Physical and Psychological Factors in Persistent Concussion Symptoms

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Elizabeth Pieroth, PsyD, ABPP
Board Certified Neuropsychologist
Associate Director
NorthShore Sports Concussion Program

NorthShore University HealthSystem

Disclosures for Dr. Pieroth:

Consult to (no personal income derived):
Chicago Bears
Chicago Blackhawks
Rockford IceHogs
Chicago White Sox
Chicago Fire
National Womens Soccer League

Volunteer consultation to:
Brain Injury Association of Illinois Board of Directors
National Advisory Board, US Football Heads Up Football Committee
US Soccer Concussion Task Force
Amateur Hockey Association of IL Safety Committee
NFL Head, Neck and Spine Committee

Objectives

1. Review prevalence of concussion symptoms, even in non-patients.
2. Provide overview of the causes of persistent symptoms in concussion patients.
3. Discuss referrals for appropriate treatments.

Keep in mind…

- Concussion symptoms are nonspecific and happen frequently in the non-injured population.
- There are no pathognomonic symptoms of concussion. Pathognomonic signs?
- That's why it can be hard to diagnose a concussion!

Prevalence of Post-Concussion Symptoms in Healthy Individuals

- 109 healthy individuals
- Specific endorsement rates of concussion-like symptoms ranged from 35.9% to 75.7% for any experience of the symptoms in the past 2 weeks
- 2.9% to 15.5% for the experience of more severe symptoms.
- Symptoms reported showed a moderately high correlation with self-reported depressive symptoms

Iverson & Lange App Neuropsychol 2003

Prevalence of Post-Concussion Symptoms in Healthy Individuals

Table 1
Description of postconcussion-like symptoms endorsed by the healthy college students

Symptoms	Severity					Total positive (%)
	0	1	2	3	4	
Fatigue	23.1	38.8	24.8	9.9	3.3	76.9
Longer time to think	39.7	33.9	17.4	8.3	.8	60.3
Poor concentration	41.3	28.1	21.5	8.3	.8	58.7
Sleep disturbance	49.6	27.3	14.0	5.8	3.3	50.4
Frustration	53.7	26.4	12.4	6.6	.8	46.3
Forgetfulness	54.5	28.1	12.4	5.0	.0	45.5
Irritable	57.9	24.0	14.0	4.1	.0	42.1
Depressed and tearful	62.8	24.0	9.1	4.1	.0	37.2
Headache	64.5	25.6	8.3	1.7	.0	35.5
Noise sensitivity	66.1	17.4	12.4	3.3	.8	33.9
Dizziness	67.8	23.1	7.4	1.7	.0	32.2
Blurred vision	71.9	17.4	7.4	2.5	.8	28.1
Restlessness	73.6	16.5	7.4	.8	1.7	26.4
Light sensitivity	79.3	14.9	4.1	1.7	.0	20.7
Nausea and/or vomiting	85.1	10.7	4.1	.0	.0	14.9
Double vision	91.7	5.8	2.5	.0	.0	8.3

RPQ: Rivermead Post-Concussion Questionnaire. $N = 124$. Severity rating: 0 = not experienced at all, 1 = no more of a problem, 2 = a mild problem, 3 = a moderate problem, and 4 = a severe problem.

Prevalence of Post-Concussion Symptoms in Healthy Individuals

- 31,958 high school athletes
- 19% of boys and 28% of girls reported a symptom burden consistent with an ICD-10 diagnosis of Postconcussion syndrome
- Students with preexisting condition even more likely: 21-47% boys, 33-72% girls
- Prior psychiatric condition was the strongest predictor followed by history of migraine and ADHD

(Iverson JAMA Pediatr 2015)

Concussion-like Symptoms with ADHD

In large study (N=39,247) students with ADHD (both medicated and non-medicated students) reported more symptoms on baseline testing than controls.

(Cook et al, 2017)

When are the constellation of symptoms NOT a concussion?

- Dehydration
- Cervical strain
- Chest/abdominal trauma
- Weight cutting
- Anxiety/psychological reaction to stressors or to the trauma itself
- Migraine
  - Exercise-induced migraine
  - Traumatically-induced migraine

Postconcussion Syndrome

“Postconcussion Syndrome” is typically reserved for individuals who continue to demonstrate symptoms attributable to concussion >3 months out from injury.

Others use >1 month as benchmark.

PCS is a complex pathophysiologic and psychological process.

PCS Symptoms are Non-specific

Non-patients have "PCS" symptoms:

Visual problems 40%	Balance 14%
Headaches 58%	Dizziness/vertigo 22%
Light sensitivity 30%	Word finding 47%
Poor concentration 35%	Forgetful 47%
Temper outbursts 30%	Anxiety 60%
Depression 33%	

(Paniak et al, 2002)

Postconcussion Syndrome

- "PCS criteria can be met after trauma whether or not the brain in injured.

  (Boake et al, 2005)

- mTBI did not predict presence of PCS 3 months after injury.

  (Meares et al, 2008)

Duration of Symptoms

Most concussions take 7-14 days for full recovery of symptoms

Modifying factors for recovery:

- Genetic basis
- Age (youth & elderly make take a little longer)
- Migraine
- ADHD/LD
- Depression/anxiety
- Chronic pain
- History of prolonged recovery from concussion*
- Females appear to also take longer*

But what is “true” recovery?

