

By the end of the talk you will...

- Recognize signs and symptoms of concussions in pediatric athletes
- Implement appropriate treatment plans for acute concussion and Post-Concussion Syndrome
- Understand role for imaging studies, neurologic testing, and referral

## A Historical View

- ▶ "Part of the Game"
- ▶ Can't see the injury
- ▶ Athletes seen as "Soft"
- ▶ Team pressure
- ▶ Underreported & Under-recognized

## Types of Traumatic Head Injuries

### Structural

Subdural Hematoma  
Cerebral Contusion  
Epidural Hematoma  
Facial/Skull Fractures

### Functional

Concussions  
Post-Concussion Syndrome

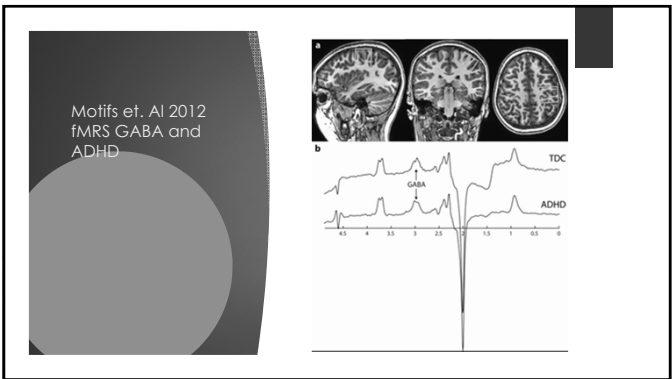
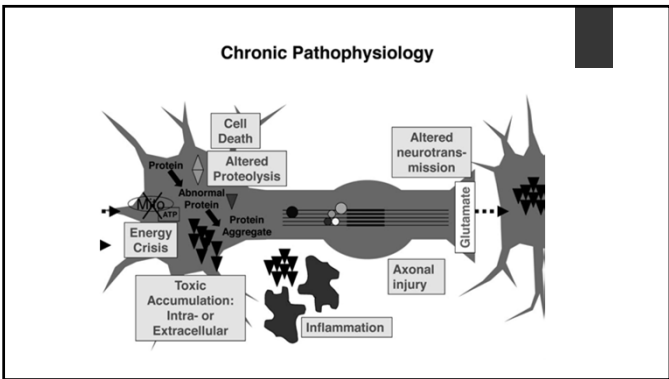
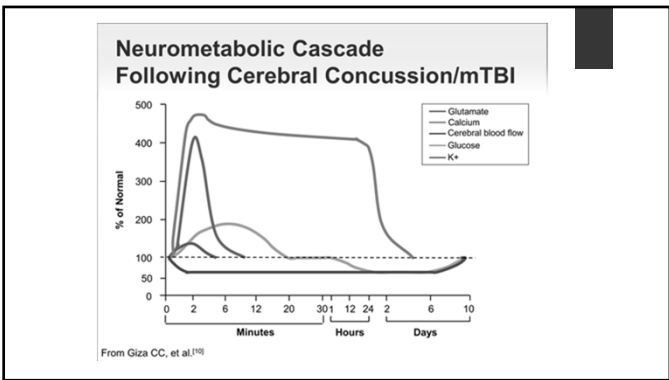
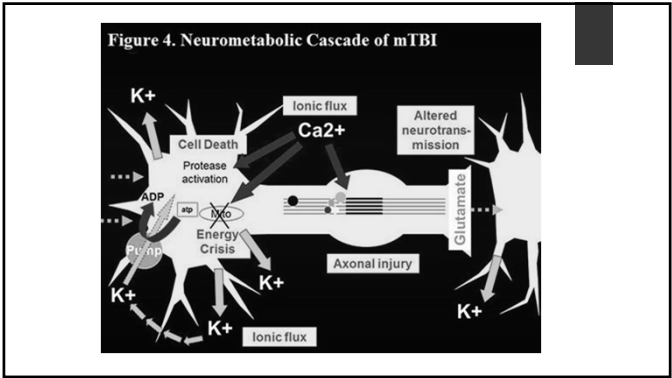
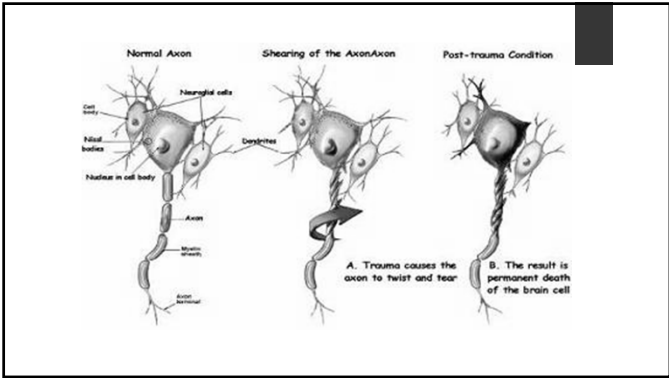
## What is a Concussion?

