Modern Concussion Management and Post Concussion Syndrome

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100% *kids.*

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Disclosure

No one involved in the planning or presentation of this material has any relevant financial relationships with a commercial interest to disclose.

Objectives

- Identify targeted management and treatment strategies to facilitate recovery of the post acute and slow-to-recover patient
- Identify risk factors for post concussion syndrome
- Gain a better understanding of the role of bio-psycho-social risk factors and cognitive biases in the persistently symptomatic patient

"There are known knowns; there are things we know we know.

We also know there are known unknowns; that is to say we know there are some things we do not know.

But there are also unknown unknowns – the ones we don't know we don't know."

Donald Rumsfeld, 2002

Case

- 19 y.o. healthy female
- College Intermurals, elbowed while playing basketball
- Signs and symptoms consistent with concussion
- Advised “complete rest” until “asymptomatic”
- Stopped going to class
- Stopped exercising
- Did not return after semester
- Referred 2 months PI
- Diagnosed with “Persistent post concussion syndrome”

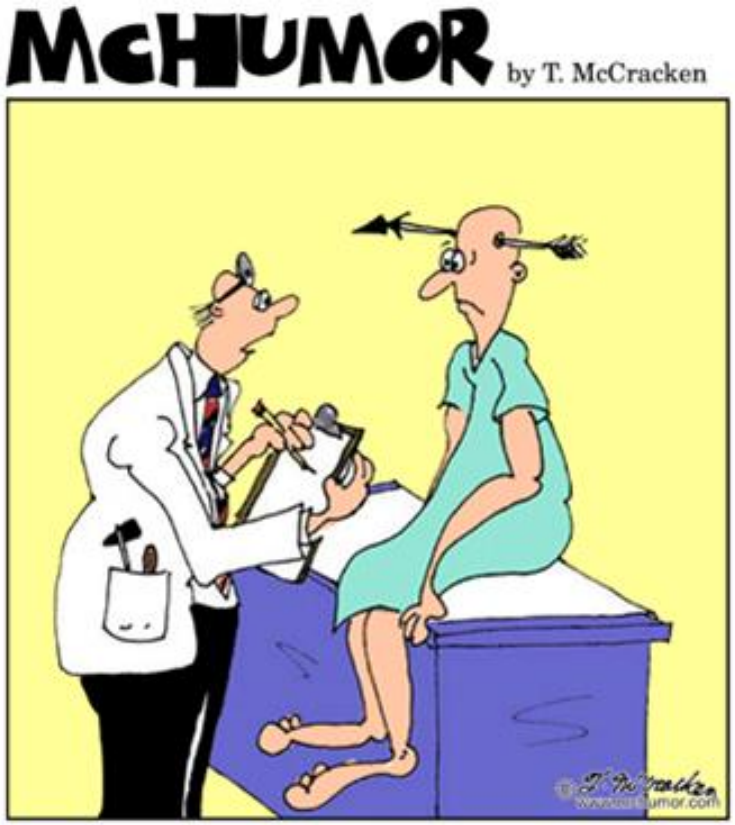
Case

Patient's Presenting Symptoms

- Headache
- Fatigue
- More emotional
- Sadness
- Sleep difficulties
- Loss of appetite
- Concentration difficulties

