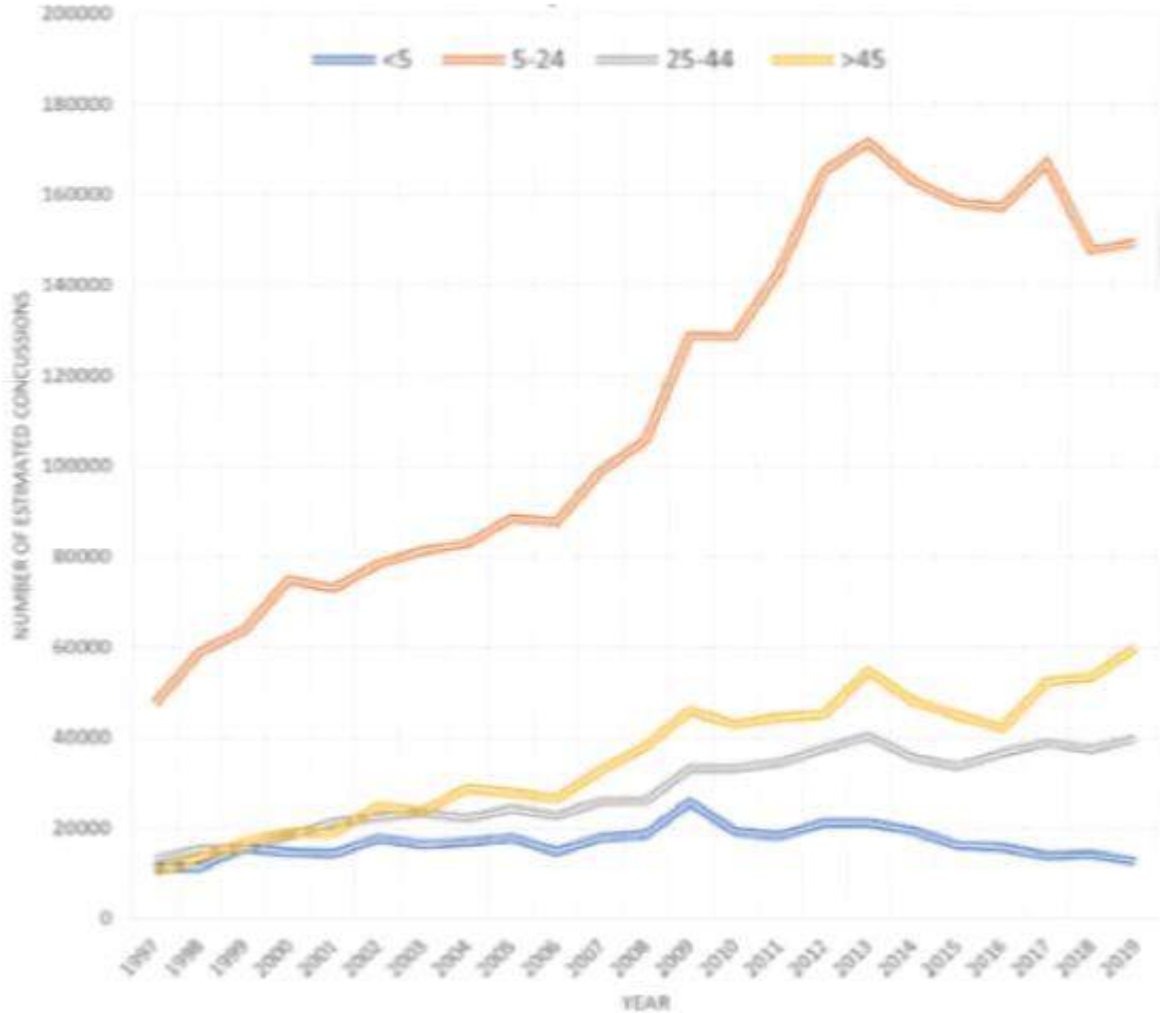


Most common injury mechanism leading to concussion by age, 1997-2019

Rank	Age					
	<5	5 to 14	15 to 24	25 to 44	45 to 64	≥65
1st	Floors (13.1%)	Football (16.4%)	Football (18.3%)	Stairs (11.5%)	Stairs (14.2%)	Floors (22.7%)
2nd	Stairs (11.4%)	Bicycles (8.3%)	Basketball (8.8%)	Floors (8.0%)	Floors (11.4%)	Stairs (14.6%)
3rd	Beds (8.4%)	Basketball (7.6%)	Soccer (8.2%)	Bicycles (7.2%)	Bicycles (8.3%)	Beds (6.0%)
4th	Couches (5.2%)	Floors (6.1%)	Bicycles (4.6%)	Baths/ Showers (4.0%)	Ladders (4.7%)	Chairs (3.9%)
5th	Tables (4.9%)	Soccer (5.4%)	Stairs (3.9%)	Horseback Riding (3.2%)	Horseback Riding (4.0%)	Baths/ Showers (3.4%)

Reid et al. 2020. Rhode Island Medical Journal

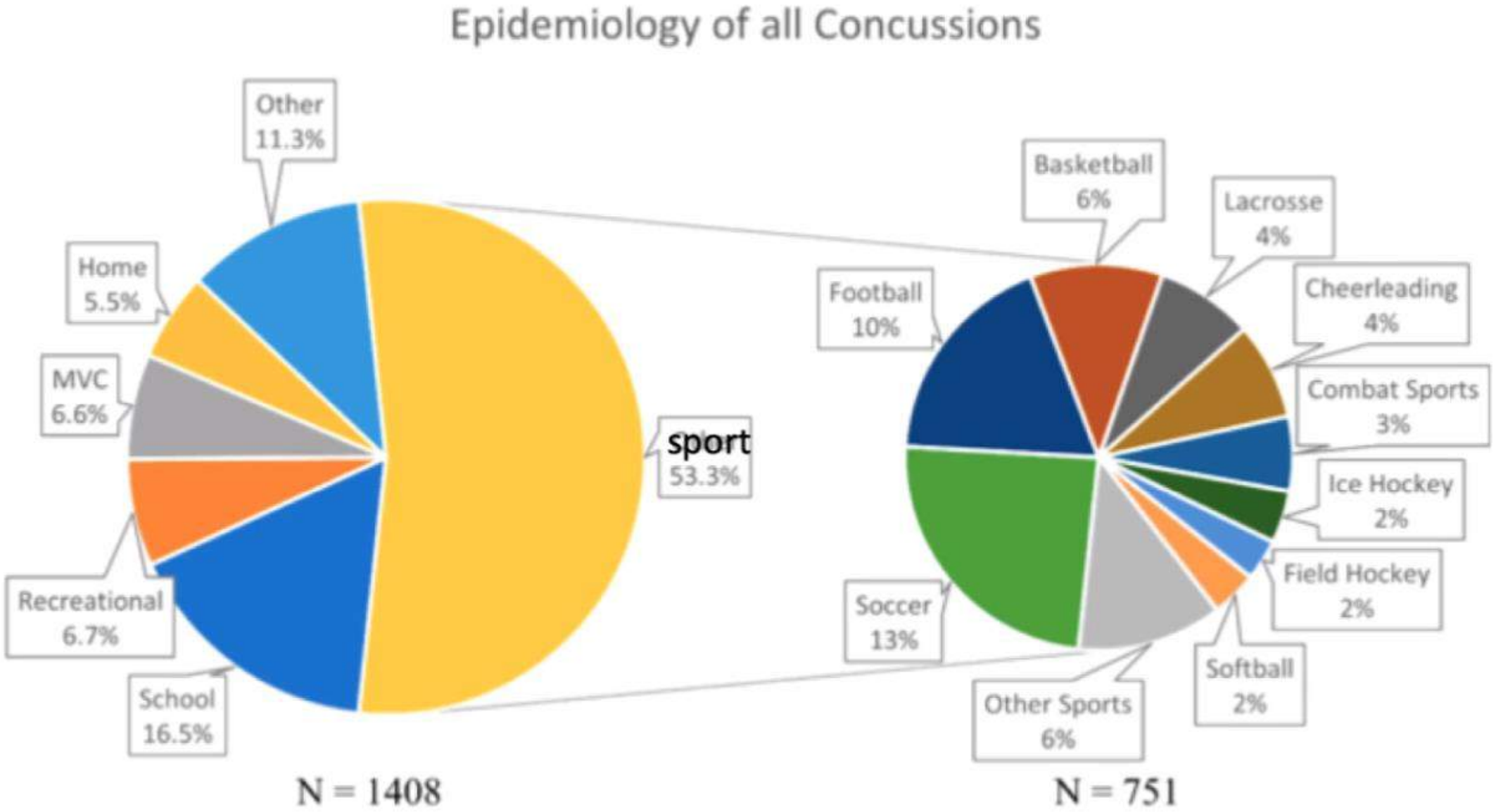
Yearly concussion estimates, stratified by age, 1997-2019



Number of cases, national weighted estimates, and incidence rate of concussion stratified by age and gender, 2019

Age/Sex	n (2019)	Estimate (2019)	Incidence/100,000 Person-Years
<5	656	12,615	63.3
Male	389	7,642	75.0
Female	267	4,999	51.3
5–14	3,559	77,234	186.4
Male	2,255	48,994	233.9
Female	1,304	28,240	137.8
15–24	2,324	72,157	170.4
Male	1,222	38,447	179.4
Female	1,102	33,710	161.2
25–44	928	31,276	36.6
Male	414	17,378	40.8
Female	514	22,482	52.3
45–64	709	31,276	37.6
Male	278	11,830	29.4
Female	431	19,446	45.2
≥65	565	28,554	55.9
Male	220	11,908	51.6
Female	345	16,646	59.4
ALL	8,741	261,722	81.0
Male	4,778	136,226	86.0
Female	3,963	125,496	76.2

Reid et al. 2020. Rhode Island Medical Journal



Yaramothu et al. 2019 Brain Science

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J Bone Joint Surg Am. 2017 Aug 2;99(15):1314-1320. doi: 10.2106/JBJS.16.01573.

Sport and Sex-Specific Reporting Trends in the Epidemiology of Concussions Sustained by High School Athletes

Michael S Schallmo [1], Joseph A Weiner, Wellington K Hsu

Affiliations + expand

PMID: 28763417 DOI: 10.2106/JBJS.16.01573

Abstract

Background: Approximately 300,000 U.S. adolescents sustain concussions annually while participating in organized athletics. This study aimed to track sex and sport-specific trends among high school sports-related concussions over time, to identify whether a particular sport predisposes athletes to a higher risk, and to assess whether traumatic brain injury law enactments have been successful in

- **Female** HS athletes are **1.56x** more likely to sustain a sports related concussion than their male counterparts when playing an equivalent sport:
  - Middle school sports concussion risk is also higher for girls
  - Girls soccer was actually the sport with the highest concussion risk of ALL high school sports

PubMed.gov

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Pediatrics. 2019 Nov;144(5):e20192180. doi: 10.1542/peds.2019-2180. Epub 2019 Oct 15.

Concussion Incidence and Trends in 20 High School Sports

Zachary Y Kerr [1 2], Avinash Chandran [3 2], Aliza K Nedimyer [4 2], Alan Arakkal [5], Lauren A Pierpoint [6], Scott L Zuckerman [7]

Affiliations + expand

PMID: 31615955 DOI: 10.1542/peds.2019-2180

Free article

Abstract

Background: Ongoing monitoring of concussion rates and distributions is important in assessing temporal patterns. Examinations of high school sport-related concussions need to be updated. This study describes the epidemiology of concussions in 20 high school sports during the 2013-2014 to 2017-2018 school years.

- 9,542 concussions occurred during 22,870,364 AE
  - 4.17 per 10,000 AE
- 63.7% occurred in competition
- 36.3% occurred in practice
- Girls > Boys

Youth Susceptibility

- Children and adolescents are considered to be more susceptible and have a more prolonged outcome:
  - Incomplete Brain Development:
    - Lower degree of myelination
    - Neck to head ratio
    - Lower BBB integrity

Young athletes with history of concussions may have more changes to their brains

Study finds changes in brain blood flow and microstructure

Date: August 25, 2021

Source: American Academy of Neurology

Summary: A new study suggests athletes with a history of concussion may show more brain injury from a later concussion, particularly in middle regions of the brain that are more susceptible to damage, when compared to athletes with no history of concussion.

Share:

RELATED TOPICS

Health & Medicine

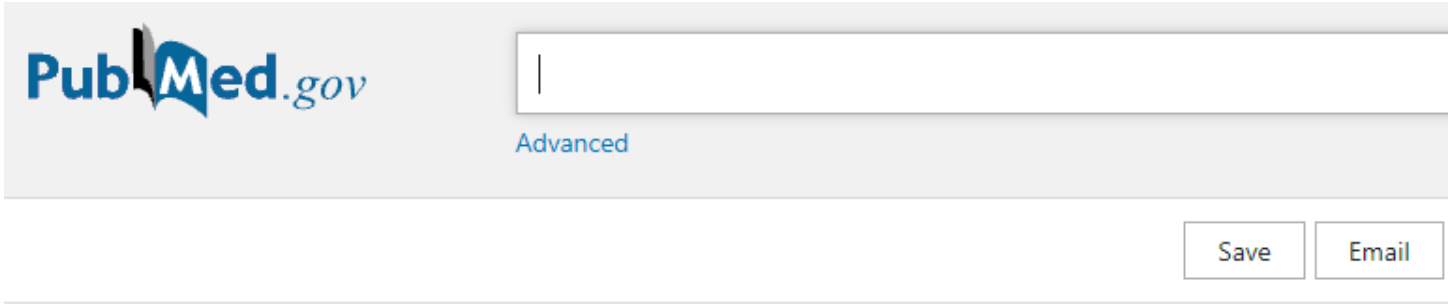
- Nervous System
- Sports Medicine
- Psychology Research

Mind & Brain

- Brain Injury
- Intelligence
- Neuroscience

FULL STORY

A new study suggests athletes with a history of concussion may show more brain injury from a later concussion, particularly in middle regions of the brain that are more susceptible to damage, when compared to athletes with no history of concussion. The research is published in the August 25, 2021, online issue of *Neurology*®, the medical journal of the American Academy of Neurology. The athletes participated in sports like football, volleyball and soccer.



Brain Inj. 2019;33(9):1151-1157. doi: 10.1080/02699052.2019.1629022. Epub 2019 Jun 26.

