Mild Brain Injury

Concussion Evaluation and Treatment

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Restoring Hope and *Freedom*

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Financial Support

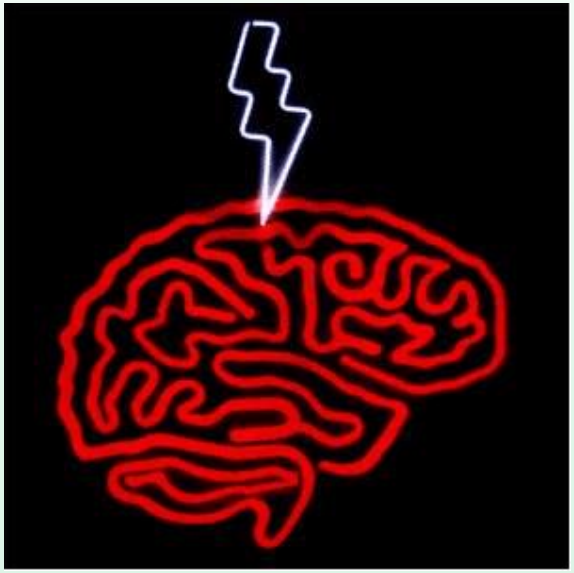
- None

Objectives

- Review current concepts in concussion management
- Increase understanding of concussion signs and symptoms and pathophysiology
- Facilitate knowledge of proper concussion assessment and management in the injured patient
- Review current concussion treatment guidelines

Mild Brain Injury (mTBI)

- Traumatically induced physiologic disruption of brain function, manifested by an alteration in neurologic function



Mild Traumatic Brain Injury

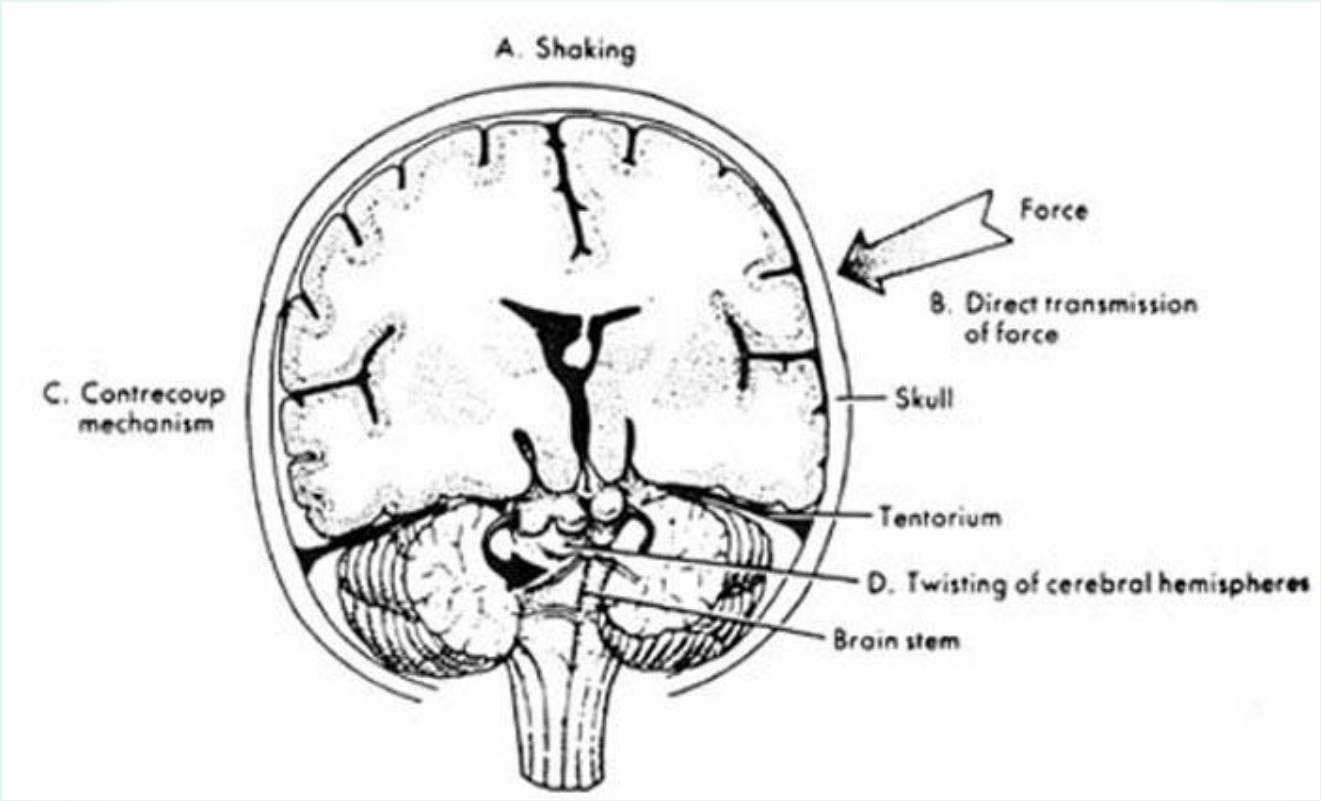
Focal, definable neurologic deficits with the following injury severity criteria:

- LOC not necessary
- GCS of 13-15 after 30 minutes
- PTA not necessary
- Normal radiologic imaging

Etiology of Concussion

- Slip and Fall
- MVA
- Work Injury
- Assault
- Recreational
- Sports

Mechanism Of Injury

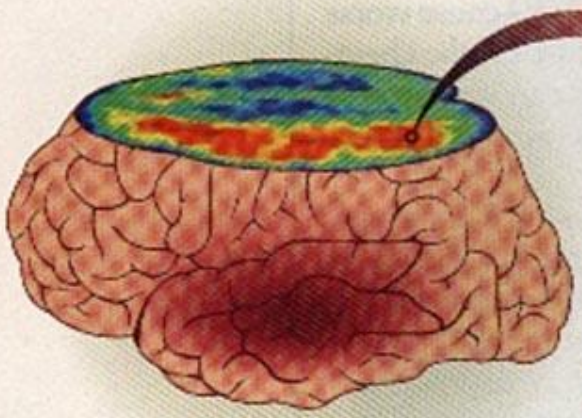

A. Shaking
Force
B. Direct transmission of force
C. Contrecoup mechanism
Skull
Tentorium
D. Twisting of cerebral hemispheres
Brain stem

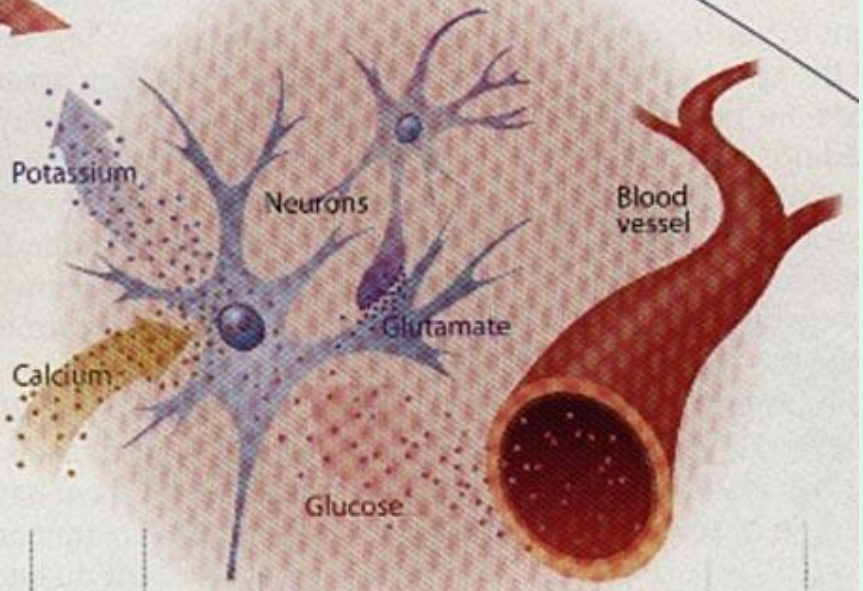
Pathophysiology

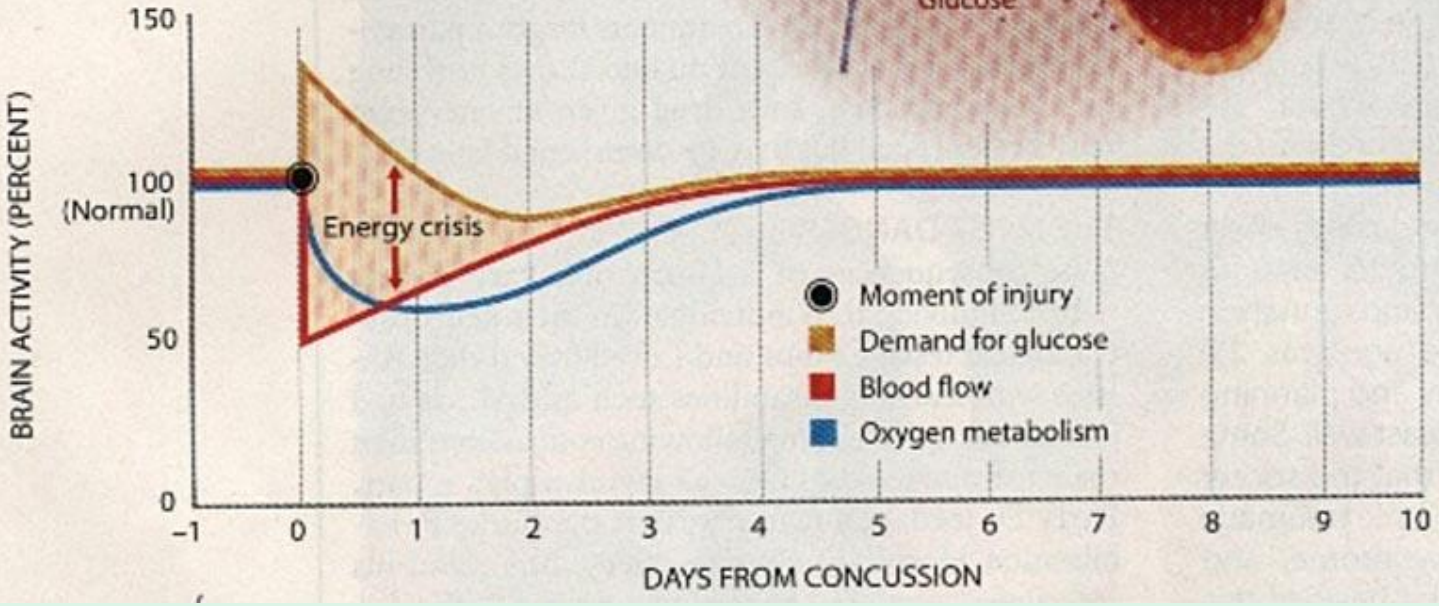
Diffuse Injury
Focal Abnormalities

- Frontal and temporal lobes
  - Primary distribution is parasagittal white matter, spreading from cortex to brainstem
- Consistent with neural/behavioral symptoms
  - That's why we see changes in attention and executive function
- Brainstem = LOC
- Diffuse Axonal Injury - Normal CT and MRI
  - Though fMRI and SPECT is promising

Anatomy of a Concussion







Concussion - Neurophysiology

- Immediate biochemical changes begin after impact
  - Efflux of K, Glutamate (Giza, JATA, 2001)
  - Influx of CA
  - Suppression of neuronal activity
- Period of “hypermetabolism” takes place in state of diminished cerebral blood flow
  - The brain NEEDS to rest to recover
    - *Journal of Athletic Training 2013;36(3):228-235*