- ▶ Any alteration in cerebral function caused by direct or indirect (rotational) force or blow to the head

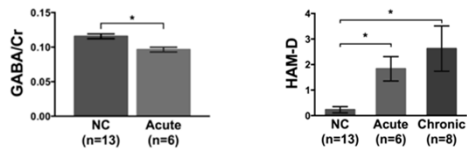
## Concussion Symptoms

PHYSICAL (10)		COGNITIVE (4)		SLEEP (4)	
Headache	0 1	Feeling mentally foggy	0 1	Drowsiness	0 1
Nausea	0 1	Feeling slowed down	0 1	Sleeping less than usual	0 1 N/A
Vomiting	0 1	Difficulty concentrating	0 1	Sleeping more than usual	0 1 N/A
Balance problems	0 1	Difficulty remembering	0 1	Trouble falling asleep	0 1 N/A
Dizziness	0 1	COGNITIVE Total (0-4)		SLEEP Total (0-4)	
Visual problems	0 1	EMOTIONAL (4)		EXERCISE (4)	
Fatigue	0 1	Irritability	0 1	Exertion: Do these symptoms worsen with:	
Sensitivity to light	0 1	Sadness	0 1	Physical Activity ...Yes ...No ...N/A	Cognitive Activity ...Yes ...No ...N/A
Sensitivity to noise	0 1	More emotional	0 1	Overall Rating: How different is the person acting compared to his/her usual self? (circle)	
Numbness/Tingling	0 1	Nervousness	0 1	Normal 0 1 2 3 4 5 6 Very Different	
PHYSICAL Total (0-10)		EMOTIONAL Total (0-4)			
(Add Physical, Cognitive, Emotion, Sleep totals)		Total Symptom Score (0-22)			

## Pathophysiology Acute

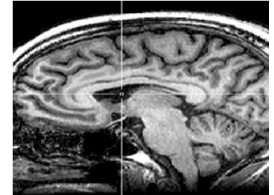


## Current UMass Research



## What Area of the Brain Affected?

- Prefrontal Cortex
  - Executive Function
  - Attention
  - Memory
- Anterior Cingulate Gyrus
  - Executive Function
  - Cognitive Processes
  - Emotional Regulation
  - Evaluative Processes



## Epidemiology

3.8 million sport related TBI's per year in US

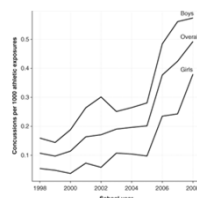
13-15% of all sport related injuries from concussion

Only 50% of mod/severe concussions will be seen by MD

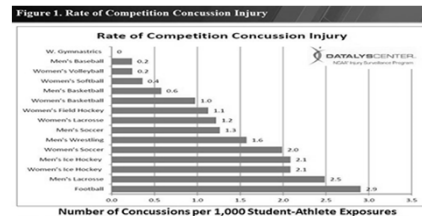
Football, Hockey, Soccer, Basketball, Snowboarding

## Epidemiology

- 248,418 Sports & Rec related concussions in persons less than 19 years
- 62% Increase from 2001 to 2009 (153,375 to 248,418)
- Less than 10% involves loss of conscious



## High Risk Sports



## Where do they happen?

- ▶ 1/3 occur during practice
- ▶ 2/3 occur during games

CONCUSSION RATE PER 1000 GAMES OR PRACTICES

SPORT	SEX	CONCUSSION RATE	CONCUSSION RATE	CONCUSSION RATE
		PER 1000 GAMES	PER 1000 PRACTICES	PER 1000
Football	Boys	22.9	31	21.5
Ice Hockey	Boys	14.6	13	13.9
Lacrosse	Boys	10.4	11	11.3
Lacrosse	Girls	8.6	13	11.3
Soccer	Girls	8.2	8	13.9
Wrestling	Boys	4.6	13	22.2
Field Hockey	Girls	4.1	14	22.2
Basketball	Girls	5.5	6	23.3
Soccer	Boys	5.3	4	23.3
Basketball	Boys	3.9	6	23.3
Softball	Girls	2.6	9	23.3
Cheerleading	Girls	1.2	14	23.3
Gymnastics	Girls	2.4	5	27
Volleyball	Girls	1.5	5	27
Baseball	Boys	1.1	1	27
Swim and Dive	Girls	4	1	2
Track and Field	Girls	4	1	2
Track and Field	Boys	3	2	2
Swim and Dive	Boys	0	1	1