Mild traumatic brain injury in the United States: demographics, brain imaging procedures, health-care utilization and costs

Vladislav Pavlov [1], Philippe Thompson-Leduc [2], Louise Zimmer [3], Jody Wen [2], Jerome Shea [2], Hadi Beyhaghi [3], Seth Toback [3], Noam Kirson [2], Mark Miller [1]

Affiliations + expand

PMID: 31241427 DOI: 10.1080/02699052.2019.1629022

Abstract

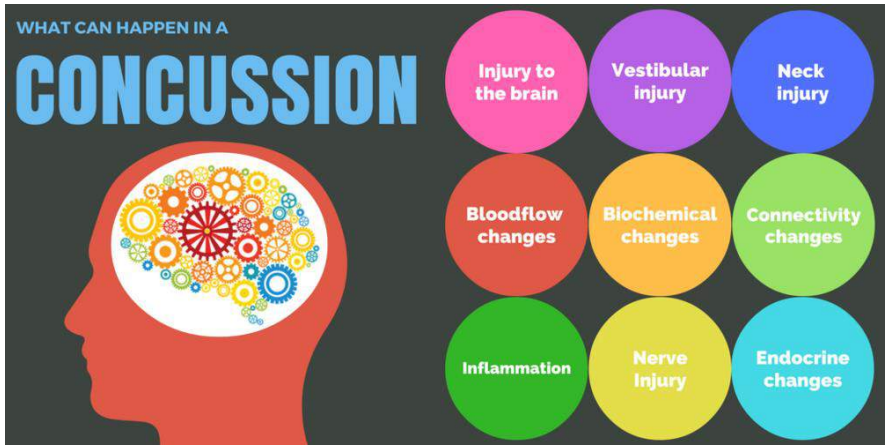
Objective: To characterize mild traumatic brain injury (mTBI) patients in the USA, describing location of diagnosis, timing, and modality of imaging procedures, health-care resource utilization (HRU) and costs in the 12-month period post-diagnosis. **Research Design**: Retrospective claims analysis **Methods**: Anonymized data from the OptumHealth Care Solutions claims database (2006-2016). The

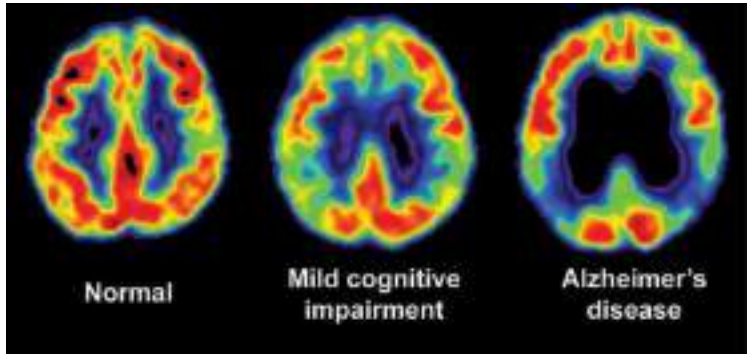
Economic Burden

- Patients with mTBI incurred $13,546 in health care costs during the 12 month follow up
- The mean health care costs of mTBI by age group were:
  - < 11 yo = $4,463
  - 11-17 yo = $5,434
  - 18-25 yo = $9,369
  - 26-64 yo = $19,661
  - > 65 yo = $38,380

Concussion

- “Bell Rung”?
- Sports Related Concussion: TBI induced by biomechanical forces or blunt trauma
  - Direct blow to the head/face/neck/body with an impulsive force transmitted to the head
  - Result in a range of clinical signs and symptoms that involve consciousness/unconsciousness
  - A cascade of neuro-chemical, ionic and metabolic changes occur after a brain injury
- Primary TBI Damage:
  - Mechanical forces → Tissue deformation at the moment of injury
  - Direct damage to neurons, axons, glia, blood vessels, etc
- Secondary TBI Damage:
  - Complication of primary damage
  - Cerebral swelling, ischemia/hypoxia, increased intracranial pressure, infection



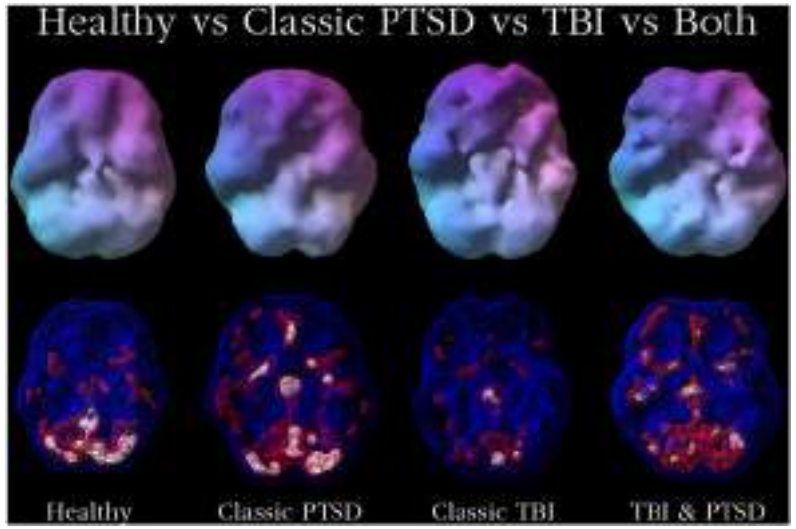


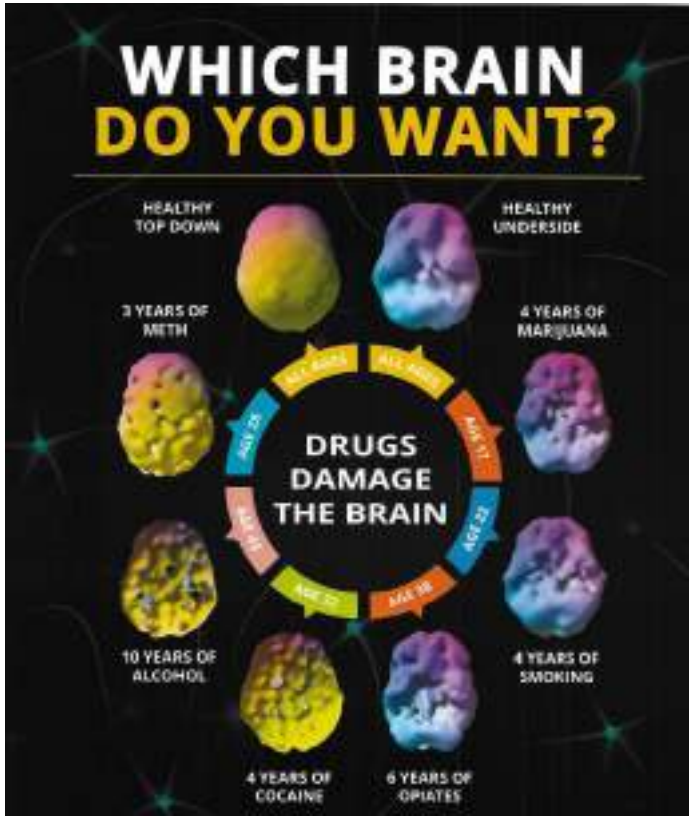
Neuro-Imaging?

- CT & MRI useful in identifying certain types of brain lesions
  - CT: Focal injuries (Subdural or epidural bleed)
    - Skull fractures and intracranial hemorrhages
    - Test of choice in first 24-48 hrs after injury
  - MRI: Excellent at hematomas that may be weeks old
    - Cerebral contusions, white matter injury
  - Used for when player experiences loss of consciousness
- However, little use in assessing cerebral concussions and/or return to play decision!!!
- Used only when player loses consciousness, severe amnesia, increasing symptoms and abnormal physical or neurologic findings

Brain SPECT Imaging

- Single photon emission computed tomography
- If patient continues to suffer from brain injury symptoms after 3 months:
  - 95% accuracy
  - 100% negative predictive value for assessing brain injury
    - Rules out no brain injury
    - Could be due to depression, fatigue, memory problems
- Three key factors:
  - Which area of the brains are working well
  - Which areas are working inordinately hard
  - Which areas are not working hard or well enough





Glasgow Coma Scale (GCS)

- Levels of TBI:
  - Mild (13-15)
    - +/- loss of consciousness < 30 min
    - Normal neuroimaging
  - Moderate (9-12)
    - Loss of consciousness > 30 min but < 24 hrs
    - Normal/abnormal neuroimaging
  - Severe (3-8)
    - Coma
    - Normal/abnormal neuroimaging
  - Vegetative

- Motor Response:
  - (1) No response
  - (2)Extensor (Rigid) response
  - (3)Abnormal (Spastic) flexion
  - (4) Withdraws from pain stimuli
  - (5) Localizes to pain stimuli
  - (6) Obeys commands for movement
- Verbal Response:
  - (1) No sounds
  - (2) Incomprehensible speech
  - (3) Inappropriate words/responses
  - (4) Confused convo, but able to answer questions
  - (5) Alert and oriented
- Eye Opening:
  - (1) No eye opening
  - (2) Eyes opens to pain
  - (3) Eye opens to speech
  - (4) Spontaneous, Open with blinking

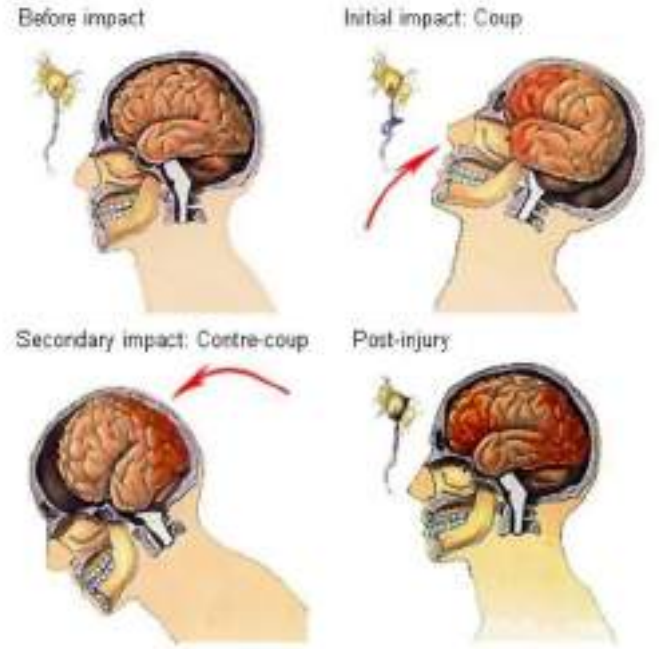
TBI: Severity Scale

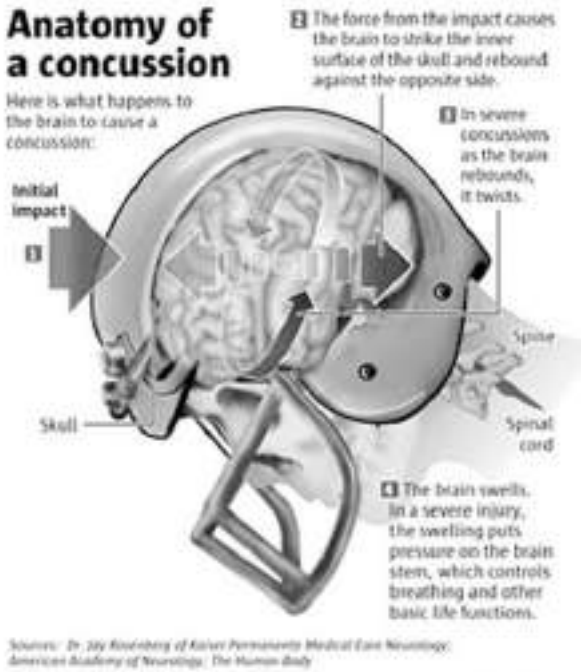
Parameter	Mild	Moderate	Severe
Structural Neuro-Imaging	Normal	Normal/Abnormal	Abnormal
Loss of Consciousness	0-30 min	30 min – 24 hrs	> 24 hrs
Alteration of Consciousness	1 min – 24 hrs	> 24 hrs	> 24 hrs
Post-Traumatic Amnesia	0-1 Day	1-7 Days	> 7 days
Glasgow Coma Scale	13-15	9-12	< 9

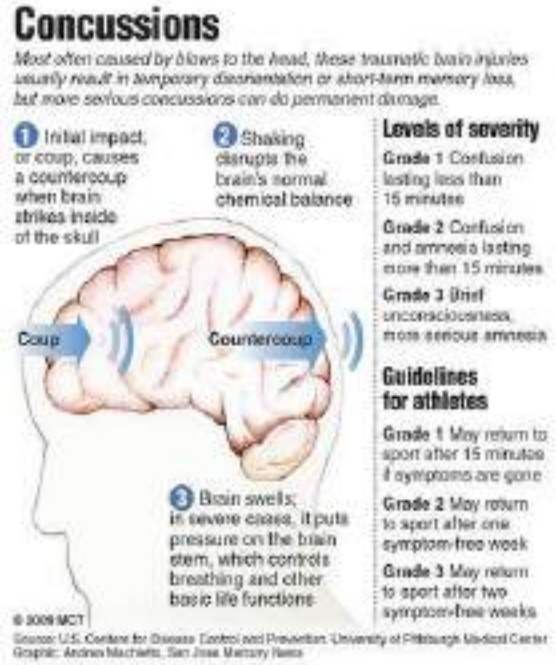
- American Congress of Rehabilitation Medicine Guidelines

Coup vs. Contre-Coup Closed Head Injuries

- Coup (Acceleration) = Forceful blow to the resting movable head
  - Injury beneath the point of cranial impact
- Contre-coup (Deceleration) = Moving head hitting an unyielding object
  - Injury opposite the site of cranial impact as the brain shifts within the cranium
- Many sports related concussions are result of both
  - One not more serious than the other

