

Diagnosis and Management of Sports Concussion

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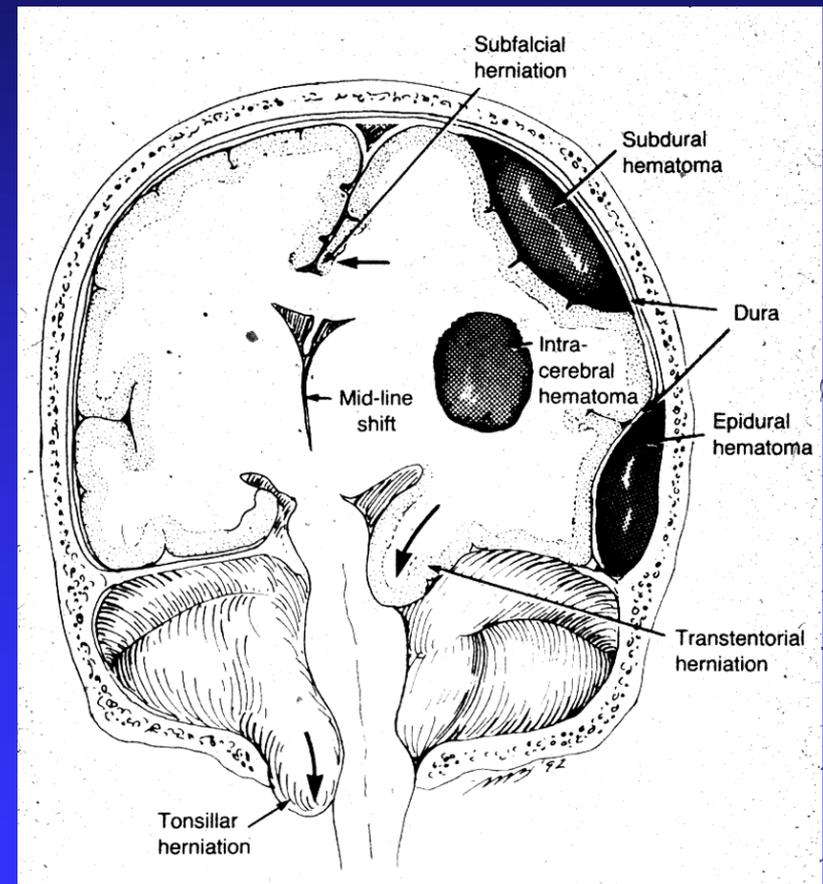
National Collegiate Athletic Association (NCAA)
Concussion Task Force

Medical Advisory Physician (MAP)
National Football League (NFL) Player Benefits

Unaffiliated Neurotrauma Consultant (UNC)
National Football League

CLASSIFICATION OF ATBI

- CONCUSSION
- DIFFUSE AXONAL INJURY
- FOCAL BRAIN INJURY
- SKULL FRACTURES
- PENETRATING BRAIN INJURY



CEREBRAL CONCUSSION

- An alteration of mental status/neurological function due to mechanical forces affecting the brain
- May or may not be associated with LOC
- Essentially a reversible syndrome without detectable pathology
- Represents a functional disturbance rather than a structural injury
- No abnormalities on standard neuroimaging studies

EPIDEMIOLOGY



EPIDEMIOLOGY

- More recent and accurate approximation may be 1.6-3.8 million sports related TBI



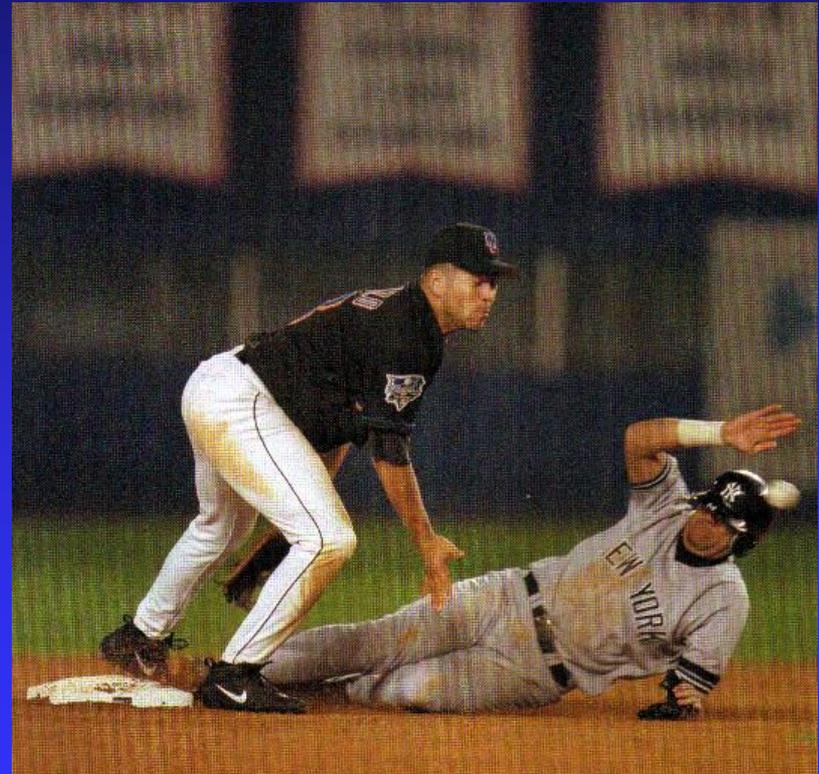
EPIDEMIOLOGY

- Concussions per every 100,000 games and/or practices at the collegiate level
 - ◆ Football: 27
 - ◆ Ice Hockey: 25
 - ◆ Men's soccer: 25
 - ◆ Women's soccer: 24
 - ◆ Wrestling: 20
 - ◆ Women's basketball: 15
 - ◆ Men's basketball: 12



EPIDEMIOLOGY

- Risk of concussion in football is 4-6 times higher in players with a previous concussion
- ? Females more susceptible
 - Soccer
 - Basketball
- Recurrent concussion is more likely to occur within 10 days of a prior concussion
- Genetic predisposition - APOE promoter gene



EPIDEMIOLOGY

- Factors associated with delayed recovery:
 - ◆ Previous history of concussion
 - ◆ Early posttraumatic headache
 - ◆ Fatigue/fogginess
 - ◆ Early amnesia, alteration in mental status or disorientation
 - ◆ Age
 - ◆ Body checking in pee wee hockey



EPIDEMIOLOGY

- Other factors associated with delayed recovery (weak):
 - ◆ Prior history headache
 - ◆ Dizziness
 - ◆ Playing quarterback position
 - ◆ Wearing a half-face shield
 - ◆ Playing on artificial turf