## Clinical Significance

## Short Term Risks

- ▶ Recurrent concussions "Vulnerable State"
- ▶ Second impact syndrome
- ▶ Post Concussion Syndrome

## Long Term Risks

Cognitive dysfunction

Mood dysfunction

Chronic Traumatic Encephalopathy (CTE)

Dementia Pugilistica

## Clinical Presentation

## Mechanism of Injury

- ▶ Force to side/temporal area most common
- ▶ Football: blow from another helmet
- ▶ Soccer: blow from another head
  - ▶ 50% Related to act of heading a soccer ball
- ▶ Ice Hockey: impact from another body part or object



## Impact

### Short Term

- ▶ Headache
- ▶ Dizziness
- ▶ Visual Disturbance
- ▶ Cognitive Delays
- ▶ Sleep Disturbance
- ▶ Sensitivity to Noise/Light

### Long Term

- ▶ Short Term Memory Loss
- ▶ Delayed Cognition
- ▶ Mood Disturbance
- ▶ Chronic Headaches
- ▶ ? CTE/Dementia



## Clinical Management

## Current Standard of Care

- ▶ Any suspected concussed athlete needs to be removed from play for the day and cannot return to cleared by qualified medical professional
- ▶ Physical and cognitive rest
- ▶ Graduated RTP once asymptomatic and normal exam (neuro/cognitive/balance)
- ▶ Prolonged recovery often requires multi-disciplinary approach



## HS Requirements

- ▶ Varies by State Interscholastic Activities Association
- ▶ All 50 States enacted Concussion Laws since 2009 (Zachary Lystedt)
  - ▶ Guidelines/Education
  - ▶ Mandatory Consent
  - ▶ Immediate Removal if Concussion Suspected
  - ▶ Written Clearance by qualified Medical Professional
  - ▶ Legal Immunity



## Acute Management

- ▶ ABCD's
- ▶ No return for any "suspected concussion"
- ▶ Monitored for progression of symptoms
- ▶ Transfer if progressive, focal or worrisome sx

## Office-Based Care

- ▶ Most athletes with concussion will be out at least 10-14 days.
- ▶ Expect longer recovery
  - ▶ Young athletes
  - ▶ Modifying factors

## Clinical Modifiers

Factors	Modifier
Symptoms	Number Duration (> 10 days) Severity
Signs	Prolonged LOC (> 1 min), amnesia Concussive convulsions
Sequelae	Frequency - repeated concussions over time Timing - injuries close together in time
Temporal	"Recency" - recent concussion or TBI Repeated concussions occurring with progressively less impact force or slower recovery after each successive concussion
Threshold	Child and adolescent (< 18 years old) Migraine, depression or other mental health disorders, attention deficit hyperactivity disorder (ADHD), learning disabilities (LD), sleep disorders
Age	Psychoactive drugs, anticoagulants
Co- and Pre-morbidities	Dangerous style of play High-risk activity, contact and collision sport, high sporting level
Medication	
Behaviour	
Sport	

## Modifiers are a "Red Flag"

"Athletes with such modifying features may need to be managed in a *multidisciplinary* manner coordinated by a *physician with specific expertise* in the management of concussive injury"

(Zurich Consensus Statement 2008)

## Office Based History

- ▶ How many
  - ▶ Including "dings", "bell rung"
- ▶ How recent
- ▶ Nature of impacts
  - ▶ Decreasing force needed?
- ▶ Recovery from prior concussion
- ▶ Presence of modifiers

## Clinical Presentation

### Acute

- LOC
- Headache
- Amnesia
- Cognitive/memory dysfunction
- Visual disturbances
- Nausea/vomiting
- Balance disturbance
- Difficulty concentrating
- Vertigo
- Tinnitus

### Delayed

- Headache
- Cognitive/memory Dysfunction
- Sleep disturbances
- Fatigue
- Depression
- Emotional lability
- Personality changes

## Office Based Physical Exam

- ▶ Head and Neck Exam
  - ▶ Neck
    - ▶ Posterior Midline TTP
  - ▶ Head
    - ▶ Crepitus/step-offs
    - ▶ Battle's sx
    - ▶ Raccoon eyes
    - ▶ Hemotympanum
    - ▶ Extraocular movements