Chronic Traumatic Encephalopathy

- Beta amyloid deposition
- Tau protein
- NFL Brain Donation Program
- Delayed onset from stopping sports to onset of symptoms (Average 8 years)

Repeated Concussion-

Guskiewicz et al JAMA 2003

Table 3. Association Between Concussion History and Risk of Incident Concussion

No. of Previous Concussions	No. (%) of Incident Concussions*	No. of Player-Seasons	Estimated No. of Athlete Exposures	Concussion Rate (95% CI) per 1000 Athlete Exposures	Rate Ratio (95% CI)	Multivariate-Adjusted Rate Ratio (95% CI)†
0	122 (3.7)	3265	185 060	0.66 (0.54-0.78)	1.0	1.0
1	41 (5.4)	756	42 850	0.96 (0.66-1.25)	1.5 (1.0-2.1)	1.4 (1.0-2.1)
2	15 (10.5)	143	8105	1.85 (0.91-2.79)	2.8 (1.6-4.8)	2.5 (1.5-4.1)
≥3	10 (12.7)	79	4478	2.23 (0.85-3.62)	3.4 (1.8-6.5)	3.0 (1.6-5.6)

Abbreviation: CI, confidence interval.

*Data are expressed as No. (%) of players from each concussion group ($\chi^2_3 = 30.11$; $P<.001$).

†Adjusted for body mass index (by quartile), academic year (freshman, sophomore, junior, or senior/graduate), years of organized football experience (≤7, 8-10, or ≥11), division (I, II, or III), and playing position (listed in Table 2).

- Prior concussion was associated with higher rate of subsequent concussion

Repeated Concussion-

Guskiewicz et al JAMA 2003

Table 4. Length of Symptom Recovery in Players With Concussion by History of Concussion*

Length of Symptom Recovery (d)	No. of Previous Concussions†			
	0 (n = 122)	1 (n = 41)	2 (n = 15)	≥3 (n = 10)
Rapid (<1)	37 (30.3)	16 (39.0)	5 (33.3)	0
Gradual (1-7)	76 (62.3)	19 (46.3)	7 (46.7)	7 (70.0)
Prolonged (>7)	9 (7.4)	6 (14.6)	3 (20.0)	3 (30.0)

*Data are expressed as No. (%) of players with concussion.
†P = .03 by Fisher exact test.

- Moreover, symptom duration was longer in those with more prior concussions

Post-Concussion Syndrome

Symptomology – 22 Signs and Symptoms

- Headaches
- Vestibular dysfunction
- Decreased memory and concentration
- Cervical and cranial myofascial pain
- Visual disturbances
- Mood disorders
- Sleep disorders

Post-Concussion Syndrome

Most Common Symptoms – mTBI at MFB

- #1 Decreased attention, concentration and memory
  - 18% with sx at 3 months, 6% at 12 months
- Headaches
  - 42% with sx at 3 months, 28% at 12 months
- Dizziness/vestibular dysfunction
  - 23% with sx at 3 months, 15% at 12 months
- Emotional lability/mood changes
  - 56% with sx at 3 months, 24% at 12 months

Incidence of Work Related Concussion

- Not much data available from majority of concussion epidemiology sources
- Primack et. al. – estimated 480,000 work related head injuries a year in USA
- Common findings: Males at higher risk than Females
- Higher incidence in 20 to 25 age range
- MFB Data – 500 referrals a year: 35% are industrial

Epidemiology In Sports

- Mild Traumatic Brain Injuries
  - Underestimate of approximately 300,000 head injuries per year in the USA
  - 63,000 MTBI's in high school alone per year
  - 85% of athletes evaluated for concussions complain of headaches lasting one week or longer