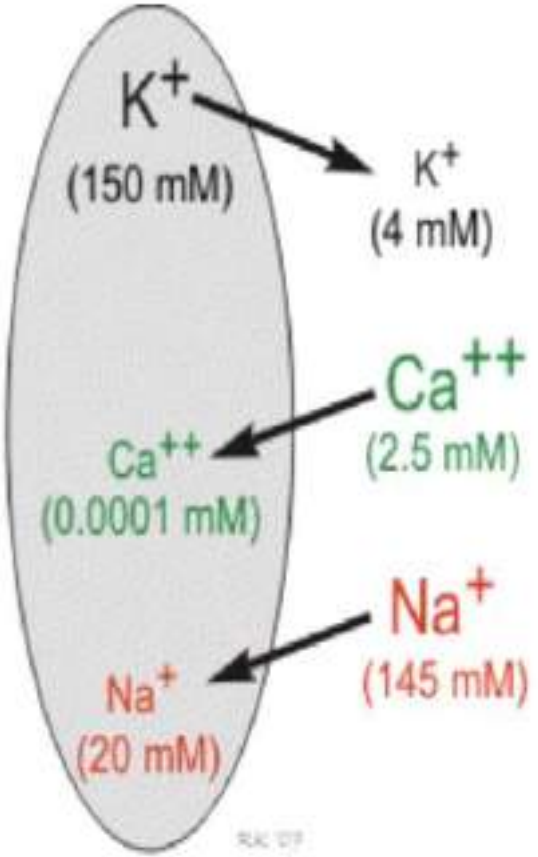




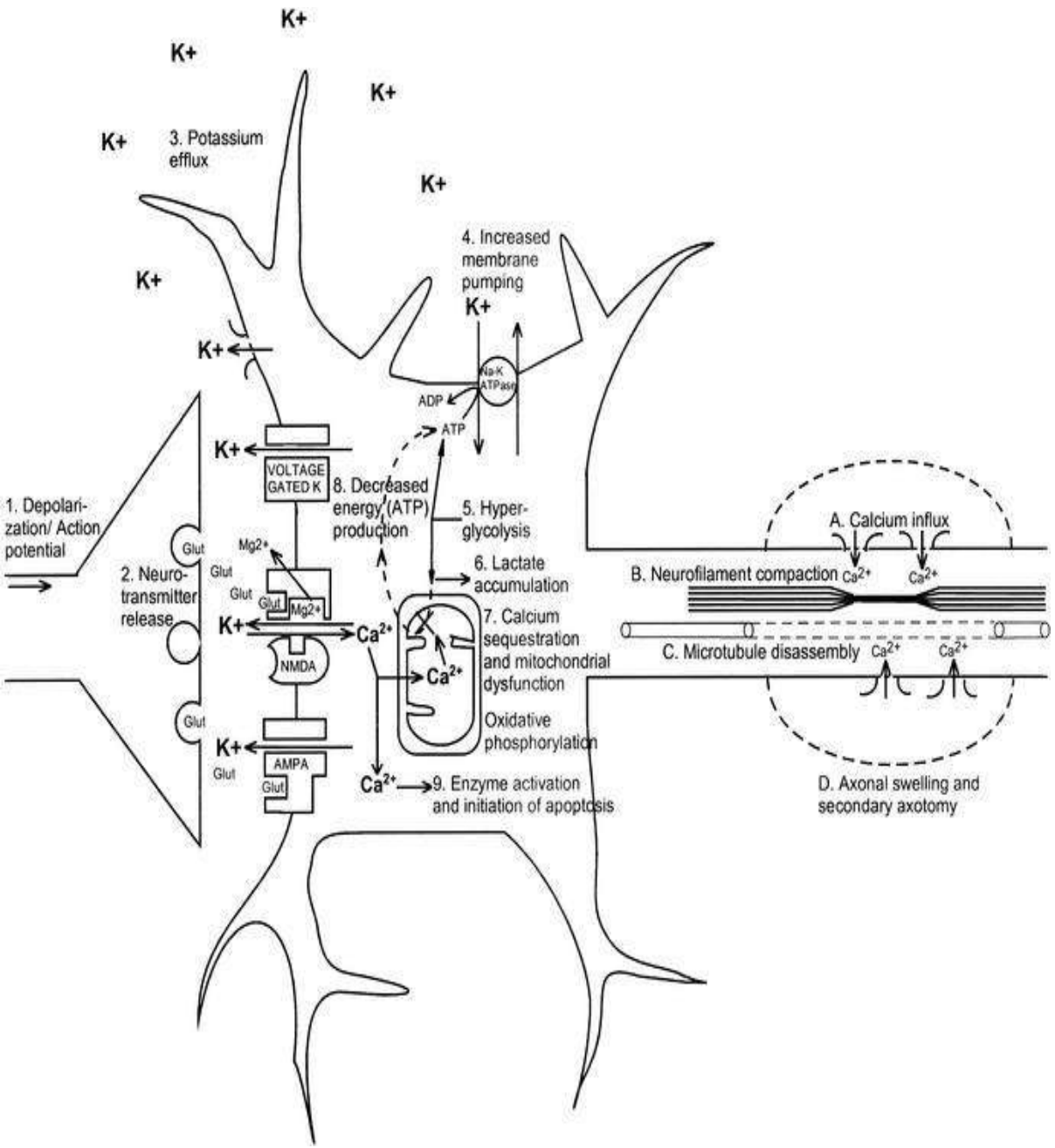


Neurometabolic Cascade: Excitatory Phase

1. Acceleration & Deceleration Injury:
   - Mechanical stretching/shearing
   - Deformation of neuronal membrane
2. Opening of Voltage-Dependent K+ Channels:
   - Increase in extracellular K+
   - Depolarization
   - Action potentials
     - Release of EAA's (Glutamate)
       - Gluatmate also activates N-methyl-D-aspartate (NMDA receptors
         - Influx of Ca++ into neuron
         - Intracellular Ca overload is the biggest problem with concussions!



Giza & Hovda, 2001 & 2014
Signoretti et al 2011

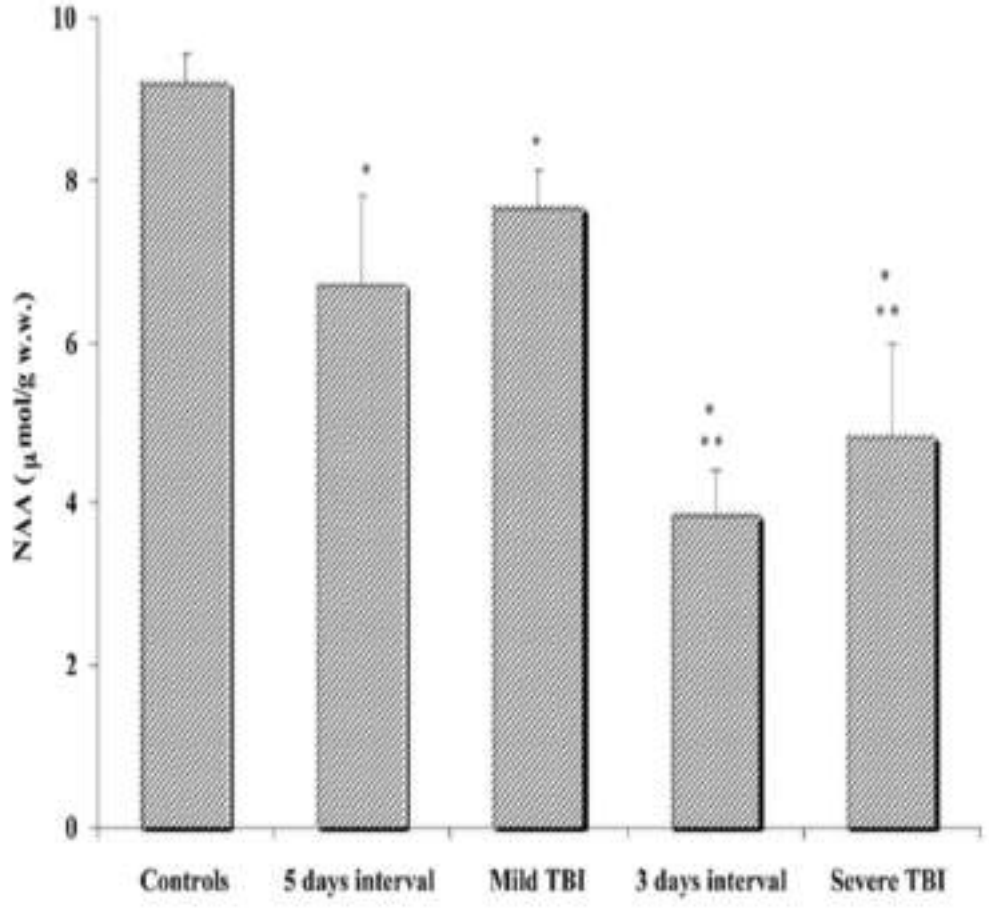


Supply Vs Demand

- Ca++ enters mitochondria (Overload)
  - Damages neurofilament side arms of axon
- Increase demand for glucose and also blood flow
  - Blood flow decreases immediately after impact (50% in animals)
- Increase Demand for ATP vs Decrease production of ATP
- Magnesium also immediately reduced for up to 4 days!
  - Mg competes with Ca++ for access to NMDA (May have a neuroprotective effect)
  - Most are deficient in Mg!

mTBI vs Severe TBI

- Mild = 20% reduction in ATP
  - Mitochondria are not irreversibly damaged by mTBI
  - Reversible energy deficit
- Severe = 50% reduction in ATP
  - Significant alteration of mitochondria
  - Potentially permanent
- 2 mTBI's that occur in close temporal proximity can lead to the same irreversible damage seen in severe brain injury!



Signoretti et al 2011

Vagnozzi et al 2005

doi:10.1093/brain/awq200 Brain 2010: 133; 3232–3242 | 3232

BRAIN
A JOURNAL OF NEUROLOGY

Assessment of metabolic brain damage and recovery following mild traumatic brain injury: a multicentre, proton magnetic resonance spectroscopic study in concussed patients

Roberto Vagnozzi,[1] Stefano Signoretti,[2] Luciano Cristofori,[3] Franco Alessandrini,[4] Roberto Floris,[5] Eugenio Isgrò,[6] Antonio Ria,[3] Simone Marziale,[4] Giada Zoccatelli,[4] Barbara Tavazzi,[7] Franco Del Bolgia,[1] Roberto Sorge,[1] Steven P. Broglio,[8] Tracy K. McIntosh[9] and Giuseppe Lazzarino[10]

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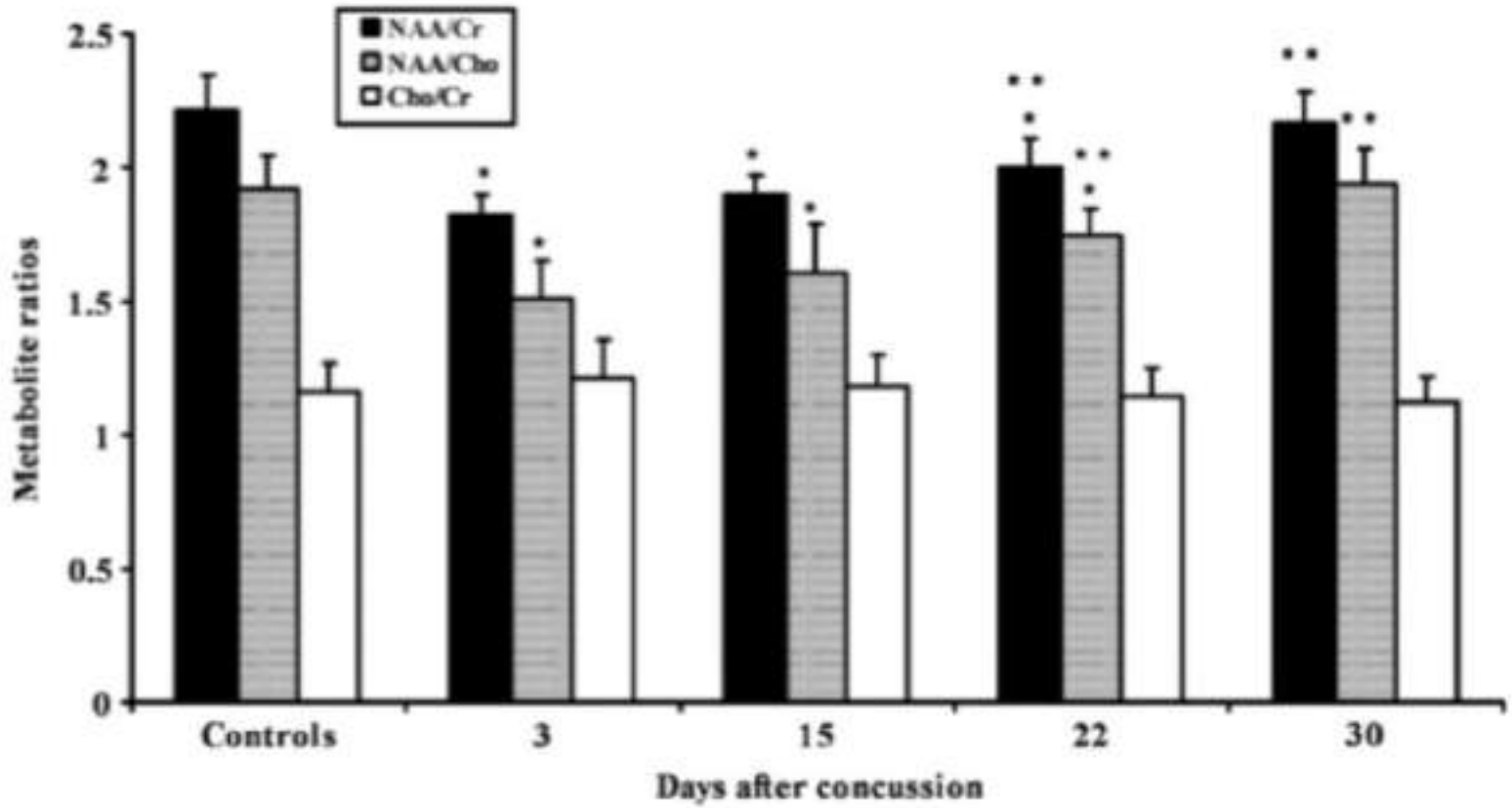

The Importance of Restriction from Physical Activity in the Metabolic Recovery of Concussed Brain

Giuseppe Lazzarino et al.*
Department of Biology, Geology and Environmental Sciences
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1. Introduction

Brain concussion is unquestionably the most common form of traumatic brain injury (TBI) worldwide (Bruns & Hauser, 2003; Tagliaferri et al., 2006). In European countries, approximately 235 individual/100,000 people are admitted annually to the hospital following TBI, 80% of which receive a diagnosis of mild TBI (mTBI). (van der Naalt, 2001; Vos et al., 2002). It has been calculated that the ratio in the occurrence of mTBI to severe TBI (sTBI) is approximately 22 to 1, with mTBI accounting for at least 75% of patients who survive after TBI each year (Tagliaferri et al., 2006). These percentages are very similar to those recorded in the United States where it is estimated that approximately 1.5 – 8 million people per year suffer from TBI and, among those requiring hospitalization, a proportion ranging from 75% to 90% are classified as "mildly" injured or "concussed" (Bruns & Hauser, 2003). These wide ranges of annual incidence are probably due to the fact that an unknown proportion of mTBI victims do not seek any medical attention (McCrea et al., 2004) (HEADS UP) but it might also be due to the fact that there is still confusion and inconsistency among researchers and organizations in defining and understanding this type of trauma. (Cantu & Voy, 1995; Cantu, 1998, 2007).