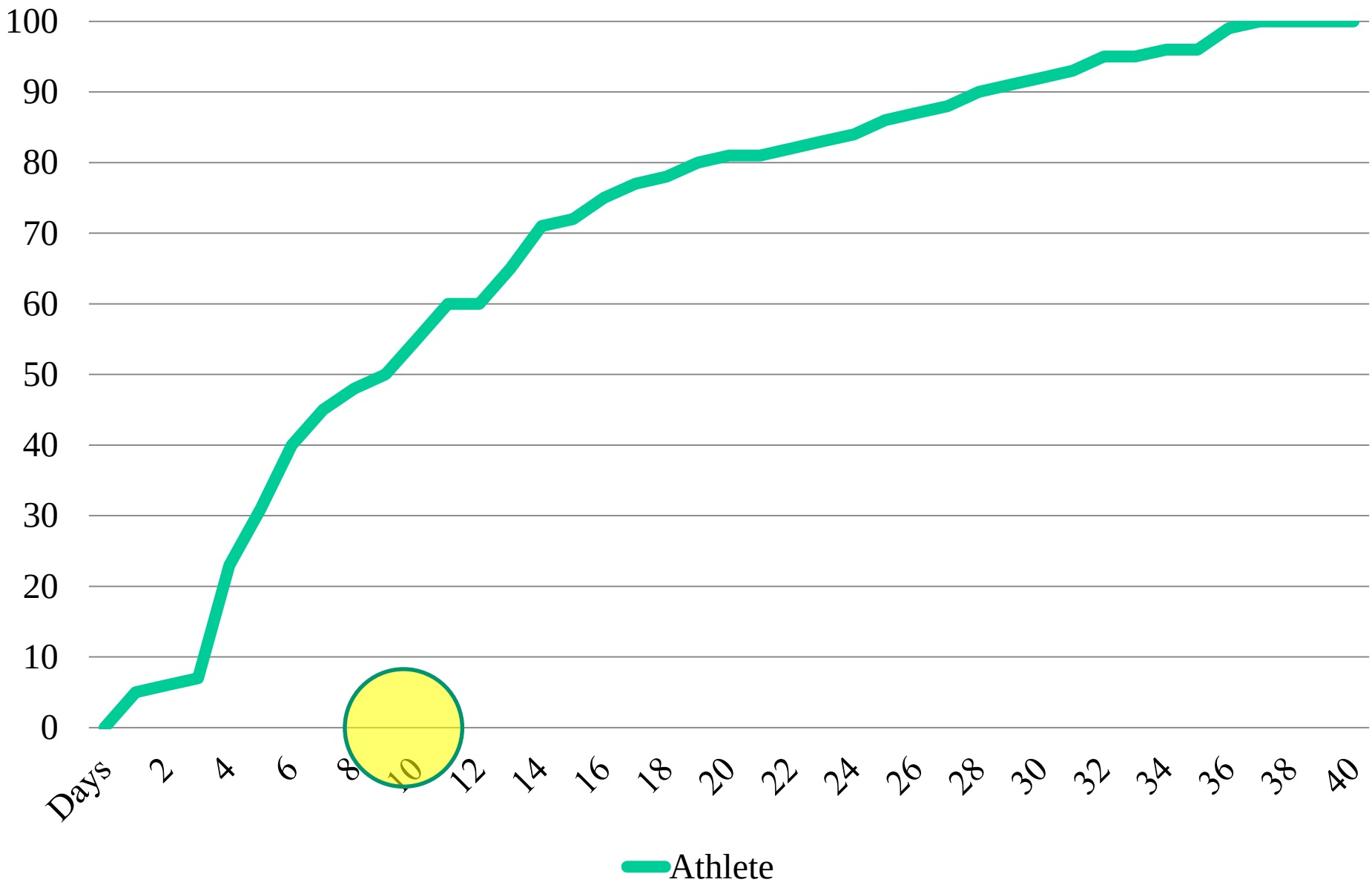
Concussion Management

- Post Acute
- Slow-to-Recover
- Persistent Post Concussion



"Off hand, I'd say you're suffering from an arrow through your head, but just to play it safe, I'm ordering a bunch of tests."

Athlete Concussion Recovery Time



Collins et. al., Neurosurgery 2006

Post Acute Management

1. Reduction in cognitive stimulation/ mental exertion in post acute period (1-5 days)
2. Decrease physical activity (1-5 days)
3. School accommodations

School & Home Considerations

Limit non-school activities requiring concentration, hand-eye coordination, rapid eye movements, or exposure to loud noise:

- Texting
- Video games
- Television
- Crowds
- Concerts

Concussion Management

Symptom management

- OTC analgesics for headache (naproxen, ibuprofen, acetaminophen)
  - Be careful about rebound headaches due to overuse
- Melatonin for sleep
- Omega-3 fatty acid? (off label)
  - 2-3 g during recovery
- Diet & hydration

Slow-to-recover patients

- > 2 weeks of minimal symptom improvement despite proper management strategies
- > 3-4 weeks of minimal symptom improvement with no or minimal treatment or poor management
  - *e.g. Post concussed athlete who has continued to play sport*

Chronic/Slow-to-Recover Management

Evaluate Risk Factors Associated With Delayed Recovery

- Previous history of concussion (especially recent)
  - If multiple concussions, did less force cause injury?
  - Time frame between injuries?
  - Any changes in symptom duration or severity?
- History of migraines or chronic headache?

