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# *Concussion: What It Is and What It Isn't*



# *Legislation*

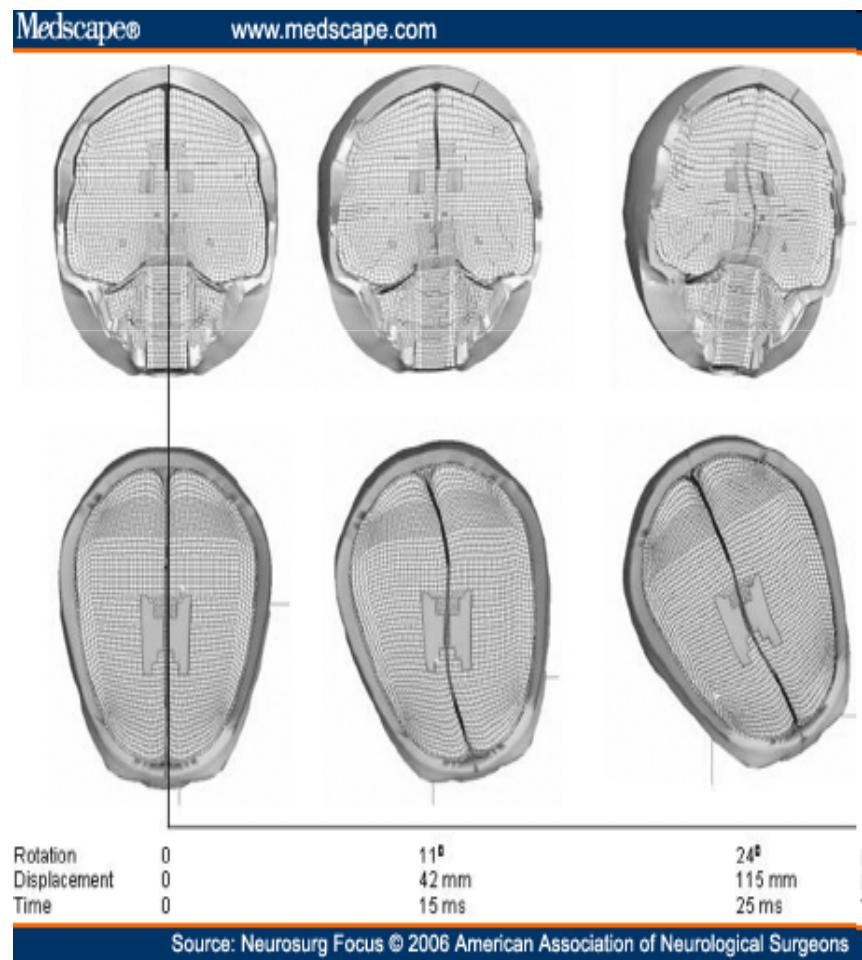
- CT Bill No. 456: An Act Concerning Student Athletes and Concussions
- All scholastic coaches must receive instruction on recognizing stroke
- Once identified an athlete must be removed from the contest
- Return to activity only with written certification

# *Concussion Defined*

- Syndrome of immediate and transient impairment of neurologic function secondary to mechanical forces
- Physiologic dysfunction without significant anatomic disruption
- Most mild of spectrum of TBI

# *Biomechanics*

- rapid deceleration
- sequential acceleration-deceleration
- rotation
- deformation



# *Traumatic Brain Injury*

- Focal Brain Injury
  - cerebral hemorrhage
- Diffuse (nonfocal)
  - cerebral concussion



# *Epidemiology*

- Contact/collision sports: football, hockey, lacrosse, soccer, boxing
- Approximately 3 million head injuries/year in the US
- 20% of high school and collegiate football players
- Many concussions are unreported
  - denial, lack of insight, result of injury

# *Female Athletes*

- Participation of female athletes is rising
- Soccer, cheerleading, lacrosse
- Higher mortality
- Longer recovery
- Persistent symptoms



# *Mechanisms of Injury*

- Direct
  - Blow to the head
- Indirect
  - Impact elsewhere



# *Signs of Concussion*

- Nausea/Vomiting
- Drowsiness
- Vacant stare
- Confusion
- Loss of consciousness
- Mood changes
- Uncoordinated/Unsteady



# *Common Symptoms*

- Headache
- Fatigue
- Amnesia
- Dizziness
- Vision changes
- Poor balance
- Light sensitivity
- Sound sensitivity
- Changes in sleep patterns
- Difficulty concentrating

# *Consequences*

- Post Concussive Syndrome
  - headache
  - depression
  - prolonged mild neuropsychological effects
  - susceptibility to repeat concussions
- Second Impact Syndrome
  - second brain injury before the brain has a chance to recover
  - brain swelling, permanent damage and possible death

# *Chronic Traumatic Encephalopathy (CTE)*

- 1928 Dr. Harrison Martland  
“Dementia Pugilistica”
- 2009 Dr. Ann McKee “Chronic  
Traumatic Encephalopathy in Athletes”
- 3 professional athletes: 1 football player  
and 2 boxers