Sub	Age	Sex	Sport	Symptoms (after 1st)	Symp Duration	Time btw	Symptoms (after 2nd)	Symp Duration	NAA Norm
1	20	M	Boxing	Headache, amnesia	3	10	LOC, HA, concentration probs, irritability, sleep probs	52	120d
2	24	M	Rugby	Headache, nausea, amnesia	4	9	LOC, HA, nausea, retrograde amnesia, irritability, sleep probs	59	120d
3	32	M	Soccer	HA, fatigue, nervousness	8	18	HA, Irritability, diff concentrating, foggy vision, nausea	44	90d
4	27	M	Soccer	HA, sleep probs	7	16	HA, nausea, sleep probs, dizziness	35	90d
5	20	M	Kickbox	HA, sleep probs	8	21	HA, retro, sleep, concentration	24	60d
6	33	M	Boxing	HA, Anterograde amnesia	5	19	HA, fatigue, dizzy, tingling, irritability	33	90d

Increasing Recovery Time Between Injuries Improves Cognitive Outcome After Repetitive Mild Concussive Brain Injuries in Mice

BACKGROUND: Although previous evidence suggests that the cognitive effects of concussions are cumulative, the effect of time interval between repeat concussions is largely unknown.
OBJECTIVE: To determine the effect of time interval between repeat concussions on the cognitive function of mice.
METHODS: We used a weight-drop model of concussion to subject anesthetized mice to 1, 3, 5, or 10 concussions, each a day apart. Additional mice were subjected to 5 concussions at varying time intervals: daily, weekly, and monthly. Morris water maze performance was measured 24 hours, 1 month, and 1 year after final injury.
RESULTS: After 1 concussion, injured and sham-injured mice performed similarly in the Morris water maze. As the number of concussions increased, injured mice performed worse than sham-injured mice. Mice sustaining 5 concussions either 1 day or 1 week apart performed worse than sham-injured mice. When 5 concussions were delivered at 1-month time intervals, no difference in Morris water maze performance was observed between injured and sham-injured mice. After a 1-month recovery period, mice that sustained 5 concussions at daily and weekly time intervals continued to perform worse than sham-injured mice. One year after the final injury, mice sustaining 5 concussions at a daily time interval still performed worse than sham-injured mice.
CONCLUSION: When delivered within a period of vulnerability, the cognitive effects of multiple concussions are cumulative, persistent, and may be permanent. Increasing the time interval between concussions attenuates the effects on cognition. When multiple concussions are sustained by mice daily, the effects on cognition are long term.

KEY WORDS: Cell death, Concussion, Mice, Mild traumatic brain injury, Morris water maze, Repeated traumatic brain injury, Sport-related concussion

Neurosurgery 71:885–892, 2012 DOI: 10.1227/NEU.0b013e318265a439 www.neurosurgery-online.com

Group 1: Concussed everyday for 5 days

Group 2: Concussed every week for 5 weeks

Group 3: Concussed every month for 5 months

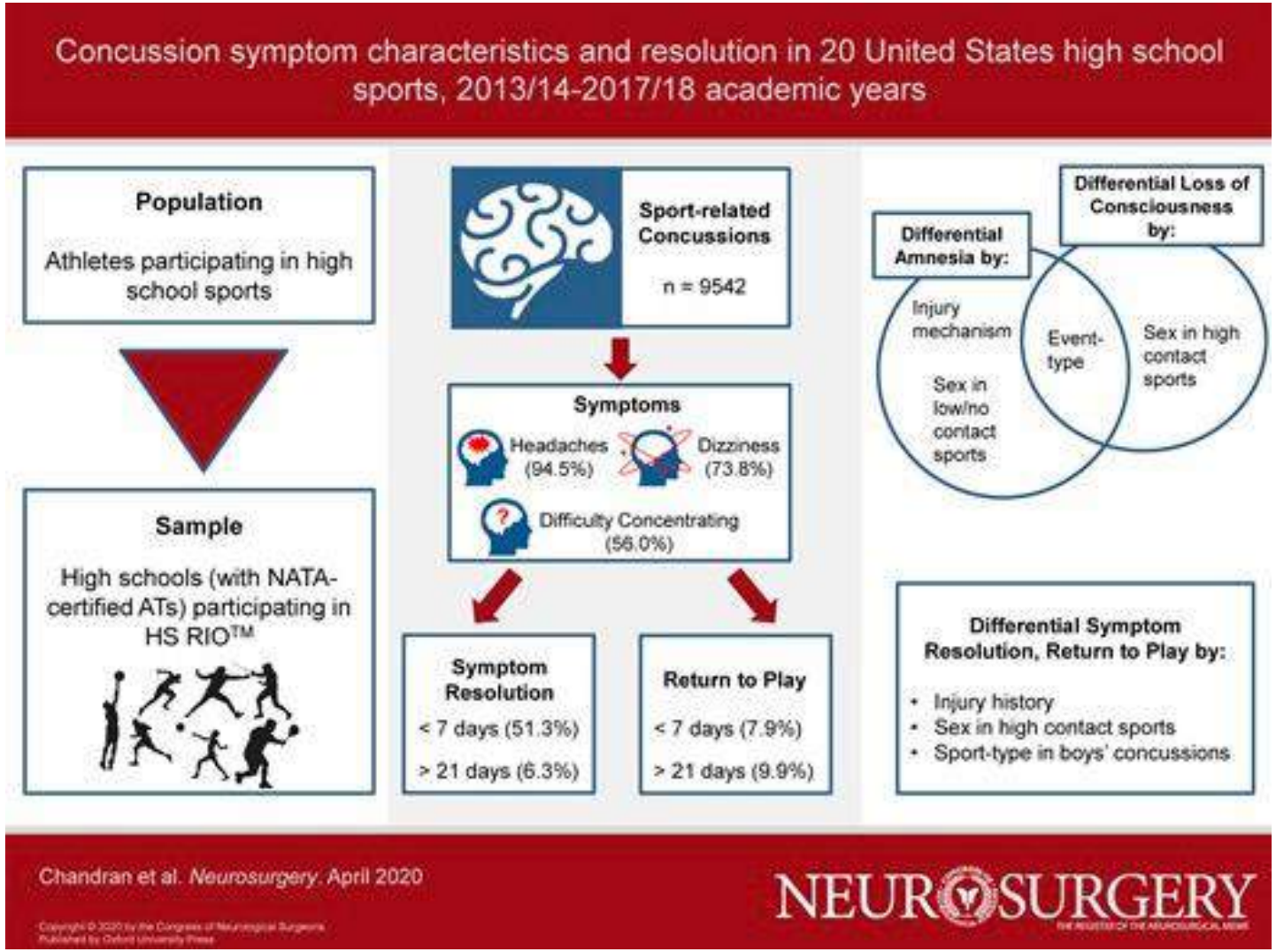
Results = Concussions delivered at 1 month intervals no difference observed

- After 1 yr mice concussed everyday for 5 days were worse

NCAA Concussion Studies

- 1999-2001: Largest prospective study
  - 7-10 day course of recovery was established
- 2014-2017: Teamed up with Department of Defense (DoD) Concussion Assessment, Research and Education Consortium (CARE)

	NCAA (1999-2001)	NCAA-DoD (2014-2017)
n	2905 athletes	40,000 athletes
Concussions	184 football concussions	701 football concussions
Time to asymptomatic	3.42 days	8.83 days
Days from asymptomatic to full RTP clearance	3.25	7.25
Total Time from injury to RTP	6.67	16.08
Rate of Repeat concussions in same season	6.52%	3.85%
Time between repeat concussions	5.59 days	56.41 days



Symptom resolution time

-~85% of the sample recovered symptomatically within 21 days of injury.

-6.3% of the sample saw symptoms resolve >21 days post injury

-~10% of the sample had missing symptom data.

RTP time

-~65% of the sample RTP <21 days post injury (~57% RTP between 7-21 days).

-9.9% RTP >21 days post injury.

-~25% of the sample had missing data or the season ended before they were able to RTP.

“Brain Slosh”

- The suspected common cause of concussions
  - Not direct impact to the head
  - Cerebral blood flow rises at higher altitudes
    - Oxygen use and caffeine can counteract this
- 21 million athletic exposures at 417 High Schools across the country
  - 28% lower concussion rate
- NFL players are 30% less likely to sustain concussions when playing at higher altitudes:
  - Atlanta, Buffalo, Charlotte, Denver, Indianapolis, Kansas City, Minneapolis, Pittsburgh, Phoenix

Name: _____ Age/DOB: _____ Date of Injury: _____

Post Concussion Symptom Scale

No symptoms"0"------Moderate "3"--------Severe"6"

Time after Concussion

SYMPTOMS	Days/Hrs _____	Days/Hrs _____	Days/Hrs _____
Headache	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Nausea	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Vomiting	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Balance problems	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Dizziness	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Fatigue	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Trouble falling to sleep	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Excessive sleep	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Loss of sleep	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Drowsiness	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Light sensitivity	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Noise sensitivity	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Irritability	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Sadness	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Nervousness	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
More emotional	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Numbness	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Feeling "slow"	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Feeling "foggy"	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Difficulty concentrating	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Difficulty remembering	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
Visual problems	0 1 2 3 4 5 6	0 1 2 3 4 5 6	0 1 2 3 4 5 6
TOTAL SCORE	_____	_____	_____

Use of the Post-Concussion Symptom Scale: The athlete should fill out the form, on his or her own, in order to give a subjective value for each symptom. This form can be used with each encounter to track the athlete's progress towards the resolution of symptoms. Many athletes may have some of these reported symptoms at a baseline, such as concentration difficulties in the patient with attention-deficit disorder or sadness in an athlete with underlying depression, and must be taken into consideration when interpreting the score. Athletes do not have to be at a total score of zero to return to play if they already have had some symptoms prior to their concussion.

Symptoms of Post Concussion Syndrome

Symptoms	% of People
Reduced Concentration	71%
Irritability	66%
Tiredness	64%
Low Mood	63%
Memory Problems	59%
Headaches	59%
Anxiety	58%
Trouble Thinking	57%
Dizziness	52%
Blurred or Double Vision	45%
Sensitivity to Bright Light	40%

Symptoms of Everyday Stress	% of People
Reduced Concentration	14%
Irritability	16%
Tiredness	13%
Low Mood	20%
Memory Problems	20%
Headaches	13%
Anxiety	24%
Trouble Thinking	6%
Dizziness	7%
Blurred or Double Vision	8%
Sensitivity to Bright Light	14%

NJ State Law

- Anyone who sustains or is suspected of having sustained a concussion or other head injury shall be immediately removed from the sports competition or practice
- The student shall not participate in further sports activity until he/she receives written clearance from a physician trained in the evaluation and management of concussions

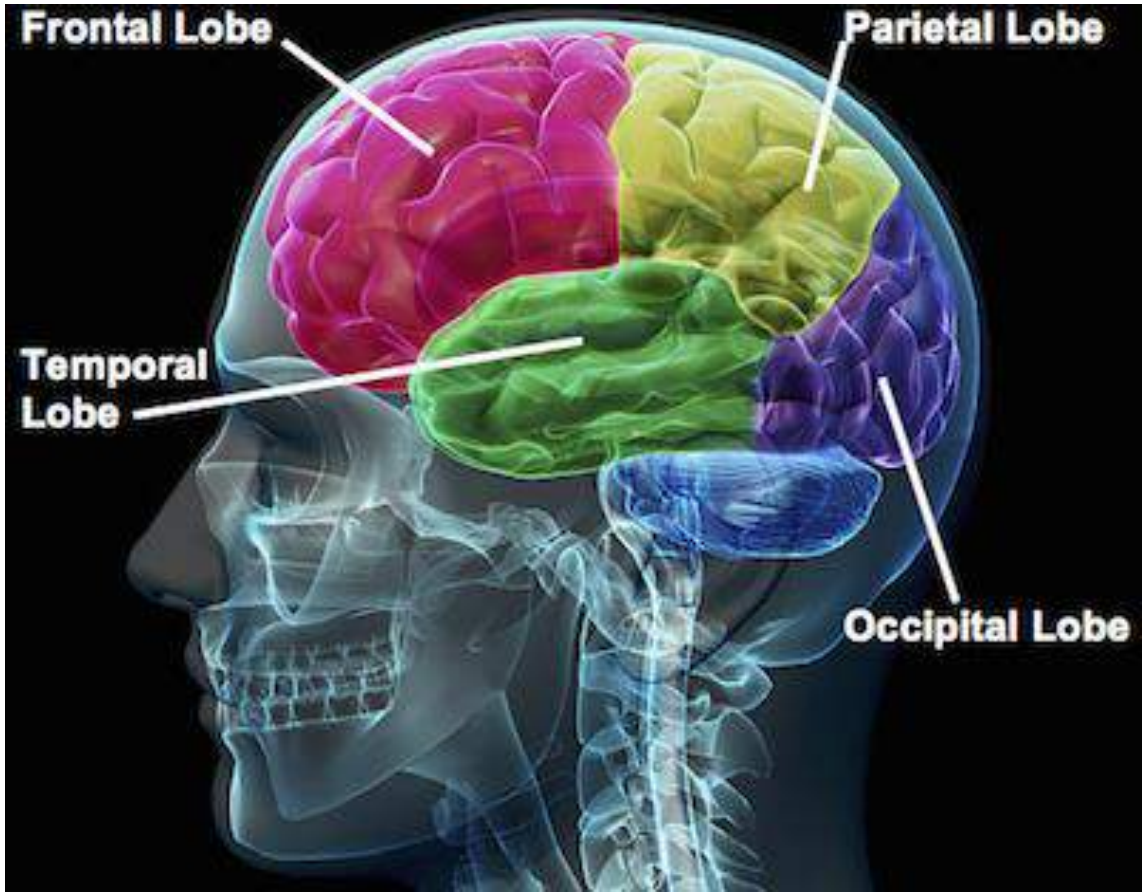
Public Law 2010, Chapter 94,C.18A:40-41.4