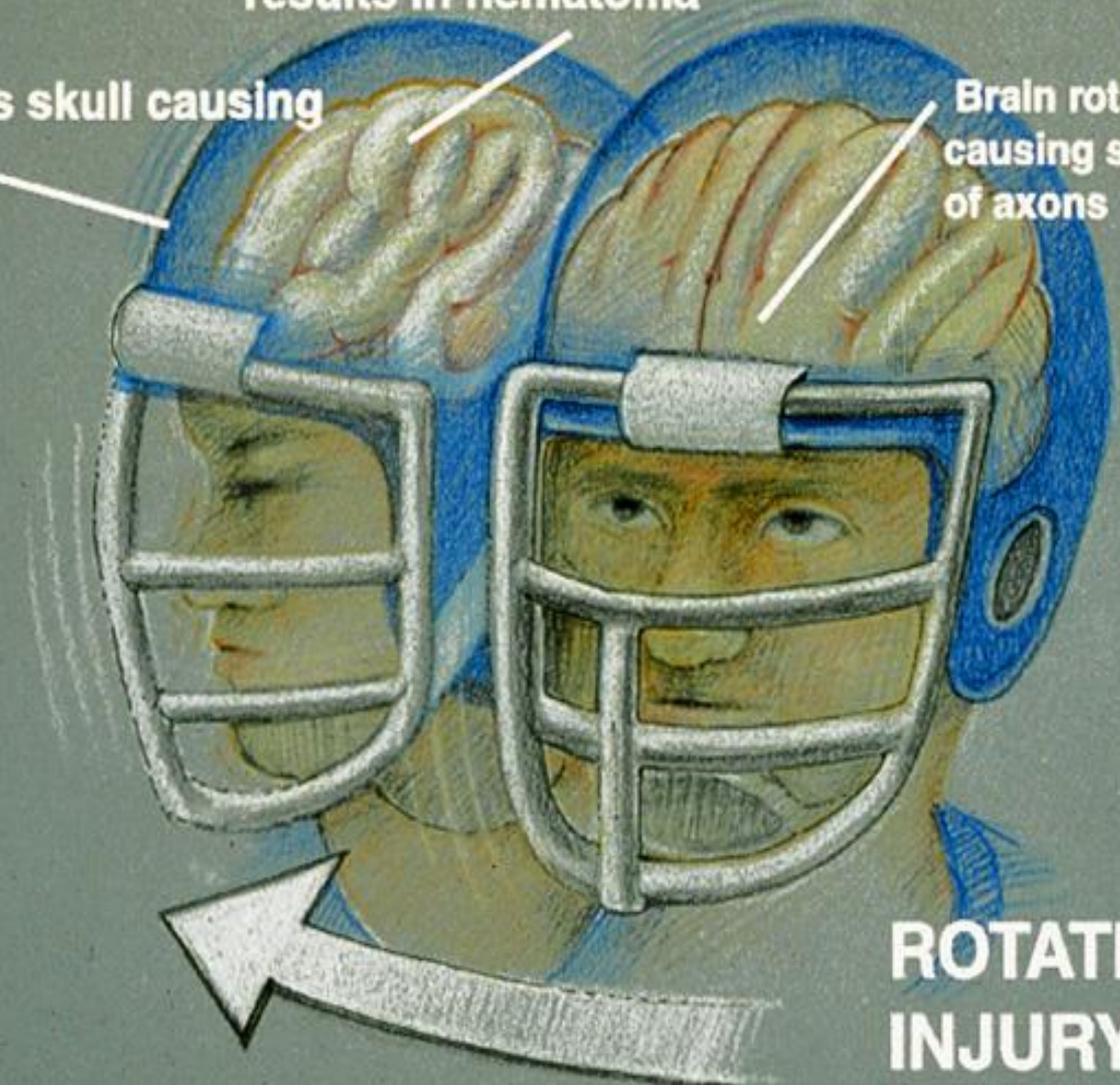
MECHANISMS OF INJURY



**2 Stretching / tearing of blood vessels
results in hematoma**

**1 Brain rotates on axis
causing stretching/tearing
of axons**

**3 Brain strikes skull causing
contusion**

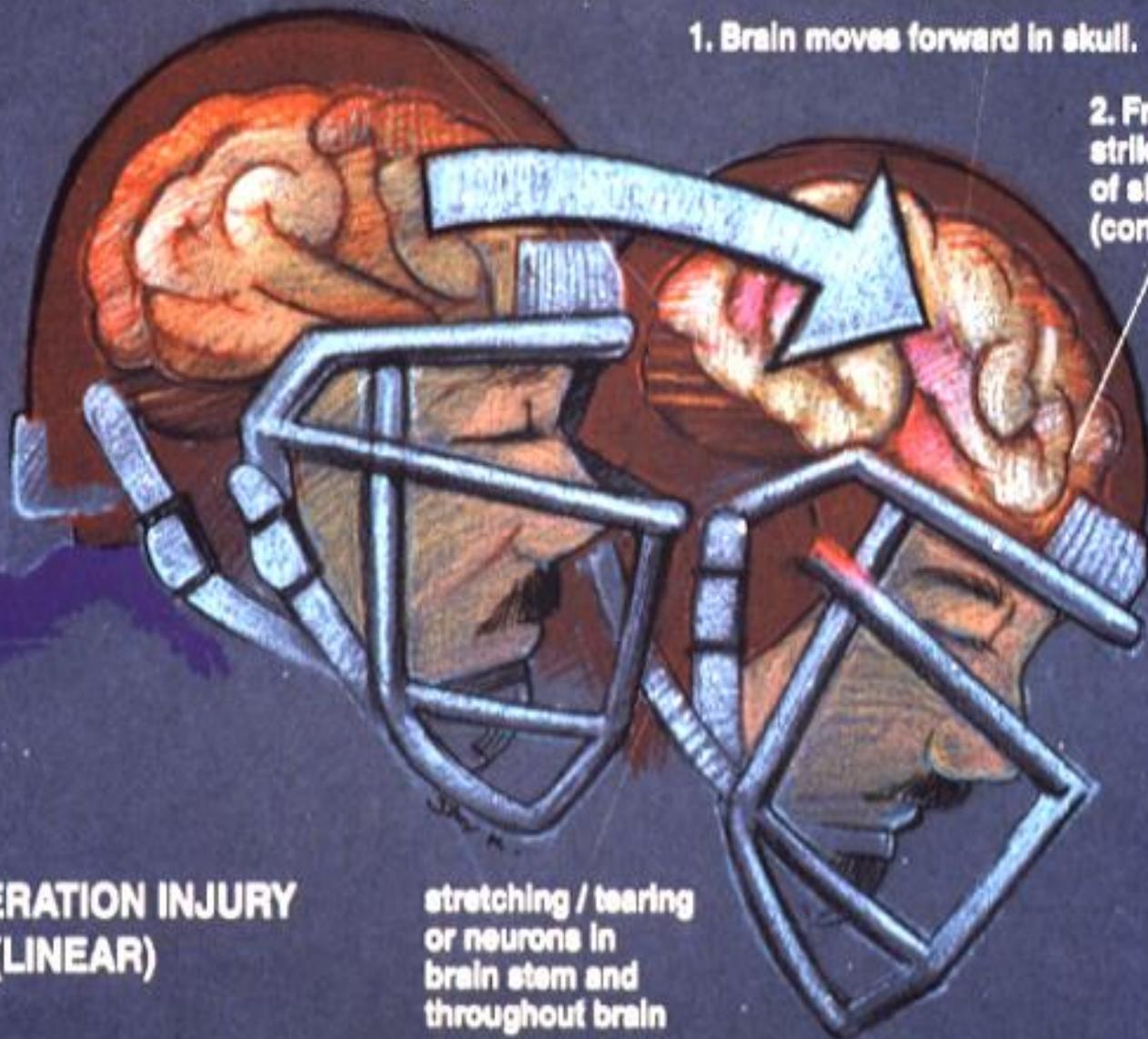


**ROTATIONAL
INJURY**

3. Rebound (contre-coup) injury to occipital lobe.

1. Brain moves forward in skull.

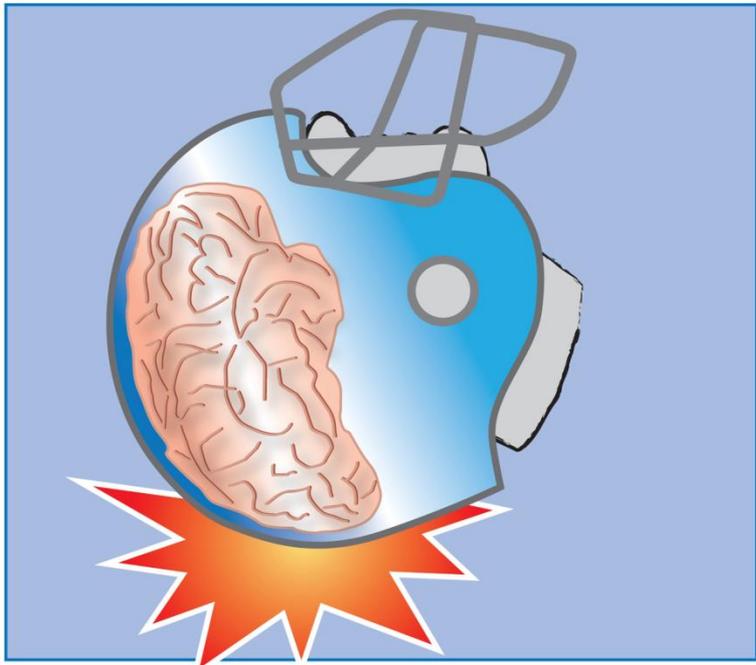
2. Frontal lobes strike inside of skull (contusion)