Initial Evaluation For mTBI

Occ Med Clinic, sideline, ER or Primary Care Clinic

- Document LOC, PTA and GCS
- Document Mini-Mental Status Exam
- Document focal neuro deficits
- Imaging studies (x-ray, CT)
- Reassurance, education
- If persistent symptoms, refer to Concussion Clinic

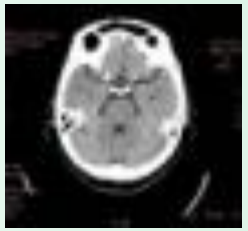
Diagnostic Testing

By Definition - Usually Unremarkable

- Plain X-rays
- CT
- MRI
- EEG
- BAEP
- VEP

Concussion - Imaging

- Brain CT/MRI should be employed whenever suspicion of an intracerebral bleed or structural lesion exists (from Zurich consensus statement, 2008)
- CT preferred in first 24-48 hours
- Normal CT and MRI in > 99% mTBI
- Emerging role for diffusion tensor imaging(DTI), MR SPECT, and functional MRI (fMRI)



» Neurosurgery 2011; 62:1268-1296

Initial Evaluation

- Confirm ABCs first.
- Assess level of consciousness
- Establish the presence of any loss of consciousness (LOC).
- Determine if confusion or amnestic.

(amnesia much more common than LOC)

On-Site Evaluation - Signs

- Confusion: impaired awareness and orientation to surroundings.
  - May appear stunned, dazed, or glassy-eyed.
  - Often recognized by coworkers, teammates
  - Ask simple orientation questions.

Initial Evaluation - Symptoms

- Amnesia: duration often related to the severity of the injury.
  - Anterograde: period of amnesia following the injury.
    - First clear memory following head injury.
    - Less correlative with symptom outcome.
  - Retrograde: period immediately preceding trauma.
    - More predictive of post-injury cognitive deficits and persistent symptoms.
    - Ask about events prior to the injury.
    - Will often shrink over time.

Post-Traumatic Amnesia

- Presence of amnesia (not LOC) most predictive of post-injury difficulties
- Workers with significant cognitive deficits and high degree of symptoms were over 10 times more likely to have exhibited retrograde amnesia, and 4 times more likely to have exhibited anterograde amnesia. Kelly et. Al.

RELATIONSHIP OF INITIAL MARKERS AND OUTCOMES

- Patients reporting amnesia following concussion had more symptoms, longer duration of symptoms, and decreased test performance. Erlanger D, Kausik, Cantu R, Barth JT, et al. Symptom based assessment of the severity of the concussion. J Neurosurg 2003;98:34-9.

Concussion Assessment Tools

- Cognitive Screening
- Physical exam
- Provocative maneuvers
- Standardized screening tools

Symptom Scale

POST CONCUSSION SYMPTOMS SCALE

	None			Moderate		Severe	
Dizziness	0	1	2	3	4	5	6
Nausea	0	1	2	3	4	5	6
Balance problems	0	1	2	3	4	5	6
Sleeping more then usual	0	1	2	3	4	5	6
Sensitivity to light	0	1	2	3	4	5	6
More emotional than usual	0	1	2	3	4	5	6
Sadness	0	1	2	3	4	5	6
Numbness or tingling	0	1	2	3	4	5	6
Feeling as if "in a fog"	0	1	2	3	4	5	6
Dificulty remembering	0	1	2	3	4	5	6
Headache	0	1	2	3	4	5	6
Vomiting	0	1	2	3	4	5	6
Trouble falling asleep	0	1	2	3	4	5	6
Drowsiness	0	1	2	3	4	5	6
Irritability	0	1	2	3	4	5	6
Nervousness	0	1	2	3	4	5	6
Feeling slowed down	0	1	2	3	4	5	6
Difficulty conentrating	0	1	2	3	4	5	6
Other	0	1	2	3	4	5	6

Sports Concussion Assessment Tool 3

- Scoring system--not to be used as a definitive “play or don’t play” score, but to follow over time.