# CTE

## CLINICAL

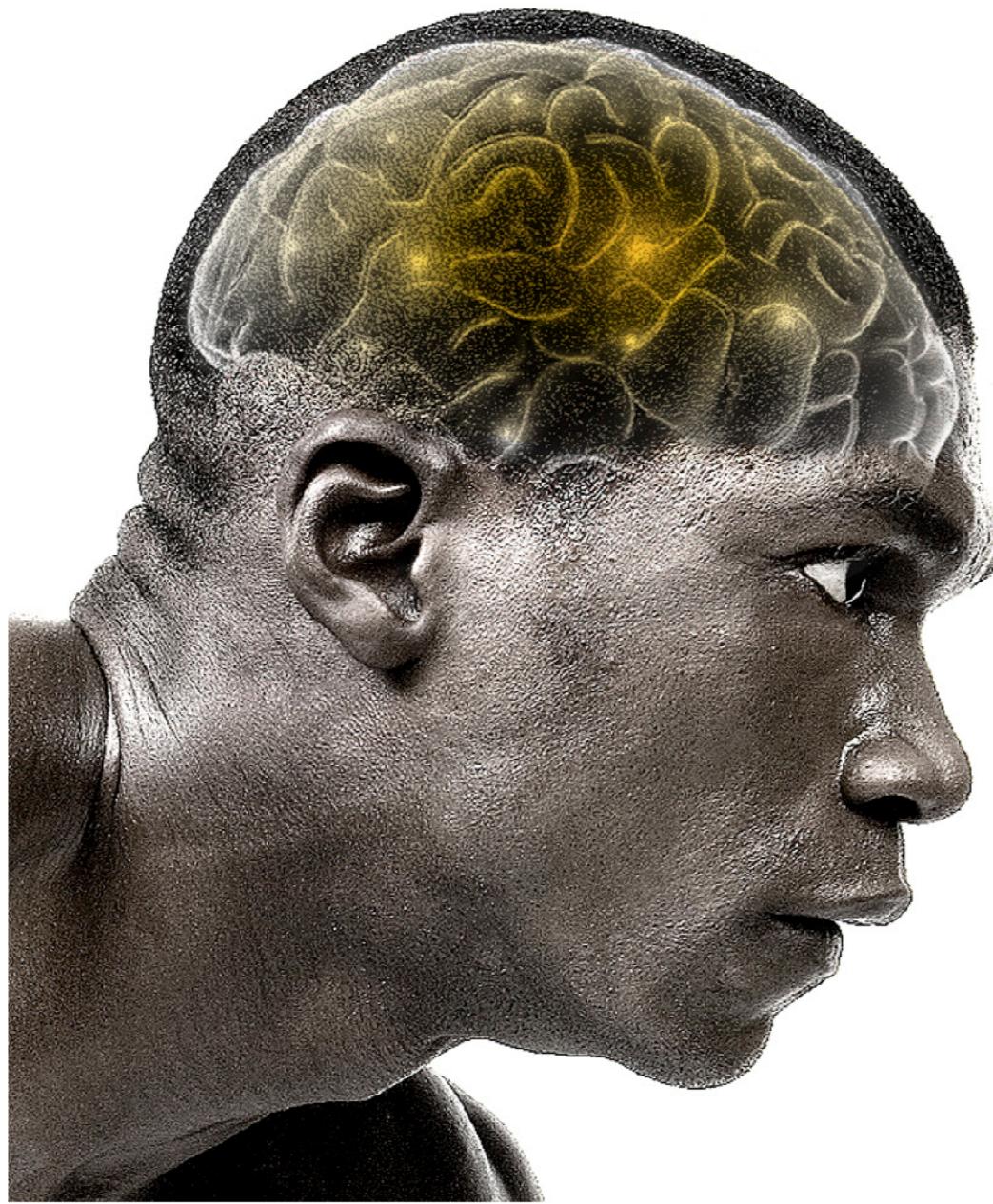
- Memory disturbances
- Behavioral and personality changes
- Parkinsonism
- Speech and gait abnormalities

## PATHOLOGICAL

- Atrophy of cerebral hemispheres, medial temporal lobe, thalamus, mammillary bodies, brainstem
- Ventricular dilatation and a fenestrated cavum septum pellucidum

# Tau Protein

- Extensive tau immunoreactive tangles
- Preferential involvement of the superficial cortical layers, frontal and temporal cortices
- Prominent perivascular, periventricular and subpial distribution
- Beta-amyloid less prominent



# *Treatment of Concussion*

- Immediately eliminate potential further harm
- Medical evaluation
- Rest
  - No computer, texting, video games, reading, physical exertion,
- Early recognition is the best treatment

# *Patient #1*

- 21y/o, LH, Division 1 special teams football player, collision with impact to left side of neck
- Left arm and leg paresthesias, no LOC
- Neuro exam normal
- C-spine MRI normal
- Symptoms resolved over hours with no headache.

# *Patient #1*

- One week later, head injury on opening kickoff
- Diffuse headache, LLE paresthesias, visual changes
- Neuro exam normal, MRI normal, CT angiogram normal
- Visual changes and paresthesias resolved in 3 hours
- Headache persisted for 2 days.

# *Patient #1*

- ImPACT testing returned to preseason baseline 9 days after injury
- Previous history of visual field loss followed by headache 4 years prior
- Maternal family history of migraine

# *Patient #1*

- Diagnosis: ?
- Treatment: ?

# *Patient #2*

- 15 y/o female cheerleader (flyer) who fell while performing a stunt
- Severe headache, nausea, vomiting and dizziness
- Imaging studies normal, normal neurological exam
- Some improvement with rest but has now missed 8 weeks of school

# *Patient #2*

- Patient now reports occasional headache and light sensitivity
- Nausea and vomiting is most consistent symptom whenever eating is attempted
- 15 pound weight loss noted



# *Patient #2*

- Diagnosis?
- Treatment?

# *Prevention*

- Equipment
  - Properly fit helmet
  - Mouth guards have not been proven to prevent concussion but do avoid dental injuries
- Technique
- Neck strengthening



# *Conclusions*

- A concussion is a brain injury that can be serious and potentially deadly
- Return to play clearance is a complex decision and computerized cognitive testing is only a piece to the puzzle
- Work with a certified athletic trainer and have a formalized concussion management plan in place



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