Chronic/Slow-to-Recover Management

Risk Factors Cont…

- History of ADD or LD
- Psychiatric History
- Psychosocial Factors
  - High pre-morbid stress/anxiety
  - Pre-morbid mood disorder
  - Cognitive biases

Slow-to-recover patients

- Secondary gain
- Other health risk factors (hypertension, diabetes, etc)
- Cervicospinal or vestibular pathology
- Sleep
- Iatrogenic symptom provocation

Slow-to-recover patients

- Headaches
  - Refer to neurology
  - Abortive and prophylactic Rx
  - Carful with long term OTC use (>3-4 weeks)
  - Neuro/biofeedback
  - Rule out cervicospinal*
  - Sub-symptom threshold exercise*
  - Cognitive behavioral therapy (CBT)

* (refer to PT with appropriate training for postconcussion treatment)

Slow-to-recover patients

- Sleep
  - Address sleep hygiene
  - Limit daytime naps to no more than 1 hour
  - Melatonin
  - Phone App – *CBT-I Coach*
  - Rx (e.g. eszopiclone, zolpidem)
    - Be careful with benzo and other Rx with anticholinergic burden (e.g. diphenhydramine, amitriptyline)

Slow-to-recover patients

- Dizziness/Nausea, Exercise Intolerance/Autonomic Dysregulation
  - Evaluate for POTS/Orthostatic intolerance
  - Consider vestibular/occulomotor origin
  - Probiotic? (off label)
  - Ginger supplement (e.g. hard candy)
  - Physical Therapy
  - Neuro-vision evaluation

Slow-to-recover patients

- Psychological symptoms
  - Reassurance, natural course of recovery, normalize experience
  - CBT/ psychological counseling (refer to provider with knowledge about post concussion symptoms)
  - Antidepressant
  - Mindfulness and stress reduction
    - Phone App- *HeadSpace*

Slow-to-recover patients

- Cognitive Deficits
  - Refer for neuropsychological consultation
  - Cognitive Rehabilitation
  - Psychostimulant
  - Amantadine? (off label)

Is Rest Best?

- The brain needs complete rest for a prescribed time and you should work with your doctor and if there is a trainer of the team, work with them [sic]. This is about your brain so there is no cheating, your brain needs rest and time to heal. The best therapy is to SLEEP!

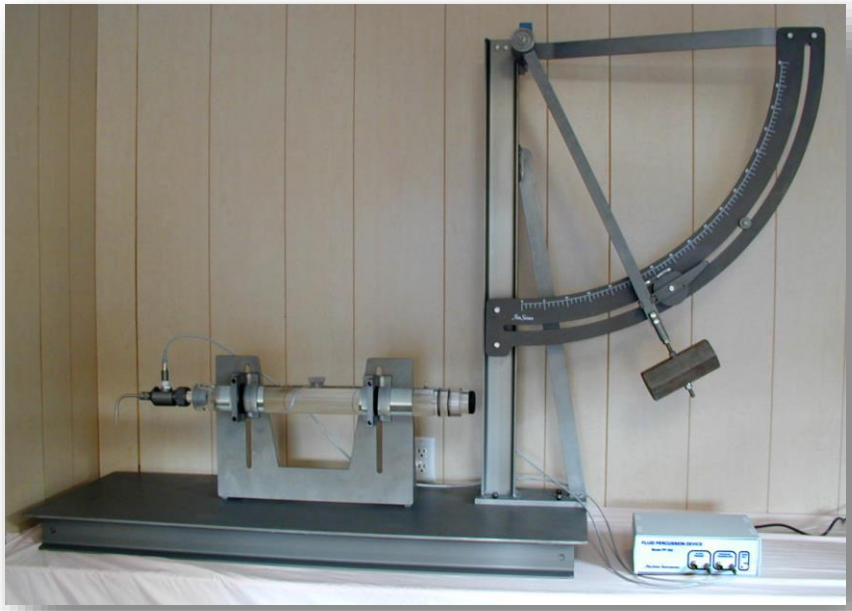
  – stopconcussions.com

Any problems with this advice?