Sports Concussion Assessment Tool 3

SCAT3™

Sport Concussion Assessment Tool – 3rd Edition

For use by medical professionals only

Name

Date/Time of Injury:
Date of Assessment:

Examiner:

What is the SCAT3?[1]

The SCAT3 is a standardized tool for evaluating injured athletes for concussion and can be used in athletes aged from 13 years and older. It supersedes the original SCAT and the SCAT2 published in 2005 and 2009, respectively[2]. For younger persons, ages 12 and under, please use the Child SCAT3. The SCAT3 is designed for use by medical professionals. If you are not qualified, please use the Sport Concussion Recognition Tool[3]. Preseason baseline testing with the SCAT3 can be helpful for interpreting post-injury test scores.

Specific instructions for use of the SCAT3 are provided on page 3. If you are not familiar with the SCAT3, please read through these instructions carefully. This tool may be freely copied in its current form for distribution to individuals, teams, groups and organizations. Any revision or any reproduction in a digital form requires approval by the Concussion in Sport Group.

NOTE: The diagnosis of a concussion is a clinical judgment, ideally made by a medical professional. The SCAT3 should not be used solely to make, or exclude, the diagnosis of concussion in the absence of clinical judgement. An athlete may have a concussion even if their SCAT3 is "normal".

What is a concussion?

A concussion is a disturbance in brain function caused by a direct or indirect force to the head. It results in a variety of non-specific signs and/or symptoms (some examples listed below) and most often does not involve loss of consciousness. Concussion should be suspected in the presence of **any one or more** of the following:

- Symptoms (e.g., headache), or
- Physical signs (e.g., unsteadiness), or
- Impaired brain function (e.g. confusion) or
- Abnormal behaviour (e.g., change in personality).

1 Glasgow coma scale (GCS)

Best eye response (E)	
No eye opening	1
Eye opening in response to pain	2
Eye opening to speech	3
Eyes opening spontaneously	4
Best verbal response (V)	
No verbal response	1
Incomprehensible sounds	2
Inappropriate words	3
Confused	4
Oriented	5
Best motor response (M)	
No motor response	1
Extension to pain	2
Abnormal flexion to pain	3
Flexion/Withdrawal to pain	4
Localizes to pain	5
Obeys commands	6
Glasgow Coma score (E + V + M)	of 15

GCS should be recorded for all athletes in case of subsequent deterioration.

Acute Concussion Evaluation (ACE)

- Developed by Gerard Giola/Mickey Collins, 2006
- Part of the CDC “Heads Up” Kit – cdc.gov/concussion/heads up
- Office version and care plan
- Allows for more individualized assessment on mTBI
- Assesses injury characteristics, type and severity of symptoms with guidelines for RTW