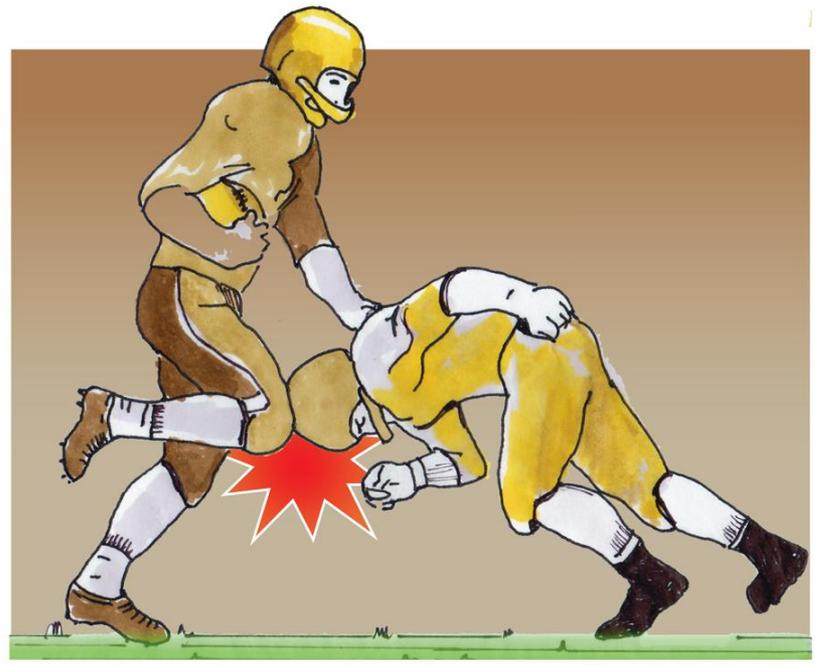
**DECELERATION INJURY
(LINEAR)**

stretching / tearing
or neurons in
brain stem and
throughout brain

Impact deceleration

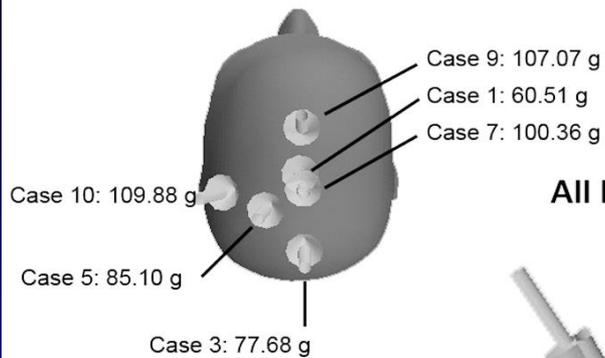


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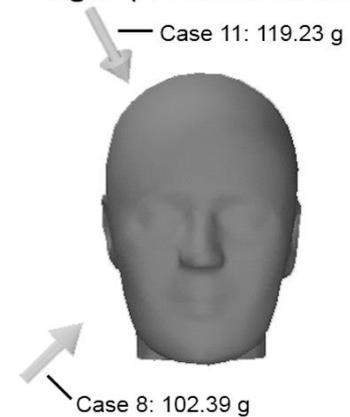


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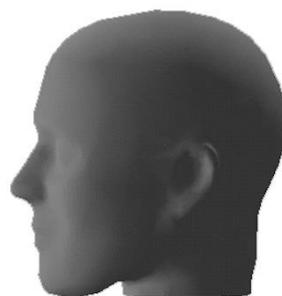
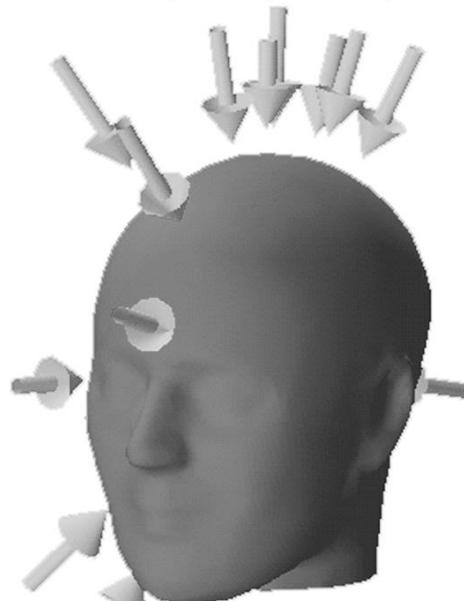
Top (6 concussions)



Right (2 concussions)

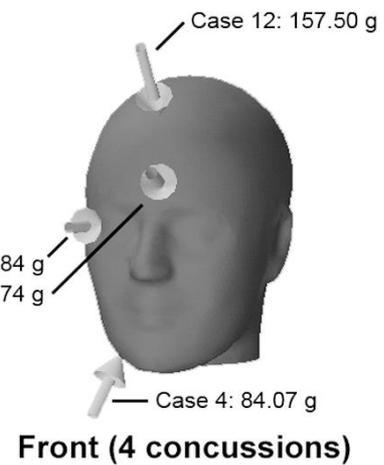


All Injuries (13 total)



Back (1 concussion)

Case 13: 168.71 g



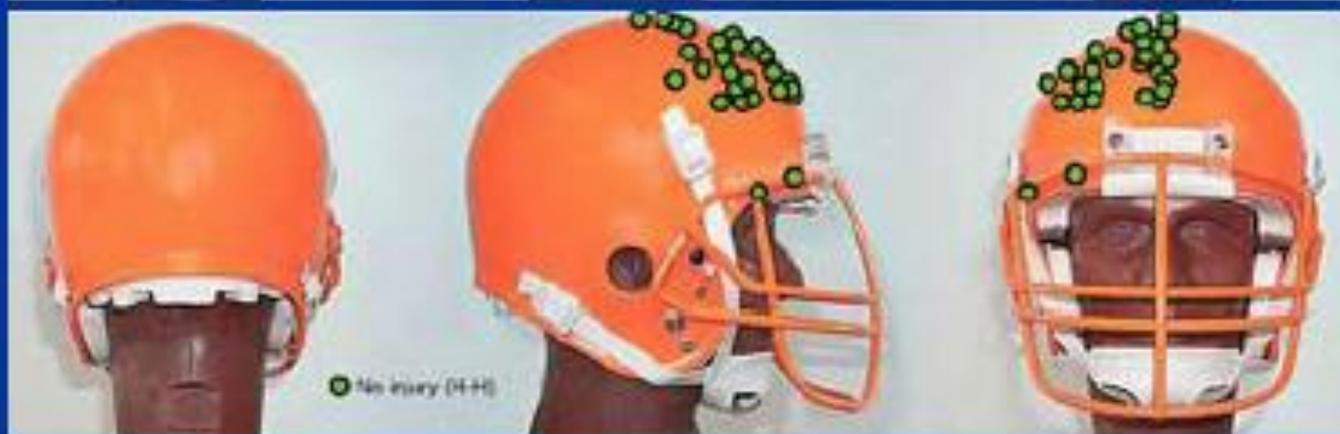
Front (4 concussions)