1. No empirical support for these recommendations
2. Patients may interpret “rest” differently
3. How do we define asymptomatic status?
4. Is complete rest consistent with how we manage other injuries?
5. Are we contributing to iatrogenic symptoms?

GET MOVING!

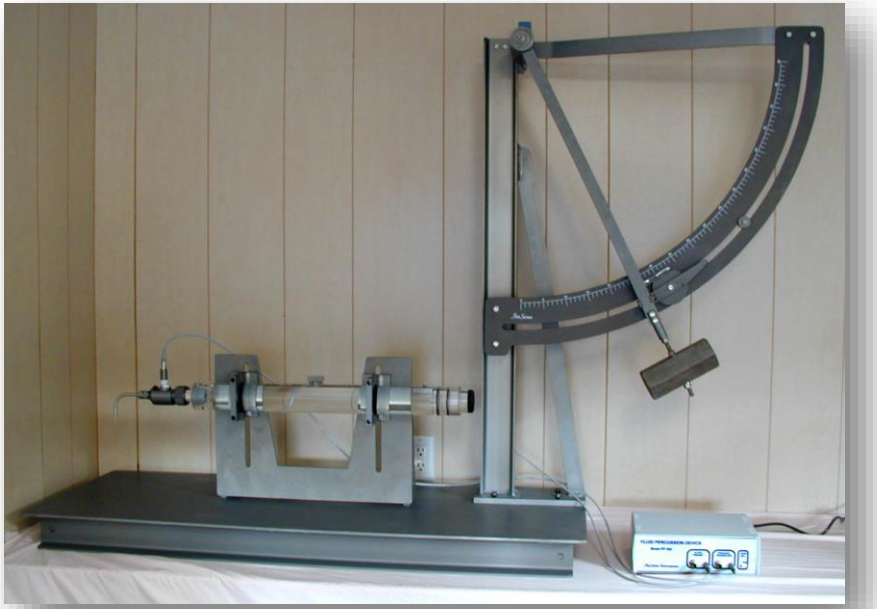
- Evaluated whether physical exercise in MTBI rats is supportive for recovery
- Exercise was encouraged in the acute (0-6 days), post acute (7-14 days) or delayed (14-20 days) periods
- BDNF one key outcome variables measured



Griesbach, Hovda, Molteni, Wu, Gomez-Pinella (2004). Voluntary Exercise Following Traumatic Brain Injury: Brain Derived Neurotrophic Factor Upregulation and Recovery of Function. Journal of Neuroscience, 125, 129-139

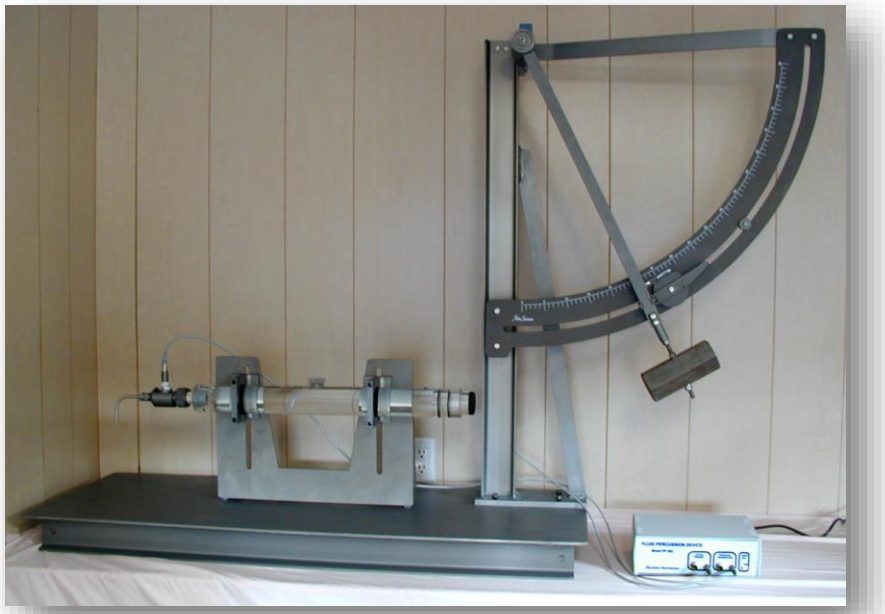
Study Conclusions

- Rats exercise day 0-6
  - No enhanced upregulation of BDNF
  - Showed decreased cognitive performance
  - Disruption of molecular response