The Brain Tells The Eyes What To See

- 50% of the CN's impact vision function either directly or indirectly
- Directly:
  - CN II, III, IV & VI
- Indirectly:
  - CN V & VII
- Vestibular Ocular Reflex (VOR)
  - Generated by CN III & VI and communicates with CN VIII
    - V_1: Neural processing of contrast
      - 21% TBI population have reduced contrast sensitivity
  - Stabilizes the visual world while the head is in motion
    - Dependent on stable, bifoveal retinal images
  - May be impaired with the presence of ocular motor deficits
- Vision & TBI:
  - Convergence Insufficiency (36-48%)
  - Accommodative Insufficiency (20-47%)
  - Saccades/Pursuits (23-32%)
  - Diplopia (6-19%)

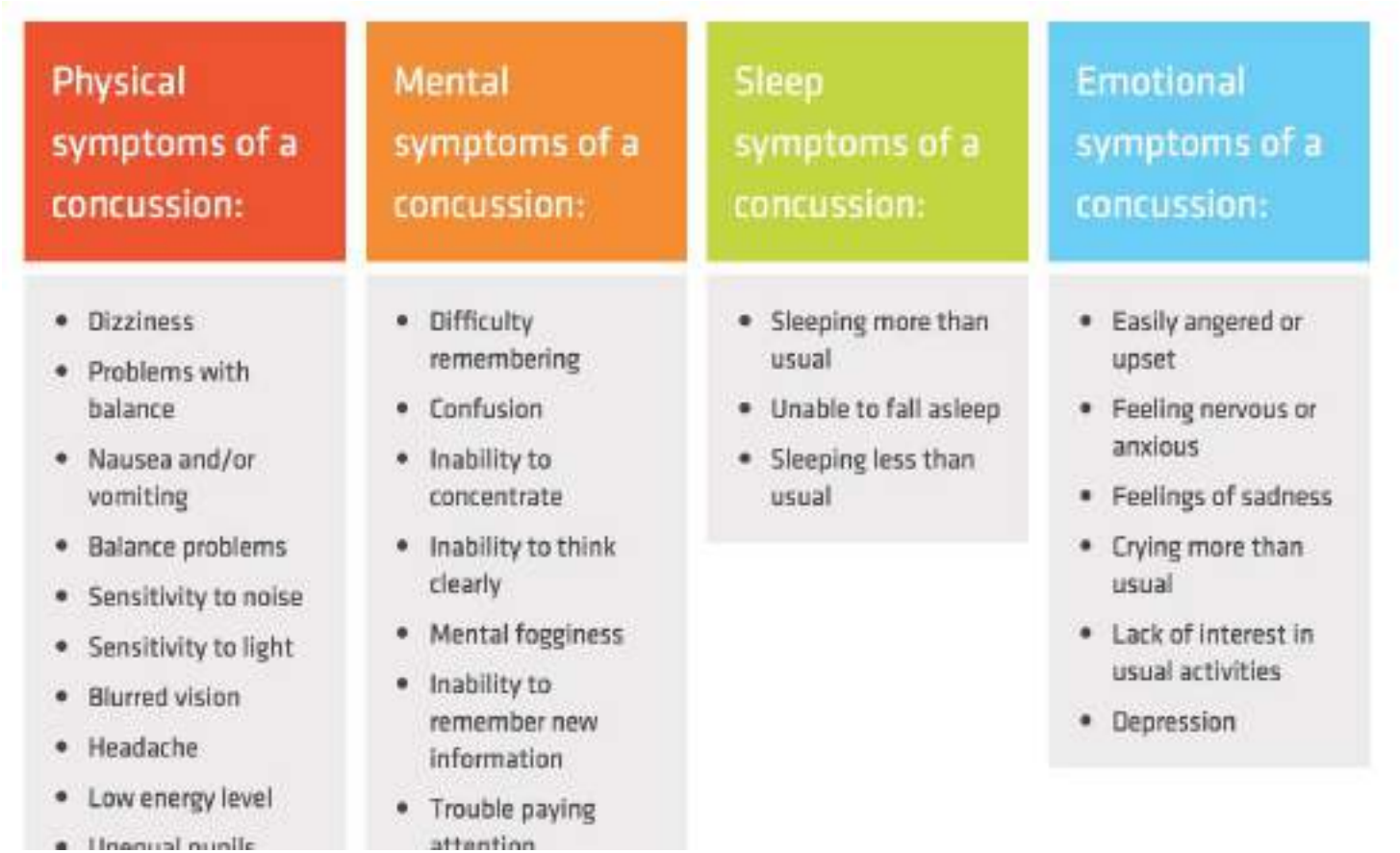
Damaged Lobes

- Frontal:
  - Visuo-motor issues
  - Spatial orientation
- Occipital:
  - Blind Sight (Riddoch Phenomenon)
  - Alexia without agraphia
  - Cortical blindness vs cerebral blindness
- Parietal:
  - Visual neglect
  - Balint's syndrome (Oculomotor apraxia)
  - Anosagnosia
  - Anton's syndrome
  - Optic ataxia
  - Abnormal egocentric localization
- Temporal:
  - Visual object agnosia
  - Prosopagnosia
  - Simultagnosia
  - Optic aphasia



Visual Skills Affected By Concussions

- Functional Vision: How you see an object in space
- Convergence/Accommodative insufficiency most common diagnoses
- 3 Most Common:
  - Eye Teaming: Both eyes ability to fixate on the same object
  - Eye Focusing: Shift focus between objects at different distances
  - Eye Movements: Follow a moving object and switch gazes to another object
- Examine:
  - Visual thinking process
  - Spatial orientation
  - Visual memory
  - Problems with figure ground
  - VOMS (Vestibular/Oculomotor Screening)
    - Smooth pursuit, horizontal/vertical saccades, horizontal/vertical VOR, convergence, visual motion sensitivity
    - 61% concussed athletes have at least 1 VOM symptom
  - Pupils:
    - Dilated/Fixed, APD, anisocoria
  - Visual fields
  - Health:
    - Retinal changes
    - Traumatic iritis
    - Traumatic optic neuropathy



Post-Concussion Vision Problems

- 90% have 1 or more ocular problems:
  - Blur
  - Double Vision
  - Eye Strain
  - Light Sensitivity
  - Eye teaming/tracking/focusing
  - Visual hallucinations
  - Visual perceptual processing (“Fog”)
- Recovery Can Last Up To:
  - 4 weeks for “symptoms”
  - 3 weeks for “memory”
  - 3 weeks for “oculomotor/vestibular”
- Hidden vision problems persist 6-9 months after concussion
  - Delay recovery if not addressed properly
- Vision rehab results in faster recovery and avoid other issues:
  - Depression
  - Social isolation
  - Sleep disorders
  - Sedentary state

Visual Perceptual Skills: Speed & Facility Processing

Speed and Span of Perception:

- Amount of visual info acquisition during an eye fixation (Attention)
- Reading, driving, mobility and visual search (Saccadic cancellation)
- Software programs (PTS II, PVT, CVT)

Visual Figure-Ground:

- Scene or pattern is separated into the main figure and background
- Without it causes visual confusion
- Visual perceptual workbooks, puzzles, games, plus lenses for near or bifocals, larger print

Visual Closure:

- Recognition of objects when there is incomplete visual info
- Need to study a scene more carefully
- Visual perceptual workbooks and software programs, games, puzzles

Visual Sequential Memory:

- Ability to remember the sequence of forms or characters
- Trouble spelling, transcribing data, writing instructions (Saccadic dysfunction)
- Memory books, visual perceptual books, software programs

Visual-Motor Integration:

- Eye-hand/Eye-body coordination
- Inaccurate reaching/grasping, poor balance, navigation, maintaining upright posture and handwriting
- Computerized wall-mounted gel light boards, occupational therapy peg boards, rotating pegboards, tracing/drawing activities in perceptual workbooks

Sensorimotor vs Visual Perceptual Testing:

Sensorimotor
CT, NPC, Phoria, Vergence Ranges
Accomodative Amps, Facility, Lag
King-Devick or DEM
Visagraph
Vectograms
Keystone Visual Skills
Fixation Disparity (Wesson Card)
Tannen Flippers
Van Orden Star
Cheiroscopic Tracing

Visual-Perceptual
Visual Memory -Sequential (Visual Span) - Simultaneous (Tachistoscope)
Visual Spatial Processing -Visual Spatial Relations -Visual Spatial Memory - Block Design
Visual Processing Speed
Gardner's

*If DVA is more than 2 lines poorer than SVA = **Visual Vestibular Problem**

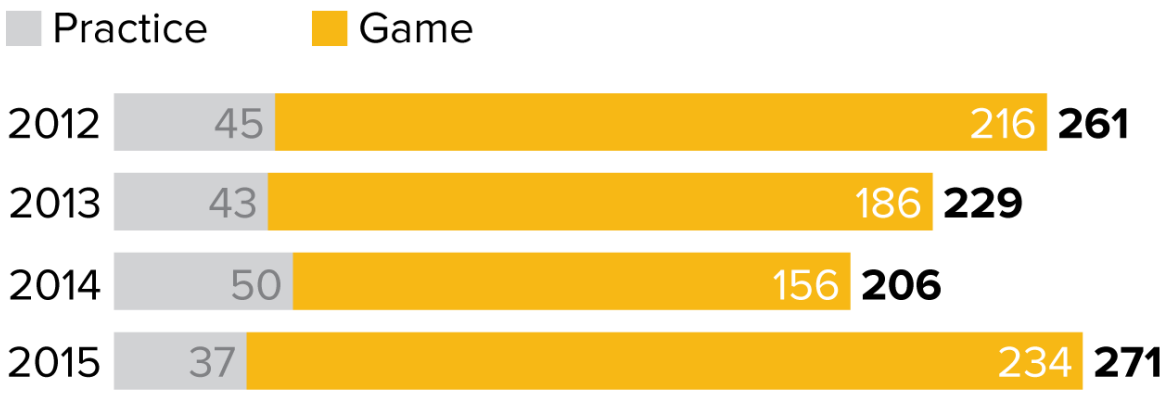
Medical Coding For Stroke & Concussion Care

Stroke	Concussion
R27.8 Lack of Coordination	**F07.81** Post-Concussion Syndrome
H53.40 Visual Field Defects	**S06.0X0A** Concussion w/o Loss of Consciousness (1st visit)
-	**S06.0X1A** Concussion with loss of Consciousness 30 min or less (1st visit)

99211 Straightforward	**History, Exam & Medical Decision-Making:** No key elements required. Problem severity does not require physician presence; service is provided under physician's supervision
99212 Low	**History:** Chief complaint, 1-2 HPI elements; **Exam:** Brief exam of affected body area; **Medical-Decision Making:** Diagnosis/Management options minimal amount of complexity, straightforward
99213 Extended	**History:** Chief complaint HPI 1-3 elements and 1 ROS; **Exam:** 2-4 body areas. Limited exam of affected body area and other related system; **Medical-Decision Making:** Diagnosis/management options limited, amount /complexity low decision-making
99214 Moderate	**History:** Chief complaint, HPI 4 elements and 2-9 ROS; **Exam:** 5-7 body areas; **Medical-Decision Making:** Diagnosis/management options multiple, moderate complexity and moderate mix
99215 High	**History:** Chief complaint, HPI 4 elements and 10 ROS or more, 2 or 3 PFSH & 3 past medical history/family history areas; **Exam:** 8 or more systems; **Medical-Decision Making:** Diagnosis/management options extensive amount/high and high risk

CONCUSSIONS IN THE NFL

In 2015 the NFL recorded 271 preseason and regular season concussions – its largest number since beginning to collect comprehensive data in 2012.



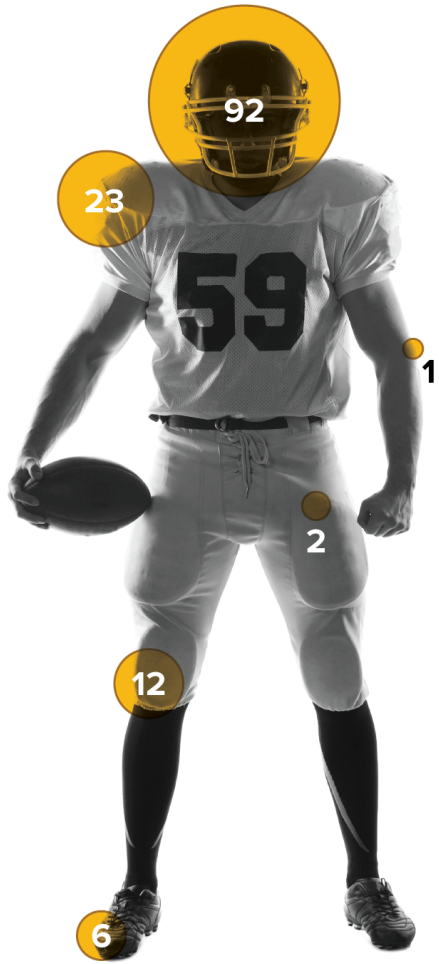
SOURCE | NFL

abc NEWS

CONCUSSIONS BY IMPACT SOURCE

Concussions in the NFL are overwhelmingly the result of an impact from another helmet, but significant increases in concussions caused by shoulders and playing surface have also been seen over the past year.

2015 totals by body part



Yearly totals by impact source

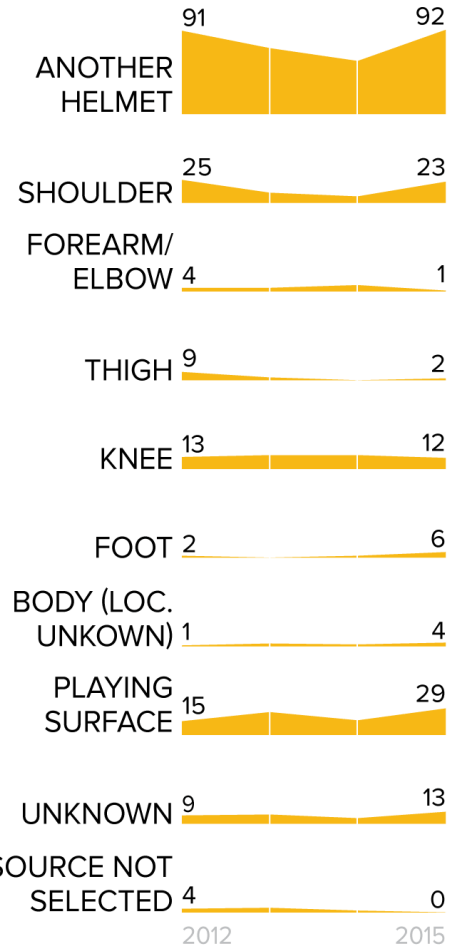


PHOTO | iStock, g-stockstudio
SOURCE | NFL

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NFL Concussion Timeline

1994

The NFL establishes its Mild Traumatic Brain Injuries (MTBI) committee.