Location of Concussions

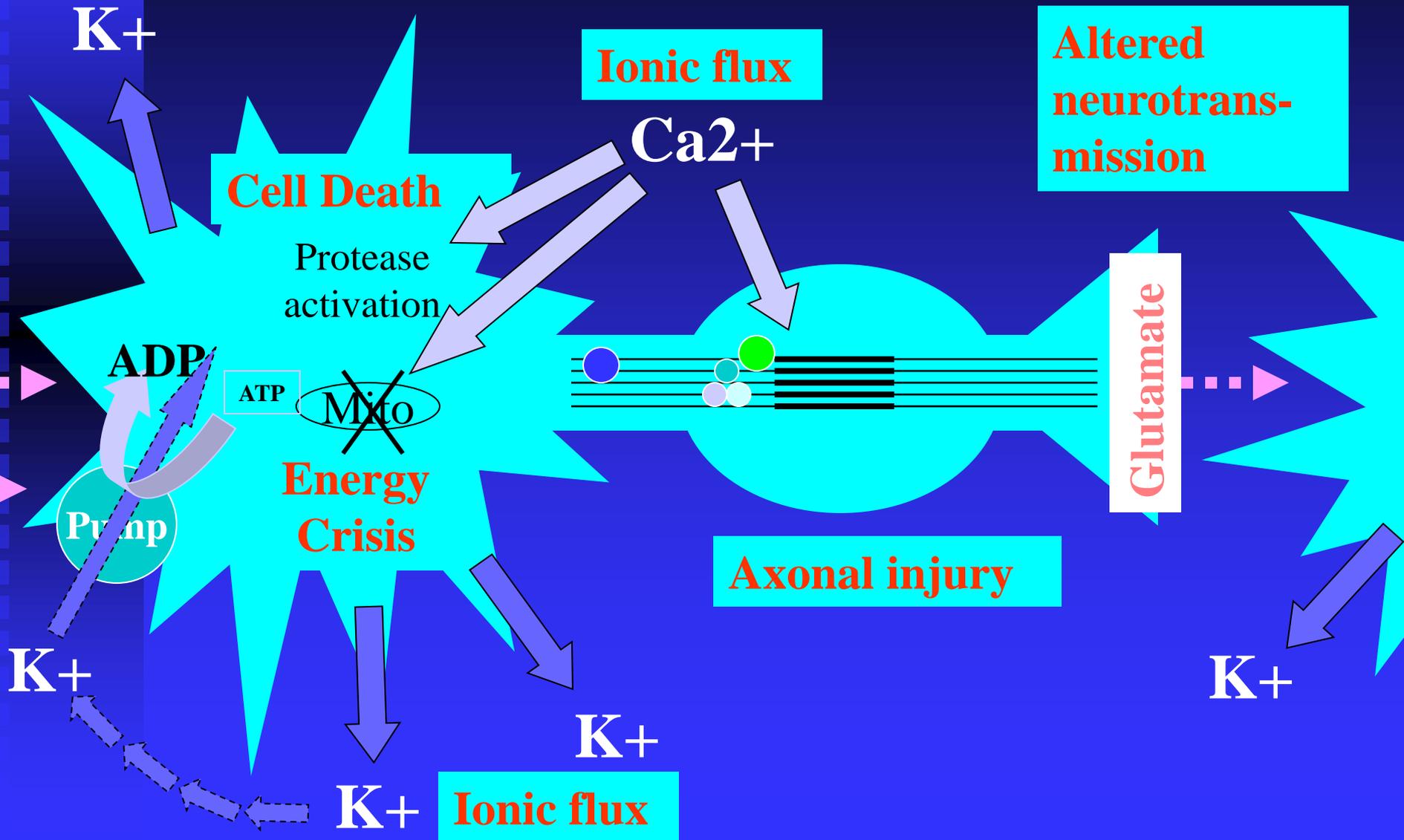
**Struck
Players
Concussed**



**Striking
Players
No Injury**

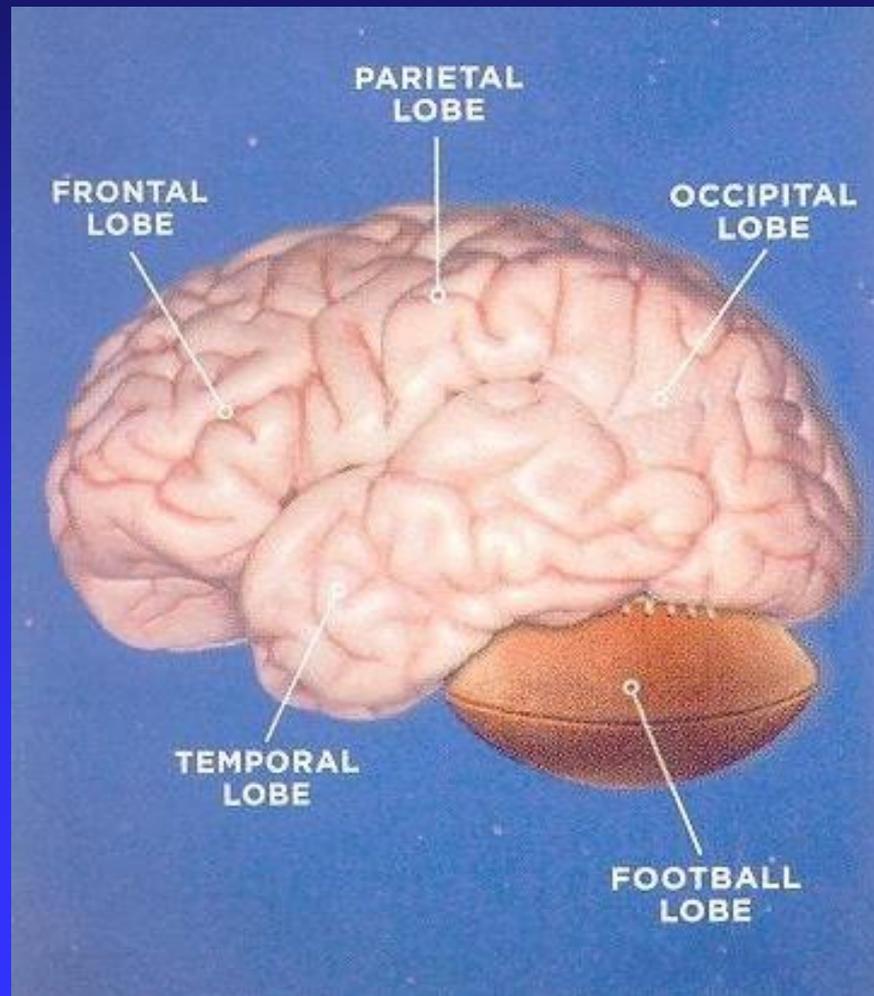


Neurometabolic Cascade of mTBI: Basic Pathophysiology



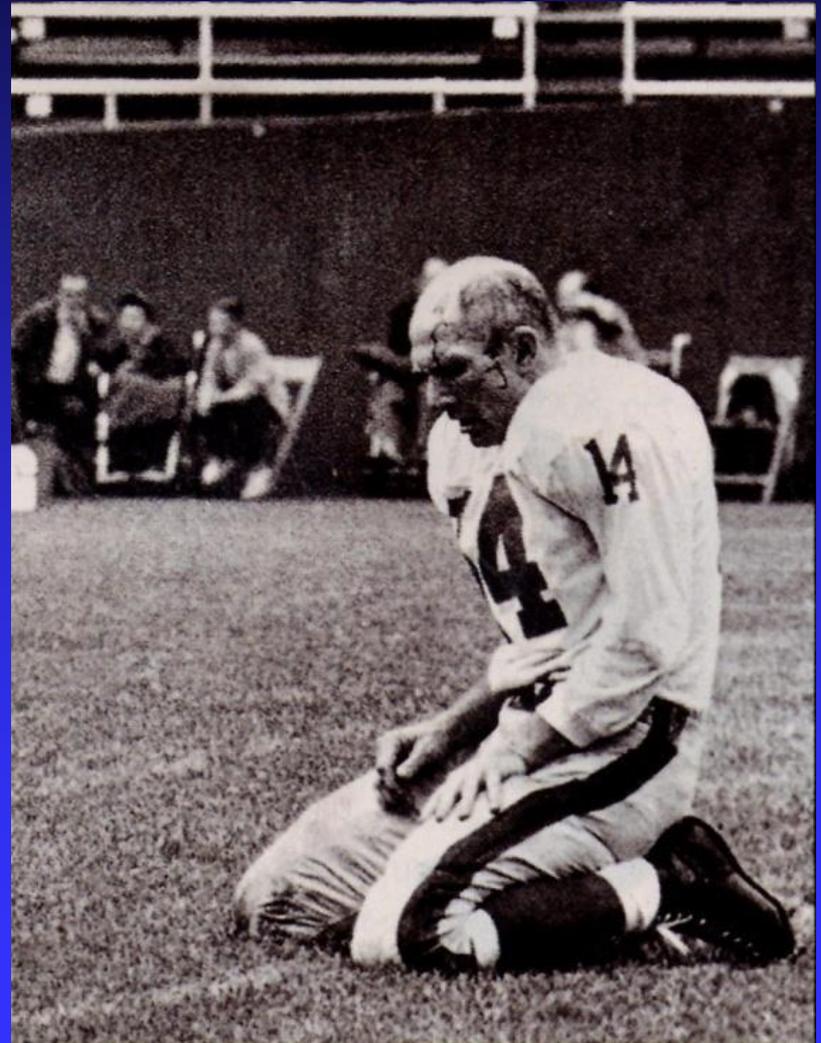
CLINICAL PRESENTATION

- Physical
- Cognitive
- Behavioral



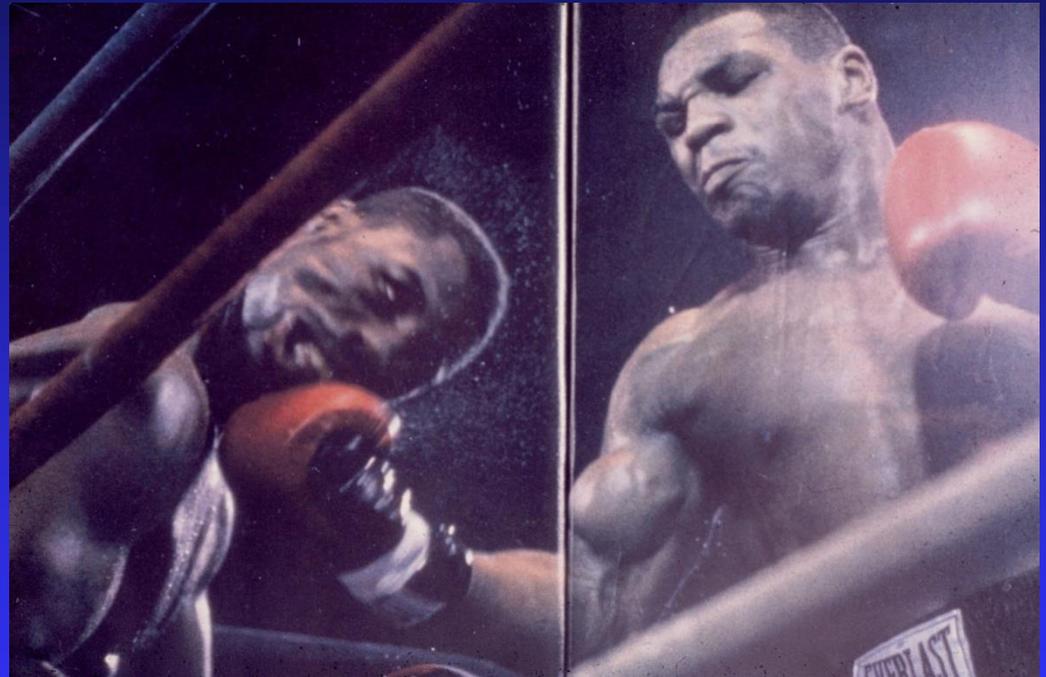
Clinical Presentation-Physical

- Headache
- Incoordination
- Impaired balance
- Dizziness/vertigo
- Nausea/vomiting
- Blurred vision
- Fatigue
- LOC



Clinical Presentation-Cognitive

- Disorientation