Study Conclusions

- Rats exercise 7+ days PI
  - –Increased upregulation of BDNF
  - –Improved performance on cognitive activity
- Rats 14-20 day period
  - – Showed benefit but not as much as 7 day group



- Objective: To evaluate the safety and effectiveness of subsymptom threshold exercise training in treatment of PCS
  - 12 refractory PCS patients <6 weeks or >52 weeks PI
  - Mix of athletes and non-athletes
  - No control group

Leddy, et. al. (2010). A Preliminary Study of Subsymptom Threshold Exercise Training for Refractory Post-Concussion Syndrome. Clinical Journal of Sports Medicine. 20, 1, 21-27

- 5-6 days/week of treadmill training at 80% max. HR
- Significant reduction in overall symptom reporting
- All participants returned to pre-injury levels of activity within 6-10 weeks

Active Rehab Recommendations

1. An initial period of cognitive and physical rest appears to be helpful in the acute period
2. Type of rest is dependent on symptom level and tolerance
3. Duration of rest is variable but research and clinical experience support 3-7 days
4. Too much physical activity in the acute period post injury may increase symptoms and delay recovery (We don't know about cognitive activity)

Clinical Recommendations

5. Graded resumption of regular pre-injury activity (except sports) within the first few days to weeks post-injury appears to speed up recovery regardless of symptomatic status
6. Delaying graded return to activity beyond a month may worsen outcome
7. Sub-symptom threshold exercise appears to aid recovery after acute period

Silverberg & Iverson, Journal of Head Trauma Rehabilitation, 2012

Post Concussion Syndrome

Symptom	ICD-10[33]	DSM-IV[30]
Headache	✓	✓
Dizziness	✓	✓
Fatigue	✓	✓
Irritability	✓	✓
Sleep problems	✓	✓
Concentration problems	✓	-
Memory problems	✓	-
Problems tolerating stress/emotion/alcohol	✓	-
Affect changes, anxiety, or depression	-	✓
Changes in personality	-	✓
Apathy	-	✓

- At least 3 symptoms
- ICD 10 = Symptom duration >4 weeks
- DSM IV = Symptom duration >90 days

Post Concussion Syndrome

Questions To Consider

What is the true incidence of PCS?

Are all individuals with PCS truly experiencing persistent sequelae from a brain injury?

How do pre-injury factors impact post injury recovery?

Considering Psychosocial Influence of PCS

- **What causes disability in PCS?**
  - Neurological symptoms (headache, dizziness, etc.)
  - Changes in personality (irritability, low frustration tolerance, etc.)
  - Physical symptoms (sleep disruption, fatigue, pain)
  - Psychological (depression, anxiety)

Psychosocial Factors As A Risk for PCS

Cognitive Bias

- Concussion sufferers may underestimate pre-concussion symptoms and overestimate functioning ("Good Old Days")

	Pre-Injury mTBI	Controls
Dizziness	3.3%	17.5%
Temper problems	5.6%	23.7%
Poor concentration	2.2%	27.1%
Memory problems	2.2%	23.7%
Difficulty reading	2.2%	16.45

Lange, R. T., Iverson, G. L., & Rose, A. (2010). Post-concussion Symptom Reporting and the "Good-Old-Days" Bias Following Mild Traumatic Brain Injury. *Archives of Clinical Neuropsychology,25*(5), 442-450. doi:10.1093/arclin/acq031

Psychosocial Factors As A Risk for PCS

Cognitive Bias

- Belief that concussion will lead to lifelong disability (expectancy bias)
  - Especially prevalent with sensationalized media coverage
  - Belief is facilitated by ill-informed medical providers
- Any non-specific symptom or cognitive error is attributed to PCS (attribution bias)
  - Can result in anxiety/symptom negative feedback loop

Psychosocial Factors As A Risk for PCS

Psychological Factors

- Pre injury history of depression, anxiety and neuroticism are better predictors of PC symptoms than post injury cognitive impairments
- Concussion as a precipitating event (diathesis)
- Poor home/social support system

Psychosocial Factors As A Risk for PCS

Post Injury Psychological Factors

- Increased isolation and loss of social support (e.g. sports team, school changes)
- Loss of identity (student athlete)
- Emotional factors related to pain and fatigue (e.g. chronic headache, sleep disruption)
- Changes in cortical and limbic pathways after MTBI (Mallya, et. al., 2015) (Chen et. al., 2008).
  - Neurobiological basis for anxiety and depression after TBI

Is It PCS or Psychiatric?