2002

Mike Webster d. 2002

Sept 2002 - Bennet Omalu MD finds structural deformities in the brain of Mike Webster, who had suffered multiple concussions and exhibited dementia plus psychosis in illness. He names the condition Chronic Traumatic Encephalopathy (CTE).

Dr Omalu with neurosurgeons and neuropathologists Julian Bailes, Robert Cantu and Ann McKee find CTE in the brains of 10 out of 14 professional athletes, all of who had died in suicides, accidents or from drug abuse.

2004

Justin Strzelczyk, d. 2004 auto accident

2005

Terry Long, d. 2005 – suicide

July 2005 - The peer-reviewed journal Neurosurgery publishes an article by Omalu reporting his findings.

Neurosurgery declines to retract Omalu's article and publishes another by him.

NFL MTBI committee dismiss co-Czars Elliot Pellman and David Viano denounce Omalu's article and demand that it be retracted.

2006

Andre Waters, d. 2006 – suicide

2007

March 2007 – The NFL adopts the "88 Plan" which provides for financial support (up to $88,000/year) to former NFL players suffering from dementia.

March 2007 – The head of NFL's MTBI committee, Dr Elliot Pellman resigns amid controversy over his qualification as a rheumatologist to lead the MTBI studies.

2008

Tom McHale, d. 2008 - accidental drug O.D.

Gerald Small, d. 2008

Curtis Whitley, d. 2008

John Grimsley, d. 2008 - accidental GSW

2009

Chris Henry, d. 2009 - auto accident

Oct 2009 - U.S. House Judiciary Committee convenes hearings on the legal issues relating to football head injuries. Dr's Omalu, Bailes, Cantu and Mckee give sworn testimony.

Lou Creekmur, d. 2009 – complications of dementia

Dec 2009 - The NFL changes return-to-play rules for players who sustain concussions and other head traumas.

2011

Dave Duerson, d. 2011 - suicide

The NFL moves kick-offs to the 35-yard line in hopes of reducing the speed of collisions during kickoff.

Aug. 2011 - Former Atlanta Falcon Roy Easterling files a lawsuit against the NFL. He will later be joined by more than 4,500 other former players.

2012

Former Atlanta Falcon Roy Easterling, d. 2012 - suicide

He is later diagnosed with CTE.

The linebacker Junior Seau, d. 2012 - suicide

A post-mortem reveals CTE.

The NFL announces Heads Up Football, a concussion awareness initiative for youth football.

In a sports conference, Dr Ann Mckee announces that she has found CTE in 33 of 34 brains belonging to former football players.

2013

The NFL Players Association announces it will spend $100 million on research into the health problems of football players.

The NFL introduces new safety measures, including a concussion assessment examination for players.

Hearings are held on whether to allow lawsuits filed by retired NFL players that claim the league fraudulently concealed the dangers the sport posed to their health. The NFL denies these charges.

Aug. 2013 - The NFL agrees to a settlement of $765 million to retired players. As part of the settlement the league does not admit wrong doing.

2014

Bears Hall of Famer Gale Sayers and 10 others file a federal lawsuit against the NFL alleging chronic head injuries leading to loss of memory, Alzheimer's and other neurological problems.

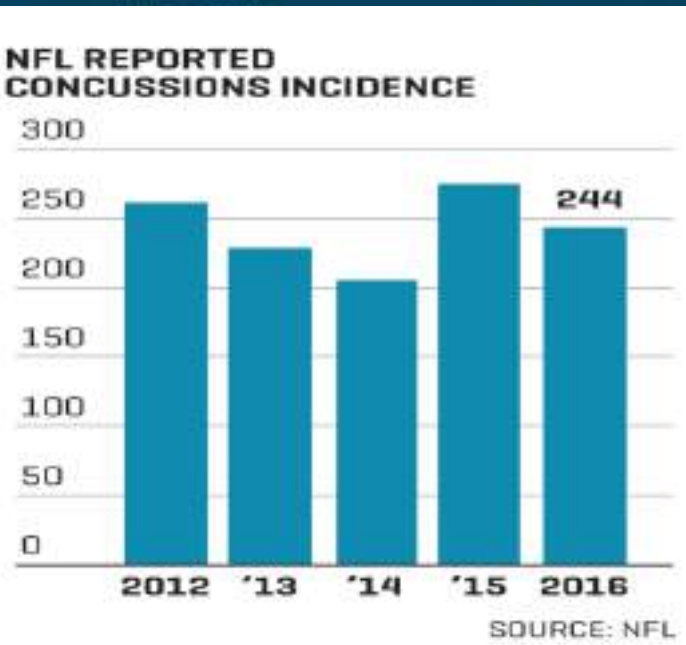
NFL NATION CONFIDENTIAL

I'D PLAY IN THE SUPER BOWL WITH A CONCUSSION.

85%
AGREE

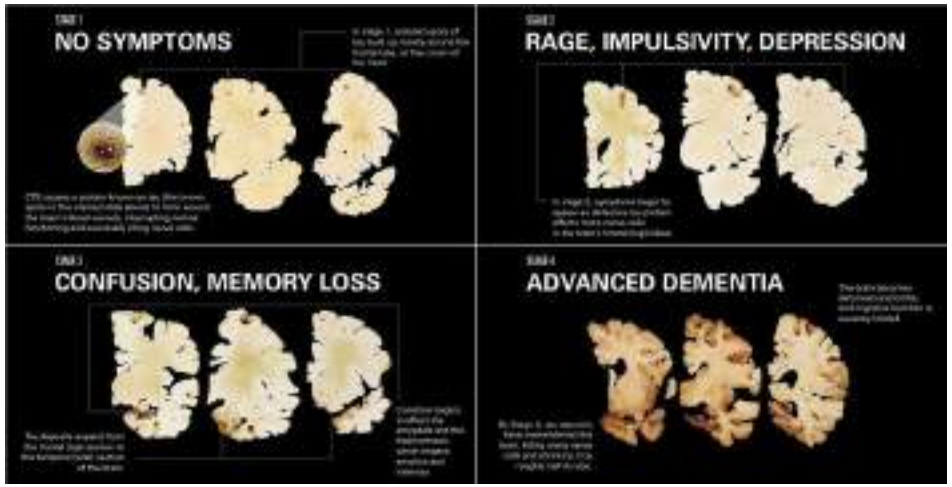
THE NFL IS COMMITTED TO PLAYER SAFETY.

60%
AGREE



Chronic Traumatic Encephalopathy

- Neurodegenerative disease associated with repetitive TBI's
- Dr. Harrison Martland (1928) "Boxers Dementia/Dementia Pugilistica"
- Robert et al (Late 1980's)
  - Diffuse B-amyloid plaques
  - Clinical Signs:
    - Memory disturbance
    - Speech abnormalities
    - Behavioral changes: Depression, suicidal thoughts, short temper, aggression, etc
    - Gait abnormalities
  - 3 Clinical Stages:
    1. ADHD, confusion, dizziness, headaches
    2. Memory loss, poor judgment, impulsive behavior
    3. Progressive dementia/Alzheimer's, speech impediments, depression, suicidal thoughts, etc
- Found in Contact Sports: Football, wrestling, hockey, soccer, rugby, boxing
  - Appears 8-10 years after athlete experiences multiple mild TBI's
  - Youngest reported is 25 years old
- NFL Case Reports:
  - Diffuse axonal injury
  - Cerebral atrophy
  - Loss of pigment in substantia nigra
  - Neurofibrillary tangles and accumulation of neurotoxic tau protein
  - 110/111 former NFL players have been diagnosed (JAMA July 2017)
- As of 2017 no specific treatment for the disease
- "Pro Football hurt my brain, prove it both in court and from the grave" – Mike Webster (Steelers)
- "If known about risks of CTE, I would never have played and discourage children from playing" - Bo Jackson (2017 USA Today)



CONCUSSION CRISIS

NFL expects **1/3** of retired players to develop long-term cognitive problems

NFL players are **4x** more likely to develop Alzheimer's & ALS

NFL players' median age at death is **57***

* SOURCE: National Institute for Occupational Safety & Health

NFL

Rob Gronkowski Tells Behavioral Neuroscience Ph.D. That CTE Is "Fixable" Because He "Fixed" His Own

Gabe Fernandez
Today 10:14AM - Filed to: ROB GRONKOWSKI

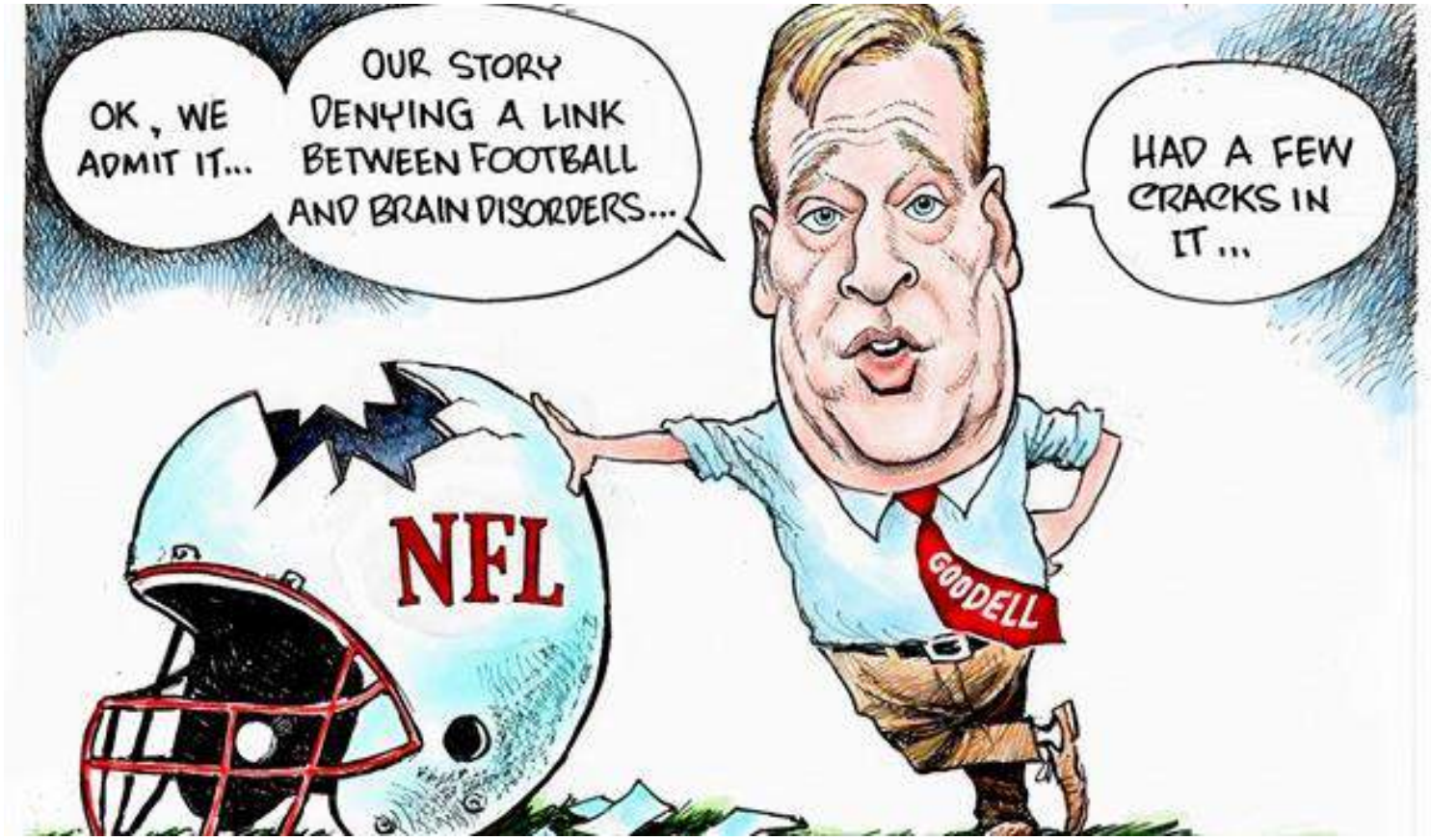
112.9K 109 Save

Photo: Ilya S. Savenok (Getty Images)

Massaro claimed in the lawsuit that injuries from wrestling 'caused her severe and ongoing pain and suffering, emotional distress and financial hardship'.

She said the organisation 'used narcotics as a tool to allow me and other wrestlers to perform through our injuries', leading to addiction for which she sought treatment through the WWE Former Talent Rehab Program in September 2010.

Massaro remained in the program for 42 days but said there was no monitoring after the program and claimed WWE ignored other aspects of the head trauma.



Concussion Protocol (NFL)

- Pre-Season Evaluation:
  - All players and coaches are required to be educated/report on concussions
  - Neurological Exam: Attention span, speech skills, organizational skills, language, memory, reasoning, planning
  - Physical exam
- In-Game Identification:
  - Unaffiliated neurotrauma consultant, team physicians, athletic trainers, officials
    - Review film throughout the game and have ability to call a medical timeout
- In-Game Evaluation:
  - Mandatory removal from playing field
  - Concussion = Prohibited from returning to the game and further neurological/physical exam
  - No Concussion = Symptoms check list, close eyes/balance test, cognitive evaluation, replays of hit reviewed before entering back into the game
- Post- Game Evaluation:
  - Monitored and examined on a daily basis
  - Must return to their baseline cognitive function
  - Graduated exercise challenge → Gradual return to practice
  - If player still feels symptoms = Evaluation starts from beginning
- (2016) Failure to comply to concussion protocol = Monetary fine or loss of draft picks

Concussion Protocol (NHL)

- Educational video and brochure to all players, coaches, medical staff and club executives
- Baseline testing (X2 SCAT3 app, ImPACT, paper/pencil testing)
- Remove player with signs and symptoms
  - Sent to locker room for 15 min uninterrupted eval
- If passes tests medical team clears to return to ice
  - No same day

Concussion Protocol (MLB)

- Mandatory baseline testing for players and umpires (ImPACT)
- SCAT-2 (Club house assessment completion)
- Player evaluated 48 hrs by athletic trainer or team physician after sustaining head trauma before diagnosis
- 7 day or 15 day disabled list for concussions established (Not mandatory)
- Cleared (By team physician with approval by MLB medical director)
  - Team must submit a RTP form to MLB medical director
  - Asymptomatic overall
  - Normal ImPACT assessment (Return to baseline)
- Teams have an independent mTBI specialist
- Buster Posey Rule (2013)
  - Defender mask (Force 3)

Concussion Protocol (NBA)

- Education: Coaches, players, medical staff
- Baseline testing (Neurological and cognitive assessment)
  - SCAT3
- Acute Evaluation & Management:
  - Concussion = Out for the game/practice
  - 24 hrs later another concussion evaluation
- RTP Protocol:
  - No symptoms at rest
  - Evaluated by physician
  - Completed RTP exertion protocol
  - Team physician discusses with director of NBA concussion program

Concussion Protocol (MLS)

- Formed a concussion committee
- Baseline testing (SCAT 3)
- Player and coaching education
- Removal from play if signs or symptoms are present
- MRI eval
- Must be asymptomatic for 3 days before beginning a progressive RTP approach

SCAT3™

Sport Concussion Assessment Tool – 3rd Edition

What is the SCAT3?