- Memory deficits
- Impaired concentration
- Decreased attention
- Feel “in a fog”
- Amnesia



Clinical Presentation-Behavioral

- Irritability
- Inappropriate emotions
- Sleep disturbance
- Personality change
- Sadness/depression
- Easily distracted

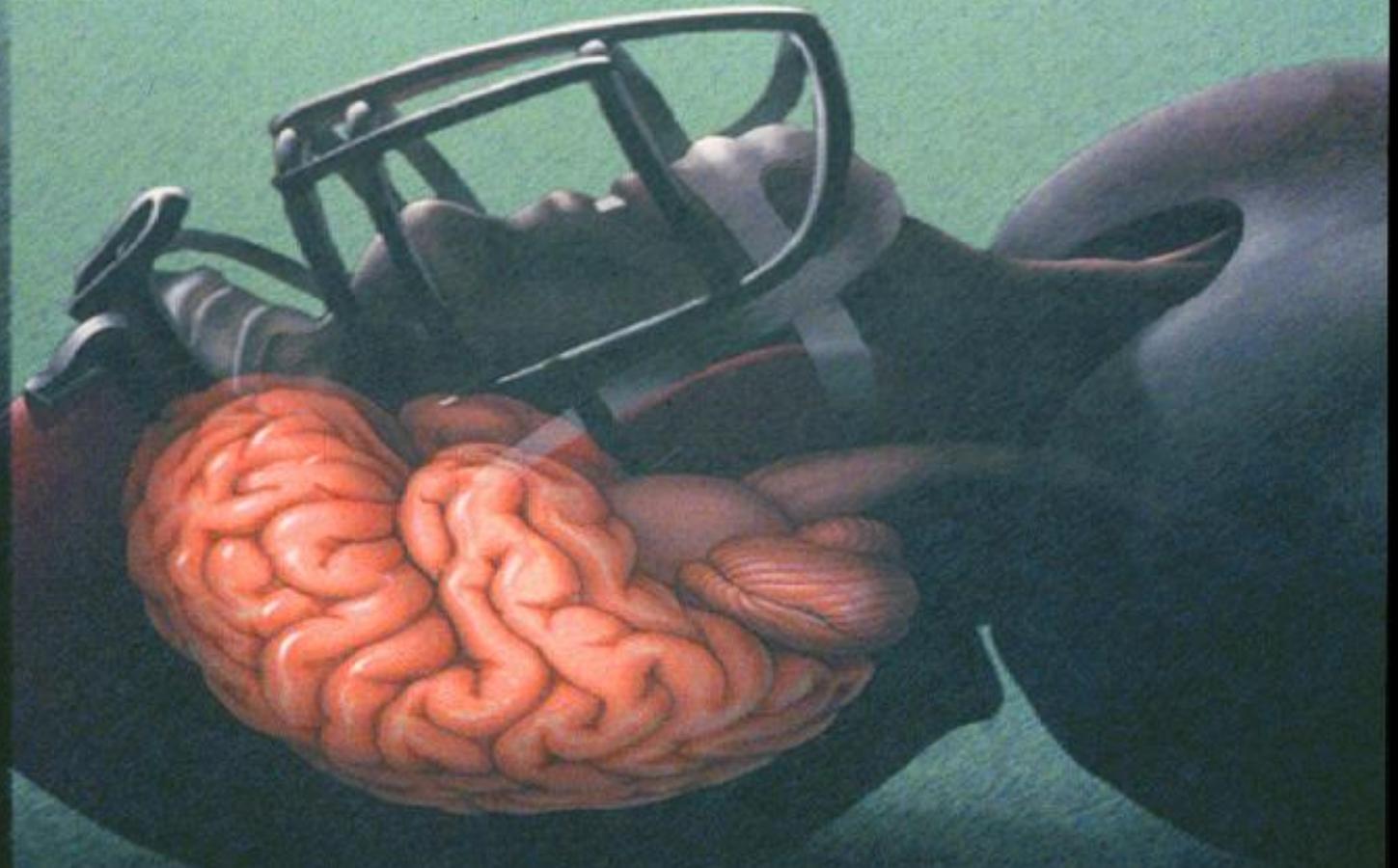


Clinical Management and Guidelines

1

2

3



Concussion Evaluation-Sideline

■ Evaluation

- ◆ sideline evaluation including neurological assessment and mental status testing is essential (e.g. McGill, SAC, SCAT3)
- ◆ memory assessment is better than orientation