PCS Symptoms

- Headache
- Fatigue
- Increased emotionality
- Sadness
- Sleep difficulties
- Loss of appetite
- Concentration difficulties

DSM IV- Depression

- Fatigue
- Sleep disturbances
- Changes in appetite
- Depressed mood
- Diminished ability to think or concentrate
- Somatic symptoms

Psychosocial Factors As A Risk for PCS

Other External Factors

- Motivation/suboptimal effort – Low resiliency, learned helplessness ("Why even try?")
- Secondary gain – Concussion becomes excuse for individual to opt out of current life stressors
- Malingering – Feigning of symptoms for monetary or material benefit (e.g. personal injury claim)

Psychosocial Factors As A Risk for PCS

Other External Factors

- Iatrogenic Symptom Maintenance
  - Overemphasis on medically prescribed rest
  - Contraindicated or poorly monitored use of medication
    - e.g. benzodiazepines, opioids
  - Poor collaboration or lack of access to medical specialists
    - e.g. neuropsychology, neurology, physical therapy, neuro-ophthalmology
  - Poor information regarding the natural history of the condition

True Incidence of PCS?

What percentage of patients with concussion go on to develop PCS symptoms that last for more than one year?

1. 50-75%
2. 0.0%
3. 10-20%
4. I have no idea

Post Concussion Syndrome At 1 yr. Post Injury

Who are the 15%?

- Alexander (1995 Neurology) Review Article – "at one year after injury, approximately 15% of MTBI patients still have disabling symptoms"
- This percentage is referenced in multiple studies, internet sources and even in CDC educational material
- Alexander cites two sources: Rutherford 1979 & McLean 1983

McCrea, M. (2008). *Mild traumatic brain injury and postconcussion syndrome: The new evidence base for diagnosis and treatment*. Oxford: Oxford University Press.

Post Concussion Syndrome At 1 year Post Injury

Rutherford et. al., 1979

- 145 MTBI cases admitted to hospital in Belfast
- 131 followed up at one year – 19 still reporting symptoms (14.5%)
- 8/19 involved in lawsuit
- 6/19 showed evidence of malingering at 6 weeks PI
- 10/19 reporting at least one new symptom not endorsed 6 weeks PI
- Age not related to symptom duration, but gender was
- No controls

Post Concussion Syndrome At 1 year Post Injury

McLean et. al., 1983

- Patients with TBI (11 mild, 8 mod., 1 severe) N = 20
- Controls N= 52, non-injured friends of patients
- Groups compared on cognitive scores and symptom checklist at 3 days and 1 month post injury
- No differences in cognitive scores, but more symptoms in patient group at 1 month

Post Concussion Syndrome

World Health Organization (2004)

- 120 “best evidence” studies on MTBI prognosis
- Conclusions
  - –Symptoms are temporary in MTBI
  - –Sound evidence for favorable prognosis
  - –Overwhelming majority of kids and adults will recover within days to weeks
  - –Little evidence of residual cognitive, behavioral, or academic deficits
  - –Persistent symptoms may be attributable to other non-injury factors (demographics, psych., medical, secondary gain)

Holm, L., Cassidy, J., Carroll, L., & Borg, J. (2005). Summary of the WHO collaborating centre for neurotrauma task force on mild traumatic brain injury. *Journal of Rehabilitation Medicine,* 137-141.

How Do We Treat PCS?

- See Treatment recs for slow-to-recover patient
- Target treatments specific to complaints
  - e.g. psych, headache, vestibular, vasomotor, etc.
- When possible, use supervised sub-symptom exercise
- Educate patient on concussion recovery and treatment protocols

Case Follow-Up: 19-year-old female

"My Take"

- "Get back in to life"
- Graduated exercise plan
- Graduated return-to-learn (CC classes)
- Increase socialization
- Patient followed up in 2 weeks "feeling much better"
- Was back at mostly all pre-injury levels of activity within a month
- Re-enrolled in school the following semester

Thank You!

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