What is a concussion?

SIDELINE ASSESSMENT

Indications for Emergency Management

Potential signs of concussion?

1 Glasgow coma scale (GCS)

2 Maddocks Score

Concussion Defined

- Trauma to the head with a normal CT scan of the brain
- Symptom severity score of 40 or greater on SCAT 3
- SAC: Score less than 24

Diagnostic Testing

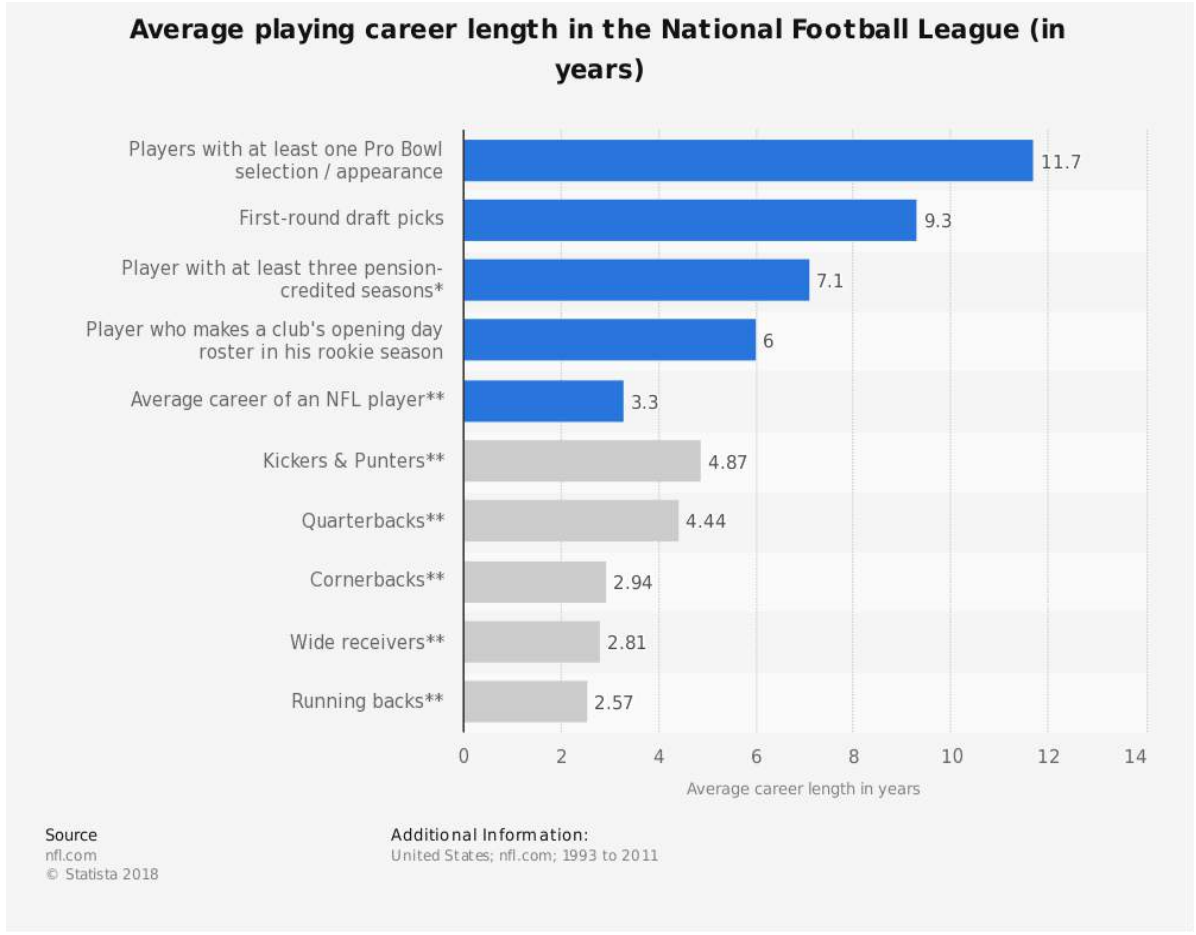
- Self-Report Symptom Checklist
- Brief Cognitive Assessment:
  - Standardized Assessment of Concussion (SAC = 52% concussions detected) 5 min test and valid for 48 hrs post injury
    - Measures orientation, immediate memory, concentration, delayed recall and detects changes in mental status
    - 30 point test (Lower score = More severe cognitive impairment)
  - Sports Concussion Assessment Tool (SCAT-5) Used for ages 13 and up
    - After 3-5 days post injury not very reliable
- Concussion Screening Test: Saccadic performance
  - King Devick (79% concussions detected)
    - 2 min tablet based test (Concussion management, reading solutions, ALS, Alzheimer's, etc)
    - Eye movements, visual processing, concentration, attention, speech, language
- Balance Tests: (Postural-Stability)
  - Balance Error Scoring System (BESS = 80% concussions detected)
    - 3 Stance positions tested on both firm and foam surfaces with eyes closed (6 trials)
  - TGT
- Computer Based Neuropsychological Tests: Good for measuring recovery not diagnosis (10 & up)
  - Immediate Post-concussion Assessment & Cognitive Testing (ImPACT – 25 min)
    - Visual reaction time, working memory, processing speed, recognition memory, attention time/span, discrimination and non-verbal problem solving
  - Automated Neuropsychological Assessment Metrics (ANAM)
  - Concussion resolution index
  - CogSport
  - Headminder
  - CNS Vital Signs
  - Axon
- King Devick & BESS = 95% concussions detected
- King Devick, BESS & SAC = 100% concussions detected

ImPACT Sideline Reference

- On-Field Cognitive Testing:
  - Orientation:
    - What stadium/rink this is?
    - What city is this?
    - Who is the opposing team?
    - What month/day is it?
  - Anterograde Amnesia: Repeat the following words
    - Girl, Dog, Green
    - Cat, Blue, Boy
  - Retrograde Amnesia:
    - What happened in the most recent quarter/period?
    - What do you remember just before you were hit?
    - What was the score of the game just before you were hit?
    - Do you remember the hit?
  - Concentration:
    - Repeat the days of the week backwards, starting with today
    - Repeat these numbers backwards: 63, 71, 419, 956
  - Word List Memory: Can you tell me the words I asked you to remember earlier
    - Girl, Dog, Green
    - Cat, Blue, Boy

Professional Sports

- NFL – ImPACT testing, League guidelines established
  - 1993 – 1994 Steeler's Project
  - 1994 – 1995 NFL Neuropsychology Pilot Program
  - 1996 – 2000 Non-computer based testing
  - 2001 – 2007 Adoption of computer based testing
    - Adopted by NHL, MLB, MLS, Indy Racing, US Ski Team
    - Hundreds of colleges & thousands of high schools
- MLB – ImPACT testing, Protocol team dependent



Safety In Action: Heads Up Football

- 2012: NFL & USA Football launched this program in Northern Virginia (www.usafootball.com)
  - Used by 7000+ youth/highschool programs
- Smarter and safer way to play and teach youth football
  - Proper tackling/blocking techniques
  - Concussion recognition and response
  - Equipment fitting
  - Heat preparedness/Hydration
  - Taking the “head” out of the game
  - Defibrillator (#1 cause of death for youth during exercise)
- Mobile app
- Coaching Certification (Only Nationally accredited course)
  - Football safety, injury prevention, injury recognition
  - 2016: Most coaches in the U.S. are certified

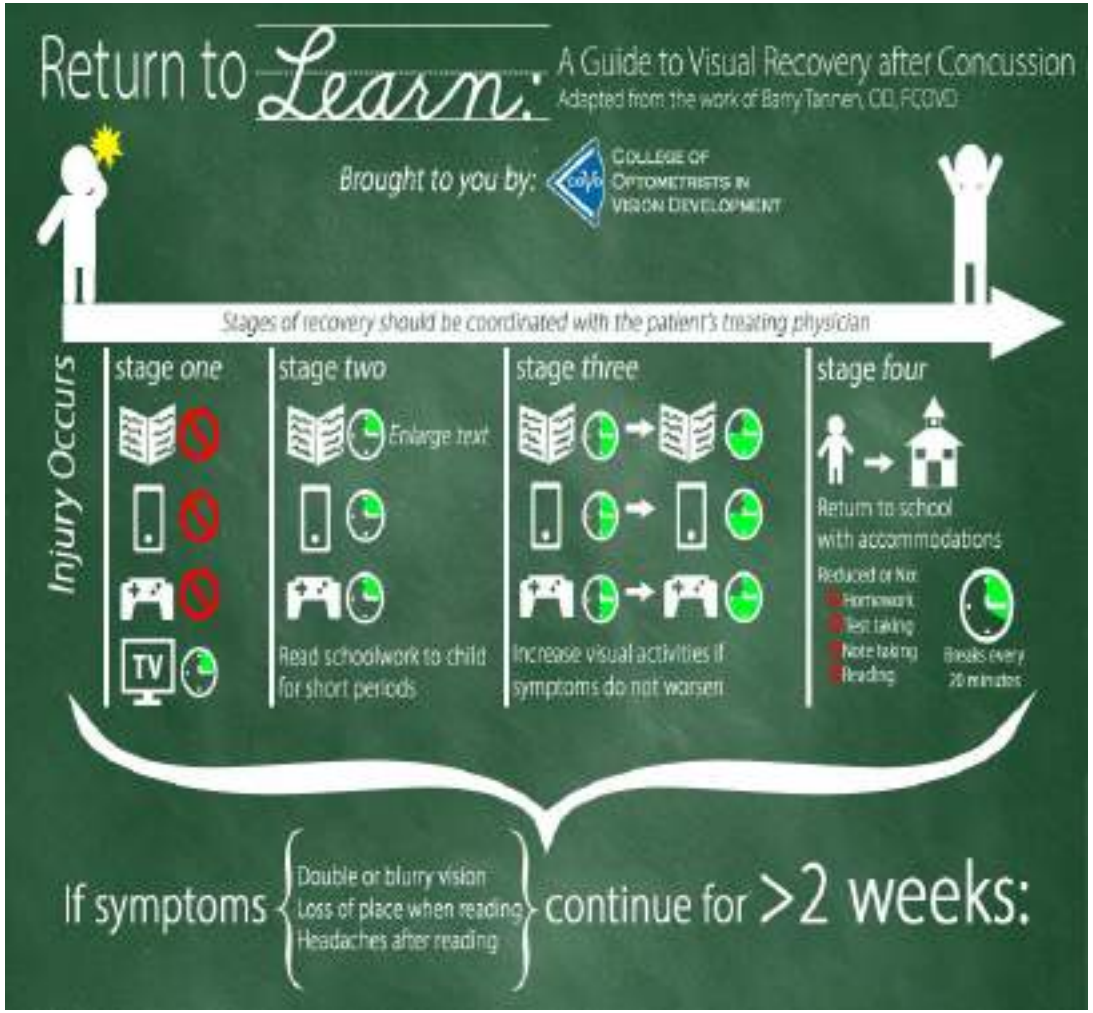
- “My son plays youth football and #1 thing we taught him is safety. Heads Up Football is tremendous and is a critical part of our game” - Urban Meyer (Ohio State)

Research Shows The Stats

- “Found significant memory deficits 36 hrs post-injury in athletes who were symptom free within 15 min of a mild concussion
- “33% of the players with concussion who RTP on the same day of injury experienced delayed onset of symptoms at 3 hrs post-injury”
  - Only 12.6% for those who did not RTP
- “Collegiate athletes have a 3-fold greater risk of suffering a concussion if they sustained 3 or more previous concussions in a 7 year period”
- “High school athletes are at an increased risk of experiencing LOC (8-fold), amnesia (5.5 fold) and confusion (5.1 fold) with 3 of more concussions”
- Merril Hoge, Eric Lindros, Al Toon, Steve Young are highly publicized cases of athletes sustaining multiple concussions with recurrent or post-concussion signs and symptoms that lasted for lengthy periods

When To Return To Play/Learn?

- Balance recovery: < 7 days
- Symptom scores: 5-14 days
- Cognitive recovery: 7-21 days
- Oculomotor recovery: 21-28 days
- Need to be cleared by physician (No same day)
- Physical/cognitive rest until asymptomatic
- Eat a well balanced diet
- Rehabilitation Stage: 5 stages
  - No activity → Light aerobic exercise → Sport specific exercise → Non-contact drills → Full-contact drills → RTP
- Prescribing Accommodations:
  - Visual Crowding:
    - Removal from gym, band, dance class, orchestra, etc
    - Double spaced text, increased font size, line guides
  - Oculomotor Dysfunction:
    - Delay tests or quizzes
    - Increase time on assignments and exams
    - Reduce amount of homework
    - Note taker



"30% of high school and college football players sustaining concussions return to competition same day while 70% average 4 days rest"

"More and more, sleep is being recognized as the most obvious, accessible and natural performance enhancer in the NFL - the kind of secret weapon that players have always dreamed about."
– *Sports Illustrated*

"SLEEP IS THE MOST POTENT PERFORMANCE-ENHANCING ACTIVITY THAT WE KNOW OF."