Treatment Options For Concussion Symptoms

Factors For Successful Treatment and Outcomes

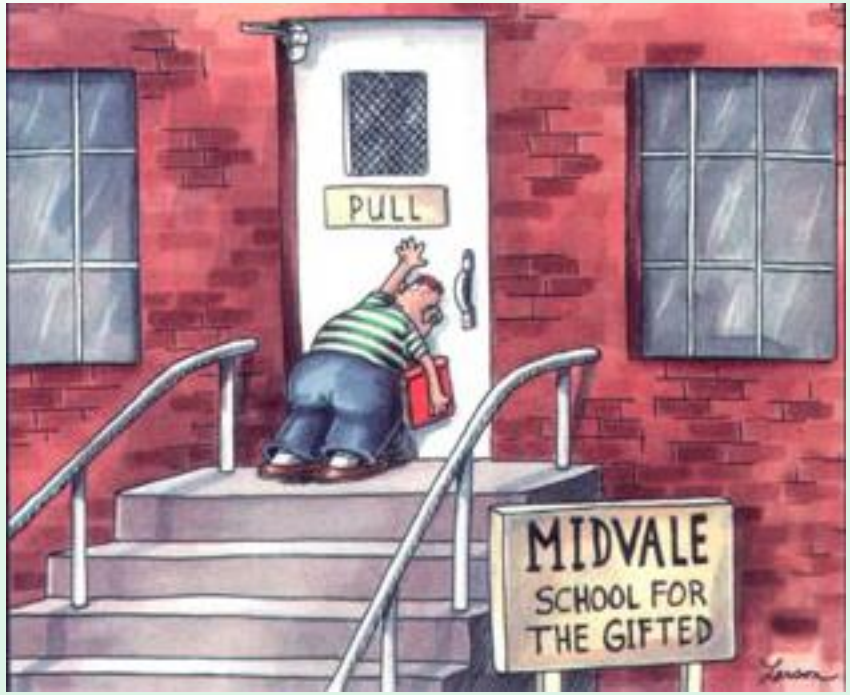
- Diagnose early
- Educate employee, coaches, family, employer
- Don’t just rest – treat!
- Cohesive team treatment with consistent message
- Pacing and graduated, successful return to work or sports

Post-Concussive Headaches

- Musculoskeletal
- Vascular
- Neurogenic

Post-Concussive Headache Management

- PT with emphasis on posture, ROM and strengthening
- Tapering of narcotics
- Treat sleep disturbances
- Trigger point injections
- Occipital nerve blocks
- Botox
- OMT/Manual Medicine
- Medications



Cognitive Therapy

Treatment?

- Negligible role for cognitive therapy in direct treatment of cognitive deficits
  - Programs that allege treatment of attention and memory are not acceptable
- Only pragmatic programs are shown to be helpful:
  - Speech for adaptive strategies
  - Psychology or social work for counseling
  - Vocational support

Vestibular Dysfunction

Treatment

- Affects 20-50% of Concussion
- Only one study has looked at dizziness and workers
- 30% those not working at 6 months were because of dizziness

Visual Disturbances

Treatment

- Occupational therapy
- Prescriptions
- Prisms
- Patching
- Photosensitivity

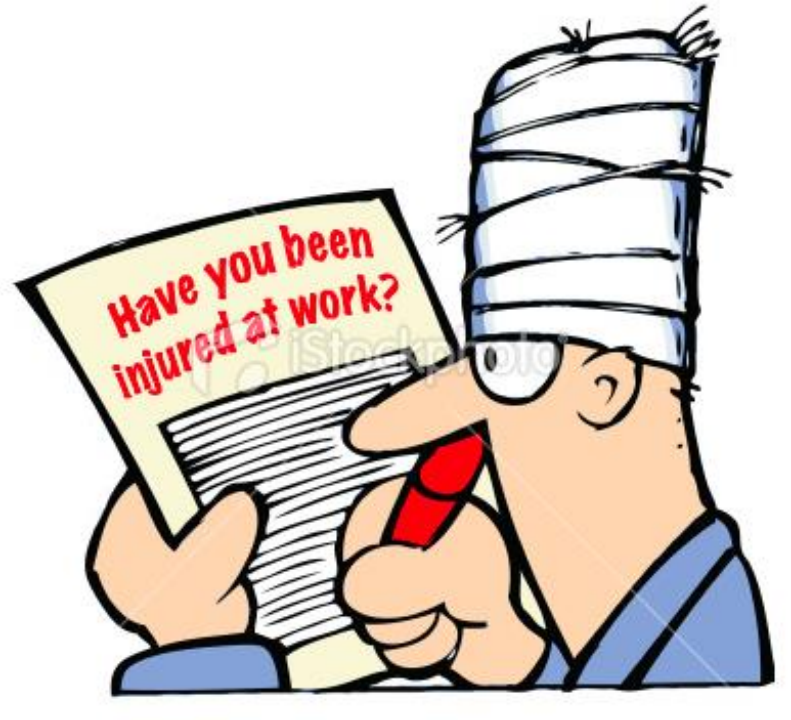
Depression Associated With Concussion

Treatment

- Medications
- Psychotherapy
- Useful for depressive symptomology ONLY, not for cognition