ATBI

- SERIOUS SIGNS AND SYMPTOMS
 - ◆ Focal weakness
 - ◆ Seizures
 - ◆ Pupillary asymmetry (in setting of unresponsiveness)
 - ◆ LOC with a delayed recovery



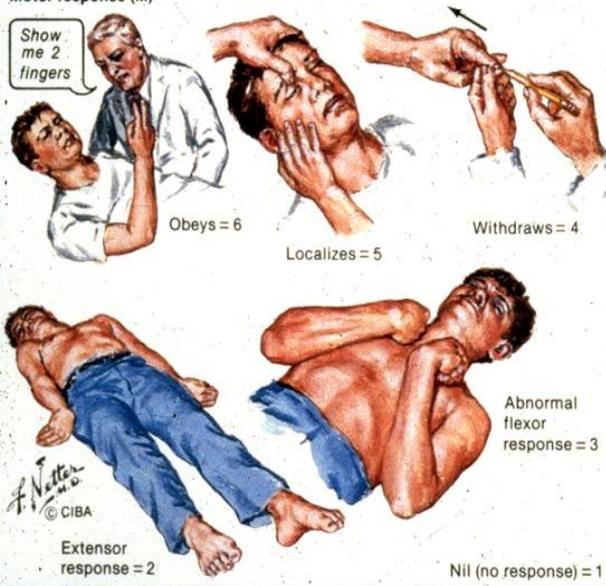
Glasgow Coma Scale

Eye opening (E)



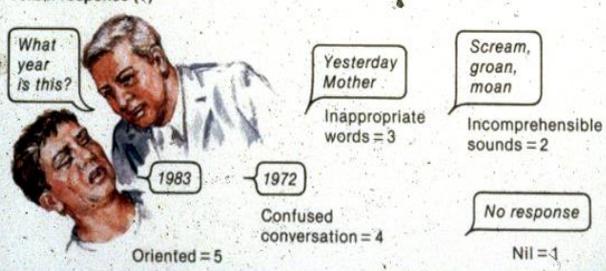
E	
Spontaneous	4
To speech	3
To pain	2
Nil	1

Motor response (M)



M	
Obeys	6
Localizes	5
Withdraws	4
Abnormal flexion	3
Extensor response	2
Nil	1

Verbal response (V)

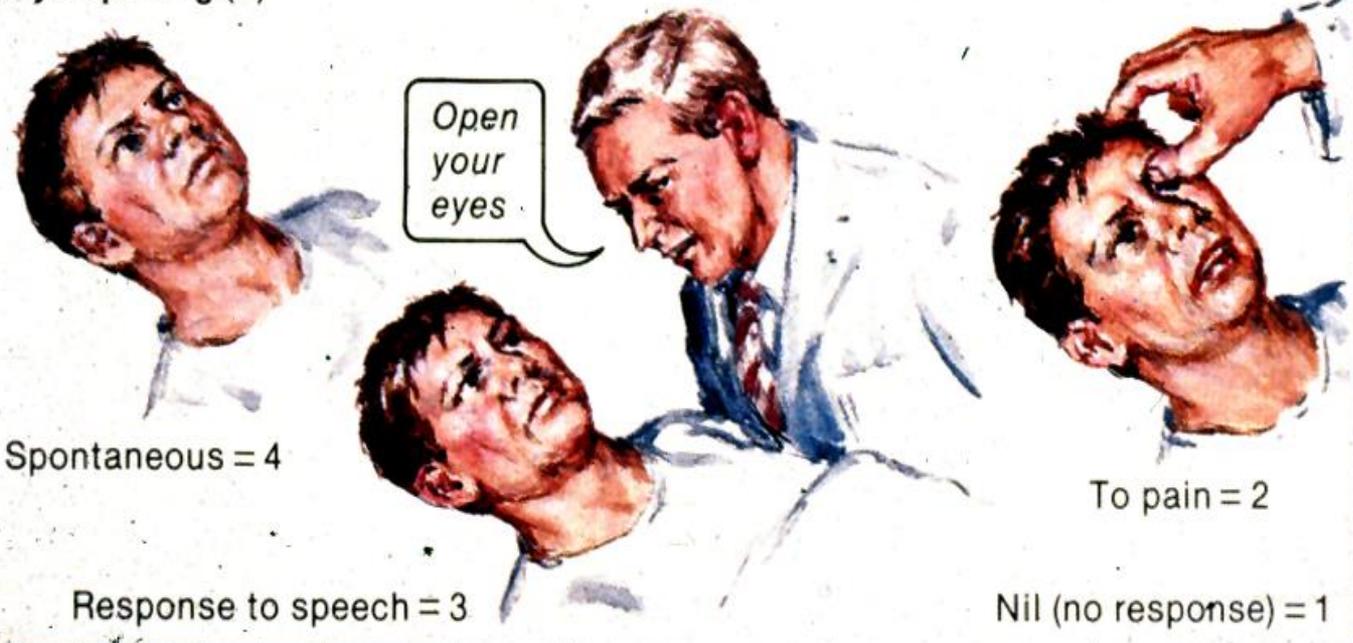


V	
Oriented	5
Confused conversation	4
Inappropriate words	3
Incomprehensible sounds	2
Nil	1

Coma score (E + M + V) = 3 to 15

Glasgow Coma Scale

Eye opening (E)



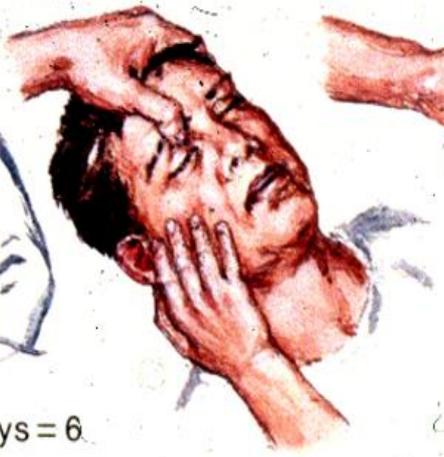
E	
Spontaneous	4
To speech	3
To pain	2
Nil	1

Motor response (M)

Show me 2 fingers



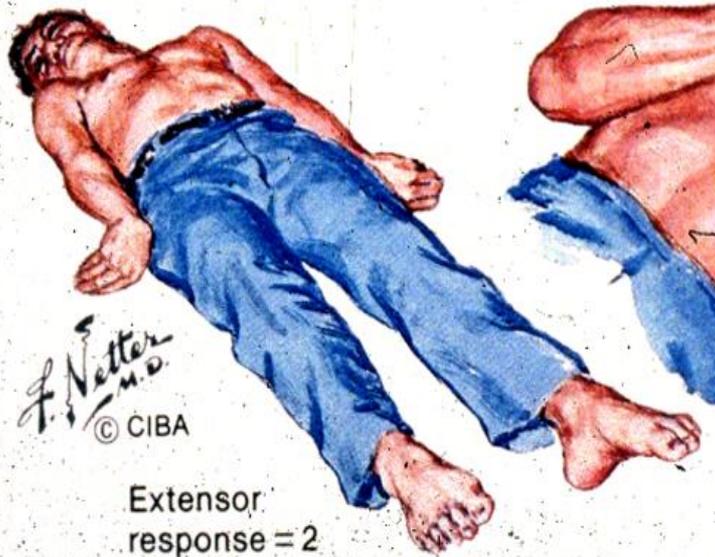
Obeys = 6



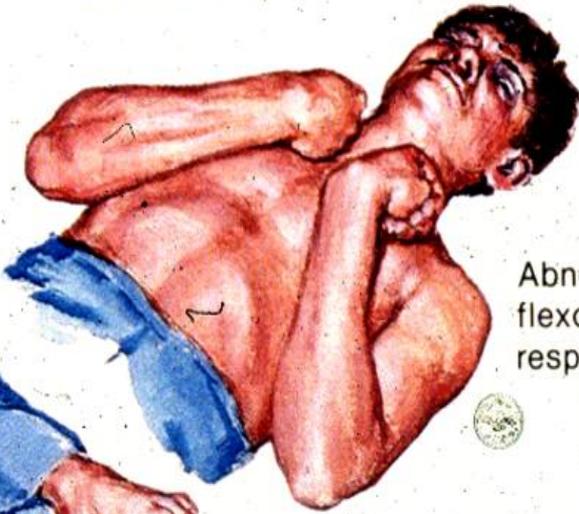
Localizes = 5



Withdraws = 4



Extensor response = 2



Abnormal flexor response = 3

Nil (no response) = 1

F. Netter M.D.
© CIBA

M

Obeys 6

Localizes 5

Withdraws 4

Abnormal flexion 3

Extensor response 2

Nil 1

Verbal response (V)



What year is this?