## Office Based Neuro Exam

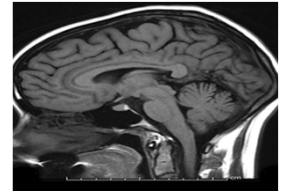
- ▶ Mental Status
- ▶ CN Exam
- ▶ 3 word recall: immediate/5 min
- ▶ Serial 7's or 3's
- ▶ Finger-nose/Romberg
- ▶ Peripheral Nerve Exam

## Office Based Tools

- ▶ ACE Form (CDC)
  - ▶ Has a Clinician and School form
  - ▶ No neuro-cog/balance testing
- ▶ SCAT 3 (4<sup>th</sup> Intl Consensus Statement)
  - ▶ May be used as baseline, sideline, office
  - ▶ <13 and > 13 yo forms
  - ▶ No return to school rec's

## Imaging

- ▶ No imaging needed unless
  - ▶ Focal symptoms
  - ▶ Worsening symptoms
  - ▶ Atypical symptoms
- ▶ MRI is test of choice over CT
- ▶ CT over utilized in ED setting



## Neuropsych Testing

- ▶ No Evidence that use improves clinical outcomes!!!
- ▶ Computer vs. traditional
- ▶ Computer based 30% false positive and negative rate

## Treatment

## Acute Days 1-14

- ▶ Physical Rest
  - ▶ Till symptom resolution
  - ▶ Then asymptomatic graduated RTP
- ▶ Cognitive Rest
  - ▶ 1-2 Days then stepwise return as tolerated
  - ▶ Academic Modifications as needed

## Randomized Controlled Trial

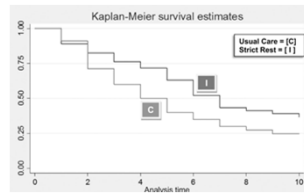
Thomas et. Al Pediatrics 2015

- ▶ RCT 99 Patients 11-22 yrs
- ▶ Dx "concussion" from ED
- ▶ Randomized 5 days "Strict Rest" vs. "Usual Care"
- ▶ Sx Score, daily diary, Neurocognitive Tests, balance assessments

**PEDIATRICS**  
OFFICIAL JOURNAL OF THE AMERICAN ACADEMY OF PEDIATRICS

## Results

- ▶ Intervention Group less school
- ▶ No statistical difference in Neurocognitive or Balance Testing
- ▶ Intervention group reported more daily post-concussive symptoms
- ▶ Intervention group had slower symptom resolution



## Graduated Return to Play

Step 1	Rest. No activity
Step 2	Light aerobic exercise 10-15 min. (stationary cycling, walking)
Step 3	Sport-specific skills 20-30 min.
Step 4	Non-contact team practice
Step 5	Full contact team practice
Step 6	Game play
Minimum 24 hrs between steps. If symptomatic drop back to previous asymptomatic level & attempt again in 24 hrs.	

## Post Concussion Syndrome

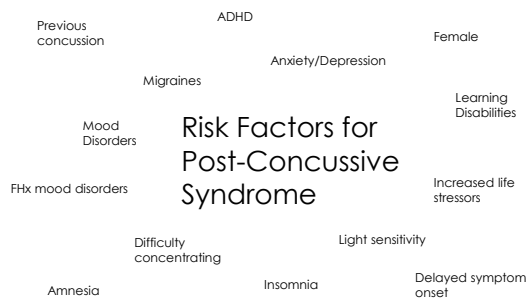
- ▶ No exact definition
- ▶ Syndrome
- ▶ >28 days
- ▶ HA, Cognitive, Mood Sx predominate
- ▶ Associated risk factors

## Post-Concussion Syndrome

- ▶ 14% of all pediatric concussions were symptomatic after 3 months, 2.3% after 1 year
- ▶ Concussed youths are 2x more likely have another within 12 months
- ▶ >30% of high school athletes have had more than one concussion



## Risk Factors for Post-Concussive Syndrome



## Post Concussion Syndrome Treatment

- ▶ Work/School Modifications
- ▶ Activity as Tolerated
  - ▶ Submaximal Exercise
- ▶ Limit Computer Time
- ▶ Medication
- ▶ PT/OMT
- ▶ Vestibular-Ocular Rehab
- ▶ Mental Health (counseling, CBT, biofeedback)



## Benefits of Exercise on the Brain

- ▶ Improved sleep quality
- ▶ Elevated serotonin levels leading to improved mood
- ▶ fMRI increased neuroplasticity and neurogenesis
- ▶ Increased BDNF levels
- ▶ As well as all the usual health benefits