Concussion Functional Outcome Tools

- Activity Specific Balance Confidence Scale (ABC)
- Dynamic Gait Index (DGI)
- Motion Sensitivity Quotient (MSQ)
- Timed Get Up and Go (TUG)
- Dizziness Handicap Index (DHI)
- Neck Disability Index (NDI)



Return To Work

MFB RTW Exercise Stages

- Stage 1—very light exercise, 30-40% HR max (isometrics, stretching, walking)
- Stage 2—light exercise, light weights, 40-60% HR max, moderate balance activities, add in head position changes
- Stage 3—moderate aerobic exercises, 60-80% HR max, all forms of strength exercise, running, challenging dynamic balance exercises
- Stage 4—job specific training, heavy exercise, 80 % HR max, no head contact
- Stage 5—full job performance, full exertion

Return To Work Progression After Concussion

- Consider a stepwise progression—may take weeks; gradually increase lifting amounts
- Modified hours (4 hours/day, 3 days/week); a worker with a high symptom score may need to be taken out of work initially for a few days
- 5-10 minute break every 1-2 hours
- Limited computer time (30 minutes q 1 hour)
- Follow symptom scores, clinical monitoring
- Avoid progression if symptoms get worse!

Achieving Medical Endpoint for Work Related Concussions

- Many of the symptoms can't be 'seen'
- May take longer than other diagnoses, based on recent concussion information from the sports related research
- Co-workers/employers may not be as empathetic for this type of injury
- Endpoint can be achieved when symptoms have resolved, balance testing is back to baseline (pre-injury), and neurocognitive data is within acceptable range of normative data, and are able to tolerate full duty

MHSAA Concussion Guidelines

- Starting 2010-2011 school year
- Adopted from the National Federation of Sports
- Athlete with signs of concussion are removed from play and not allowed to return until cleared by MD/DO
- The officials no longer have any role in assessing the athlete

MFB GRADUATED RETURN TO SPORTS Protocol

1. Rest until asymptomatic (physical and mental rest)
2. Light aerobic exercise (less than 70% of maximum heart rate - example: stationary bike)
3. Sport-specific exercise (drills specific to athlete's sport)
4. Non-contact training drills (more intense sport drills with no contact from other players)
5. Full contact practice (following medical clearance)
6. Return to competition (game play)

CONCERNS: TOO QUICK TO RETURN?

- CONCERNS: TOO QUICK TO RETURN? Are the new guidelines, even with NP testing, too lenient?
- Concerns:
  - Research suggests that EEG recordings, transcranial magnetic stimulation, balance testing, PET scanning, and diffusion tensor MRI shows persistent damage
  - May indicate that safe RTW might require at least 4-6 weeks to facilitate more complete recovery and to protect from re-injury

Serious Questions

- What is the significance of cognitive deficits after other symptoms resolve?
- What are the significance of other symptoms after cognitive deficits resolve?
- How “back to baseline” does a person have to be to go back to work or sports; should this be based on NP testing?

Confused?… Where are we in 2016?

Conclusions

- Current information on concussions needs to be updated and improved
- Good success rates are possible, with early and appropriate treatment
- Modifications in the workplace, school and sports are crucial
- Consider effects of multiple concussions on long term issues
- A multi-disciplinary brain injury rehabilitation team may be needed for an athlete or employee with persistent symptoms

Concussion Resources

- Brain Injury Association of America: (www.biausa.org)
- Brain Injury Association of NH: (www.bianh.org)
- Sports Legacy Institute: (www.sportslegacy.org)
- ImPACT: (www.impacttest.com)
- www.cdc.gov/concussion/HeadsUp
- Heads Up toolkits


83
88