1983

1972

Oriented = 5

Yesterday
Mother

Inappropriate words = 3

Scream,
groan,
moan

Incomprehensible sounds = 2

No response

Nil = 1

Confused conversation = 4

V

Oriented	5
Confused conversation . .	4
Inappropriate words	3
Incomprehensible sounds . .	2
Nil	1

Coma score (E + M + V) = 3 to 15

SEVERITY-GCS

- MILD 13-15
- MODERATE 9-12
- SEVERE 3-8



Concussion Evaluation

- Clinical History
 - ◆ previous concussions and concussion symptoms
 - ◆ disproportionate impact and matching of symptoms (i.e. more pronounced persistent symptoms from smaller hits)



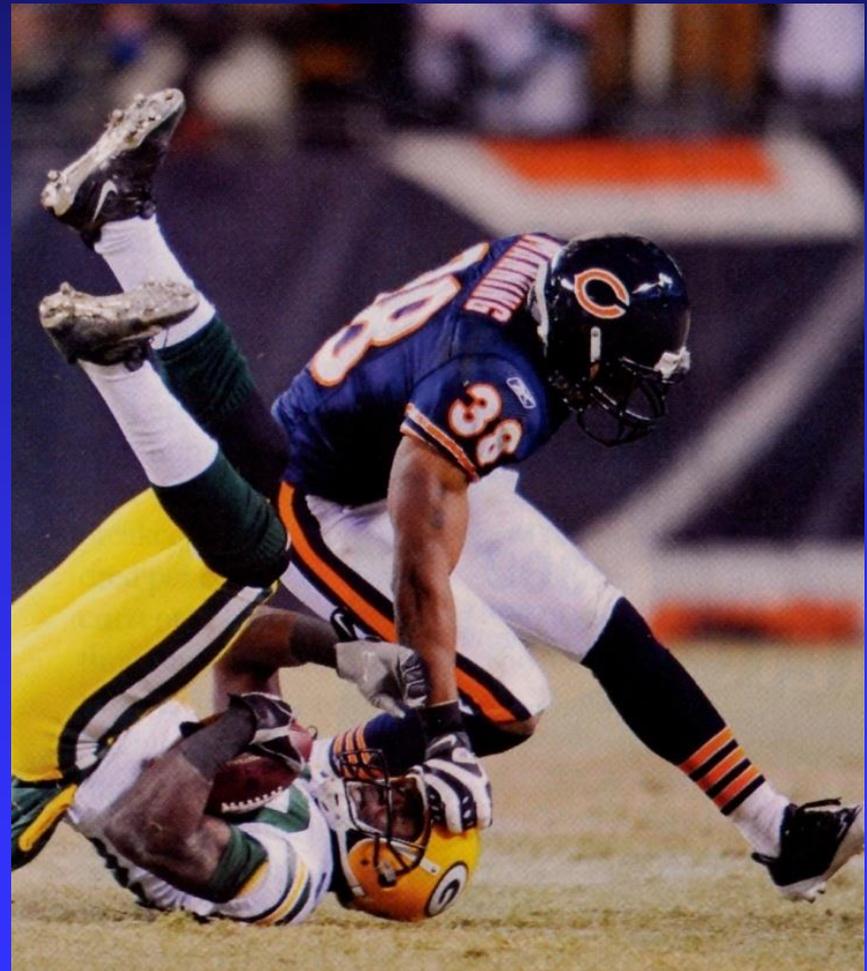
Concussion Evaluation

- Clinical history
 - ◆ PTA may be a surrogate marker of injury severity
 - ◆ LOC may not be a useful marker of severity



Concussion Evaluation

- Neurodiagnostic Testing
 - ◆ Neuroimaging
 - ◆ Neuropsychological Testing
 - ◆ Objective Balance Assessment
 - ◆ Genetic testing
 - ◆ Biomarkers of brain injury



Clinical Management

- Not be allowed to return to play in current game or practice while symptomatic
- Should not be left alone
- Should be medically evaluated after injury
- Mainstay of management is physical and cognitive rest until symptoms have resolved at rest and exertion



Clinical Management

■ Return to Competition

- ◆ Return to play on an individual basis (avoid the use of grading scales)
 - ◆ All symptoms have resolved
 - ◆ Neurological examination is normal
 - ◆ Cognitive function has returned to baseline
- ◆ Not only symptom free but also not on any medications for concussion
- ◆ Return to play should must follow a medically supervised stepwise process

Graded Return to Play Protocol

Rehabilitation stage	Functional exercise at each stage of rehabilitation	Objective of each stage
1. No Activity	Complete physical and Cognitive Rest.	Recovery
2. Light aerobic exercise	Walking, Swimming, Stationary Bike, HR<70% Maximum	Increased heart rate
3. Sport Specific Exercise	Skating or Running Drills without contact.	Add Movement
4. Non Contact training	More complex Drills without contact.	Exercise, coordination and cognitive load.
5. Full Contact	Normal Training	Restore confidence
6. Return to Play	Game Play	

Concussion Recovery and Graded Exercise Program Log

Name: _____

Injury Date: _____

First Asymptomatic Date: _____

Cleared for Full Recovery Date: _____

Date	Activity	Signs/Symptoms	Comments	Signature

Return to Play (BRAIN)