– *Jeffrey Kahn, Sports Performance Scientist*

Optimal skill learning in athletes is dependent on quality sleep within the first 24 hours after training because that is when the human brain learns. It's practice, with sleep, that makes perfect.
– *Role of sleep in performance and recovery of athletes: a review article*

THE EFFECTS OF MORE SLEEP ON ATHLETIC PERFORMANCE

BASKETBALL PLAYERS: improved foul shot accuracy by 9%, 3-point shot accuracy by 9.2%, court sprint time by .7 seconds

SWIMMERS: improved 15-meter sprint times by .51 seconds (8%), reaction time off starting blocks by .15 seconds (17%). American records broken

BASEBALL PLAYERS: faster reaction times by 122ms (a fastball takes 400ms) and decreased fatigue by 40%

TENNIS PLAYERS: improved hitting accuracy by 42% and sprint times by 8%

FOOTBALL PLAYERS: improved 40-yard dash and 20-yard shuffle times by .1 seconds,[5] field-goal accuracy by 20%. Fewer mental errors by 50%

After sleep education, 100% of **STUDENT ATHLETES** got more sleep and 89% experienced improved athletic performance

ALL: One night of sleep improves motor-learning task speed by 20% and accuracy by 39%

10TH GRADE STUDENTS: significantly improved reaction time with 1 day/week later school start time

4th – 6th GRADE STUDENTS: significantly improved reaction time and memory tests with 35 more minutes of sleep

sleep for success
A local 501(c)(3) non-profit founded by Westport moms
For more details and study references for this info-graphic, please visit
www.sleepforsuccesswestport.com

THE EFFECTS OF LESS SLEEP ON ATHLETIC PERFORMANCE

ALL: student athletes sleeping < 8 hours = ~70% more likely to get injured

ALL: Sleep duration = strongest predictor of injury (not practice hours, # sports played, strength training, gender, or coaching style)

ALL: Sleeping 6 hours/night lowers reaction time by 18%

TENNIS PLAYERS: significantly decreased serving accuracy after one night of less sleep. Caffeine did not change result

BASKETBALL: significantly decreased shooting accuracy and fewer points scored, rebounds, steals, and blocks significantly increased # of technical fouls

TRACK AND FIELD: significantly decreased reaction times, increased false starts and lapses in attention

WEIGHT-LIFTERS: lifted significantly less weight during biceps curl, bench press, leg press, and dead lift

BASEBALL: 7 yrs. of data showed visiting team's sleep loss due to travel resulted in home team scoring 1.24 more runs

YOUNG ADULTS: ~ 5 hours of sleep/night for 2 nights = a 3X increase in lapses of attention and reaction times

ADULTS: 19 hours awake = decrease in reaction time & eye-hand coordination similar to performance when well rested but legally intoxicated

ALL: sleeping 4 hours/night for 6 nights = ~ 35% decrease in glucose metabolism, which is similar to patients with type-2 diabetes

"I really can't say it enough. I don't think people really pay enough attention to how important sleep is." – *Michael Phelps*

Devices Help RTP Decision-Making

- Senaptec Sensory Station: (10 components)
  - Visual clarity
  - Contrast sensitivity
  - Depth perception
  - Multiple object tracking
  - Near-far quickness
  - Target capture
  - Perception span
  - Eye-hand coordination
  - Go/No-Go
  - Hand reaction/response times

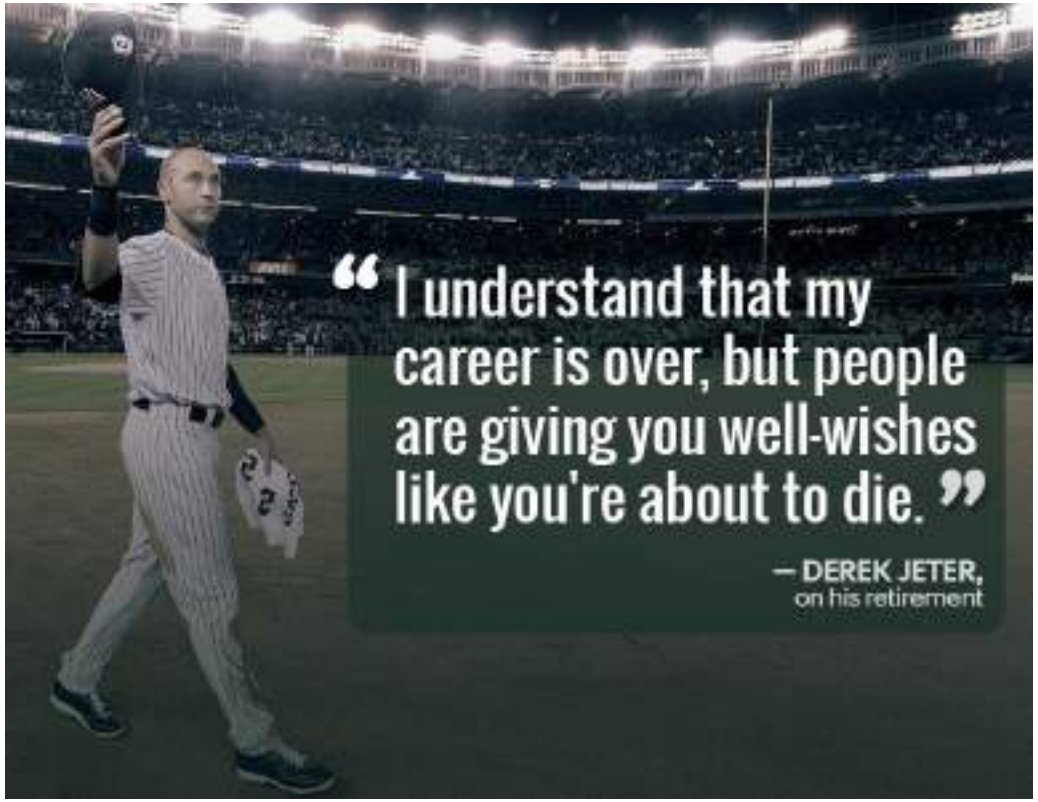
- Neurotracker:
  - Multiple object tracking system that simulates the decision making process in athletic competition
  - Correlated with actual game performance in professional basketball players

Potavski & Biberdorf (2017)

- Evaluation of the effectiveness of Sports Vision programs in improving performance and health in ND youth athletes
  - 100 13-17 yo youth hockey players trained 10 weeks on oculomotor and visual software visual processing skills
  - 5 weeks of oculomotor training alone effectively improved 6/10 SENAPTEC measures in both concussed and non-concussed athlete
  - Both oculomotor and visual software training showed SENAPTEC improvement for concussed and non-concussed athletes
  - Oculomotor training was somewhat more effective than software training for non-concussed athletes on measures of reaction time and eye-hand coordination

Considering Retirement?

- Pathophysiology/Neurology/Neuropsychology
- Social/Financial factors or pressures
- Legal implications
- Season Ending:
  - Prolonged post concussive symptoms
  - 3 or more concussions in a single season
  - 2 or more severe concussions in a single season
  - Decreased academic/athletic performance
  - Clinically relevant imaging abnormality
- Career Ending/Retirement:
  - Persistent prolonged post-concussion syndromes
  - 3 or more major concussions
  - Clinically relevant imaging abnormality
  - Pathologic abnormality (Chiari malformation)
  - Intracranial hemorrhage
  - Symptoms of CTE
  - Decreased academic performance/cognitive abilities

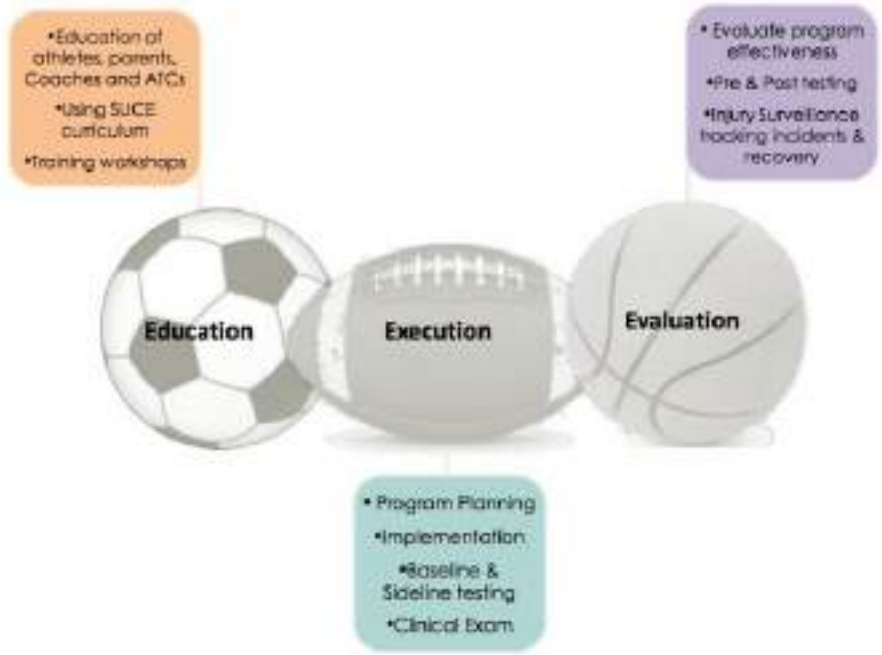


Examining Patients With Concussion

- Keep exam room relatively dim!
  - Use incandescent lighting vs fluorescent lighting
- Minimize movements as much as possible
- Have patient close their eyes in between tests
- Change lenses slowly while on the phoropter during refraction, vergence and accommodative testing
- Speak slower, softer and more clearly!
- C/F, Cover test D/N, NPC (Repeat NPC later to check for fatigue)
- Evaluate signs of diplopia, lid ptosis, fixed or dilated pupil, head tilt, head turn, facial droop or lagophthalmus:
  - CN III = Lid ptosis or dilated pupil
  - CN IV = Head tilt
  - CN VI = Head turn
  - CN VII = Facial droop or lagophthalmus

Concussion Treatment Options

- Addressing Visual Symptoms/Dysfunctions:
  - New glasses or contact lenses:
    - Hyperopic /cylinder shift: +0.50/-0.25 or greater
    - Myopic /cylinder shift: -0.25/-0.50 or greater
    - Full correction for astigmatism
    - Prescribe a second pair of reading glasses instead of bifocals (Accommodative issues)
      - FT/round segment computer top/reading bottom bifocal for prolonged computer work
      - Line bifocals for those who were once in progressives
    - Contact lenses for anisometropia
    - DO NOT CYCLO for a final refraction
    - If they feel symptomatic with new Rx slowly increase wear time
  - Yoked and Fusional Prisms (Try to avoid if possible)
  - Binasal or Selective occlusion
  - Tints/Coatings (5-20% Blue with A.R.) Reduces contrast
    - Indoor Tints= 15% and no more than 30%
  - Sunglasses
  - Severe Diplopia: Stay shut down in a dark room until can move around again
  - VT (Most appropriate) Helping eye's ability to communicate, focus and converge/diverge
    - 5.8 weeks = Average time to return to play
    - 12.3 weeks = Average time to return to play with no VT
    - No more than 5 min per exercise (Can lead to increased symptoms)
  - Omega-3 Fish oils (DHA)
- Avoid Meds Containing Aspirin or NSAIDs (Can possibly increase intracranial bleeding)
  - Acetaminophen use sparingly (Tylenol)
- Post-Concussion Follow up: 1 → 3 → 6 months



Vision Training

- Concussions Baseline, Neuro-Diagnostic Tool & Sports Performance Enhancement:
  - Light board training tools (Eye-Hand/Body Coordination)
  - Brock's string (Convergence/Minimize suppression)
  - EYEPORT training (Convergence/Minimize suppression)
  - Accommodative flippers (Enhance reflex action)
  - Tachistoscope (Increase recognition speed/Consciously recognized)
  - Strobe glasses/Pinhole glasses with pitch and catch (Vision processing/Focus)
  - Saccadic eye movement training (Fast movement of the eyes)
  - Near far training (Focus eyes near and far)
  - Stereopsis (Depth perception)
- Vision training, when initiated as a team wide exercise, decreases the incidence of concussions in those players when compared to players who do not receive any vision training!
  - Pre-Season: 2x a week for 6 weeks (20 min) or 6x a week for 2.5 weeks (20 min)
  - In-Season: 1x a week as a maintenance program

Oculogica (EyeBox)

- FDA clears eye tracking test for concussion that requires no baseline assessment
- Non-invasive test:
  - Measures the function of the CN's
  - Can detect intracranial swelling
- Watch a video for less than 4 minutes:
  - No literacy or language fluency required
- 5 years old- 67 years old
- Score of 10 or more is threshold for concussion
- Device Tested:
  - Department of Defense (2016)
  - U.S. Olympic training center (2015)
  - CHOP, Boston's Children Hospital, Mayo clinic

Clinical Pearls For The Optometrist

- Ocular health issues should be addressed first
  - Ant Seg: Tear dysfunction, dry eye, keratitis, pterygium, conjunctivitis, neurotrophic cornea and lagophthalmus
    - Major Contributor to TBI = Surface dysfunction
  - Post Seg: Valsalva and Purtscher's retinopathy, Terson's & fat embolism syndrome, papilledema, whiplash maculopathy
- Patients are put on Meds:
  - Can affect refractive error, ocular motility, vergence, accommodative effort
  - Heighten sensitivity to light, produce color vision defects or haloes
    - Sensation of pain and light sensitivity linked via trigeminal nerve and its nuclei
    - Photosensitivity = Major diagnostic criteria for migraine headaches (> 50% TBI population, 75% blast related TBI)
- Prescribing +0.25sph of plus/minus/cyl can relieve asthenopic complaints
- Prescribing 0.25 vertical prism takes care of "I know I can see but something is off" complaints
- Blue indoor tinted glasses (40%) decrease level of hypersensitivity
  - Alleviates fatigue and daytime sleepiness
- Polycarbonate, High Index and Trivex
- Hemianopsia:
  - Fresnel Prism: BO temporally to the eye that coincides with the side of the visual field defect
  - Peli Lens: 40 prism diopter BO placed above and below fixation on the lens of eye toward defect
  - Visual Field Awareness System: 18.5 prism diopter BO round prism button mounted on the temporal side of px's lens
- Patients with ocular paresis may need to hold reading material in primary gaze position
- Choosing the Right Frame:
  - Craniotomy = May have swelling in the temple regions
  - Facial fracture = May have nasal bridge sensitivity

Summary

- When vision training is initiated the incidence of concussions decreases compared to those who have no training
- Concussion treatment is all about rehabilitation (Visual, Vestibular, Neurological, Psychological and Physical)
- Go out and talk to your local coaches, athletic trainers, YMCA, etc and tell them the importance of vision and on field/in classroom success
- It takes a team to manage a concussion
- Doctors of Optometry are integral to return to play/learn symptom free!
- When in doubt sit ‘em out and refer to a colleague!


PLAY SMART
PLAY SAFE
NFL
THANK
YOU!!!