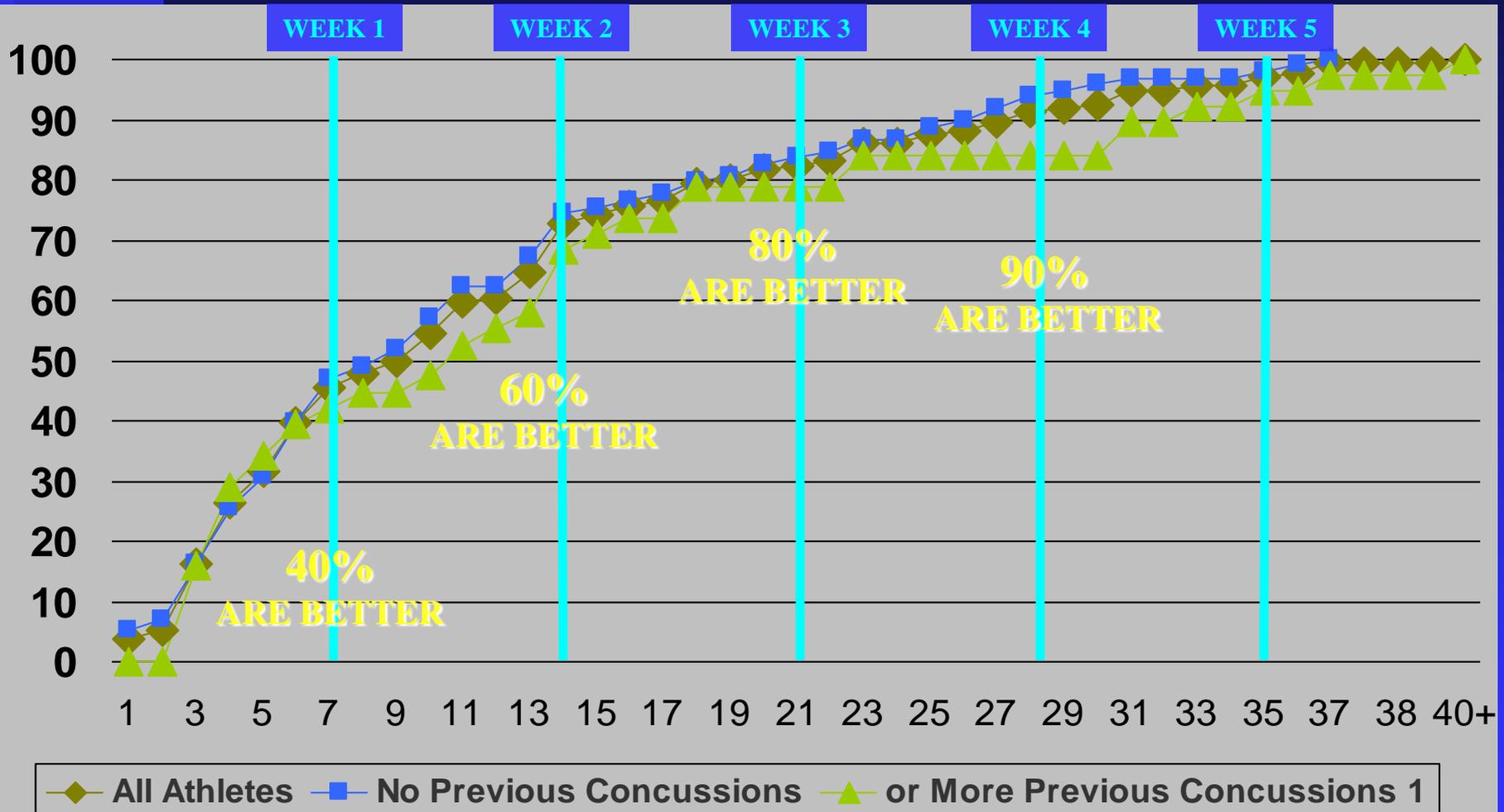
- Bike
- Run
- Agility
- In red (drills no contact)
- No restriction



Management and Rehabilitation of Atypical Cases

Prolonged or persistent symptoms!

How Long Does it Take in HS Football Players?



N=134 HS Football Athletes

[Collins et al., 2006, Neurosurgery](#)

Clinical Management and Rehabilitation

- Gagnon et al (2009)
 - ◆ Developed a rehabilitation program for children and adolescents who were considered slow to recover (> 1 month) from a sports related concussion
 - ◆ Controlled and closely monitored rehabilitation program in the post acute period



Clinical Management and Rehabilitation

- Gagnon et al. (2009) (cont'd)
 - ◆ 16 cases (11.2%) with persistent symptoms
 - ◆ Aged 10-17 years
 - ◆ All cases showed rapid and significant improvement in symptoms
 - ◆ Were able to resume their normal physical activity at the end of the program
 - ◆ Mean duration was 4.4 weeks



Clinical Management and Rehabilitation

■ Graded Rehabilitation Program

- ◆ Aerobic phase
- ◆ Coordination phase
- ◆ Home program phase
- ◆ Standard return to activity protocol if asymptomatic at rest for 1 week



Graded Rehabilitation

- Aerobic phase
 - ◆ Sub-maximal (50-60 % maximal capacity) aerobic capacity either on a treadmill or a stationary bike for 15 minutes
 - ◆ Any increase in symptoms the activity was stopped



Graded Rehabilitation

- Coordination phase
 - ◆ Light coordination exercises tailored to the athletes favorite or main sport
 - ◆ Performed up to 10 minutes
 - ◆ Purpose of this phase is to continue light aerobic exercises and introduce familiar activities
 - ◆ Any increase in symptoms the activity was discontinued



Graded Rehabilitation

- Home Program
 - ◆ Allows for continued training outside of the clinic
 - ◆ Facilitate school attendance
 - ◆ Minimize disruptions to daily life
 - ◆ Consists of light aerobic and coordination exercises
 - ◆ Any increase in symptoms the activity was discontinued



Graded Rehabilitation

- Standard RTP protocol
 - ◆ Symptom free for 1 week
 - ◆ Standard graduated return to activity



When should an athlete retire?

- No consensus
- Extent and duration of neurological signs and symptoms
- Evidence of Chronic Traumatic Brain Injury (CTBI)



Prevention Goals

- Identification of concussion
- Implementing sideline evaluations & treatment recommendations
- Recognize and treat post concussion syndrome
- Prevent second impact syndrome
- Prevent chronic traumatic brain injury
- Prevent additional morbidity and mortality

CONCUSSION

A Must Read for NFL Players ... Let's Take Brain Injuries Out of Play

CONCUSSION FACTS

- Concussion is a *brain injury* that alters the way your brain functions.
- Concussion can occur from a blow to the head/body:
 - following helmet contact with the ground, object, or another player.
 - contact with the helmet, ground, object, or another player.
- Most concussions occur without being knocked unconscious.
- Severity of injury depends on many factors and is not known until symptoms resolve and brain function is back to normal.
- All concussions are not created equally. Each player is different, each injury is different, and all injuries should be evaluated by your team medical staff.

CONCUSSION SYMPTOMS

Different symptoms can occur and may not show up for several hours. Common symptoms include:

- Confusion
- Headache
- Amnesia/difficulty remembering
- Balance problems
- Irritability
- Dizziness
- Difficulty concentrating
- Feeling sluggish, foggy, or groggy
- Nausea
- Sensitivity to noise
- Sensitivity to light
- Double/fuzzy vision
- Slowed reaction time
- Feeling more emotional
- Sleep disturbances
- Loss of consciousness

Symptoms may worsen with physical or mental exertion (e.g., lifting, computer use, reading).

WHY SHOULD I REPORT MY SYMPTOMS?

- Your brain is the most vital organ in your body.
- Practicing or playing while still experiencing symptoms can prolong the time it takes to recover and return to play.
- Unlike other injuries, there may be significant consequences to "playing through" a concussion.
- Repetitive brain injury, when not managed promptly and properly, may cause permanent damage to your brain.

*For more information about concussion and other types of repetitive brain injuries, go to www.cdc.gov/Concussion

What Should I Do if I Think I've Had a Concussion?

REPORT IT. Never ignore symptoms even if they appear mild. Look out for your teammates. Tell your Athletic Trainer or Team Physician if you think you or a teammate may have a concussion.

GET CHECKED OUT. Your team medical staff has your health and well being as its first priority. They will manage your concussion according to NFL/NFLPA Guidelines which include being fully asymptomatic, both at rest and after exertion, and having a normal neurologic examination, normal neuropsychological testing, and clearance to play by both the team medical staff and the independent neurologic consultant.

TAKE CARE OF YOUR BRAIN. According to CDC, "traumatic brain injury can cause a wide range of short- or long-term changes affecting thinking, sensation, language, or emotions." These changes may lead to problems with memory and communication, personality changes, as well as depression and the early onset of dementia. Concussions and conditions resulting from repeated brain injury can change your life and your family's life forever.

Work smart. Use your head, don't lead with it. Help make our game safer. **Other athletes are watching...**

Prevention Tools

- Rule changes
- Use helmets and other protective equipment
- Education
- Proper medical surveillance
- Ongoing research

WORK SMART ... PROTECT YOUR FUTURE

USE YOUR HEAD...

DON'T LEAD WITH IT

All Concussions **ARE NOT** Created Equally

If you're hurt, don't hide it. Report your head injury to your team medical staff and take time to recover.

MACKEY TBI WHITE COMMITTEE

CALL 800.372.2000 FOR MORE INFO

THANK YOU

QUESTIONS?