One study looked at a number of physiological measures

- Functional MRI
- Diffusion Tension Imaging (DTI)
- Magnetic Resonance Spectroscopy (MRS)
- Cerebral blood flow
- Electrophysiology
- Heart rate
- Exercise tolerance
- Fluid biomarkers
- Transcranial Magnetic Stimulation

(Kamins et al, 2017)

Authors concluded: “It is not possible to define a single ‘physiological time window’ sports-related concussion recovery.”

So….

“Multiple studies suggest physiologic dysfunction may outlast current clinical measures of recovery, supporting a buffer zone of graduate increasing activity before full contact risk.”

(Kamins et al, 2017)

Etiology of Persistent Symptoms

"The Big 5"

- Cervical
- Vestibular
- Ocular-motor
- Migraine
- Psychological

"Red Flags" for Cervical Issues

- Headaches are often (but not always) constant
- Often complain of waking with a headache
- Pain is often in the back of the head or on the side (unilateral headache pain can be misattributed as evidence of migraine)
- Aggravated by physical activity (e.g., walking/ stationary bicycle versus running)
- Patient has complaints of continued neck pain/ tightness/discomfort

Vestibular Dysfunction

Self-report of balance disturbance does not corroborate with objective measures. One-month post-concussion balance disturbance was found, even in athletes who denied imbalance.

(Rochefort et al, 2017)

Vestibular assessment is particularly important in complicated mTBI

(Julien et al, 2017)

"Red Flags" for Vestibular Dysfunction

- Continued complaints of imbalance or dizziness (rule-out BPPV)
- Headaches tend to (but not always) come/go
- Headaches triggered by ocular activity, such as reading, computer/phone use, moving eyes up/down in class, visually busy environment, riding in the car
- Sense of nausea/motion sickness with movement
- Often headaches are behind the eyes or forehead

Oculomotor Dysfunction

After a concussions, adolescents with convergence deficits exhibited significant gait-related deficits compared to healthy controls. Those with normal convergence did not.

(Howell et al, 2017)

Oculomotor assessments, particular convergence and optokinetic stimulation, improved concussion assessment.

(McDevitt et al, 2016)

Migraine

Sometimes persistent headaches are actually migraines headaches.

- Unilateral headaches
- Associated symptoms, such as nausea, photosensitivity, visual changes,
- No clear pattern/ triggers for headaches
- Family history of migraines

Other contributing factors to consider:

- Pain
- Sleep disturbances
- Medication side effects
- Anxiety/depression
- Malingering
- Factitious Disorder/Somatoform Disorder
- Adolescence!

"The brain controls everything but a brain injury doesn't cause everything."

Pain

- Pain is distracting!
- Are we distinguishing between cognitive complaints secondary to concussion versus pain?
- Chronic pain significantly impacts the athlete.

Chronic headache pain

After 3 months, no differences in headache rates between concussed sample and orthopedic controls

(Stovner et al., 2009, Meares et al., 2011)

Sleep Disturbance

- Sleep impacts baseline cognitive testing

  (McClure, et al, 2014)

- Preinjury sleep difficulty may exacerbate cognitive symptoms post-injury

  (Sufrinko et al, 2015)

- No difference in sleep quality on between concussion patients and controls

  (Gosselin et al, 2009)

Sleep Disturbance

Students without a full night of sleep reported more headache, fatigue, irritability, impaired sleep and feeling slowed down. Irritability scores tripled!

“Take home message: An athlete who sleeps 6.5 hours or less per night may report more concussion-related symptoms than when getting a good night’s sleep.”

(Beebe et al, 2017)

Sleep Disturbance

Our students can be chronically sleep deprived.

*This impacts both baseline and post-injury cognitive testing.

After 1-2 days post-injury, no more naps.

After a concussion, we need to make sure we are talking about sleep hygiene issues!

Pre-injury Psychiatric History

Cnosson et al (2017) found the strongest predictors of six-month post-concussive symptoms were:

- Years of education
- Pre-injury psychiatric disorders
- Prior TBI*

*The issues regarding history of previous TBI are very complex.

Pre-injury Psychiatric History

Athletes with a history of preseason anxiety were at an increased risk of injury (not just concussions) during the season. The risk was even higher if the athlete also had symptoms of depression.

(Hongmei et al, 2017)

Depression, anxiety, poor sleep, stress and medication overuse are potential factors for poor prognosis in chronic headaches.

(Probyn et al, 2017)

Pre-injury Psychiatric History

Strongest predictor for persistent PCS symptoms three months post-injury was pre-injury physical or psychiatric condition, not TBI (trauma controls)

(Ponsford et al, 2012)

"In contrast to the neurological measures, the presence of self-reported depressive symptoms following mTBI was significantly associated with postconcussive symptoms and functional impairment across visits."

(Dikman et al, 2010)

Pre-injury Psychiatric History

53% of a group with depression met conservative criteria for PCS (3 or more symptoms at a moderate or greater level) and 89% met liberal criteria (Iverson 2006)

Post-injury Affective Disturbance

Individuals with anxiety and depression after the concussion have statistically significant higher rates of acute post-traumatic headaches and chronic post-traumatic headaches.

(Yilmaz et al, 2017)

"Whether they had a TBI or not, all (anxiety) patients presented with PCS, headaches, sleep and mood complaints."

(Julien et al, 2017)

Malingering/Factitious Disorder

Malingering-

The purposeful feigning or exaggeration of symptoms for monetary gain.

Factitious Disorder-

The purposeful feigning or exaggeration of symptoms for psychological reasons.

Malingering

Malingering is well-known issue to be addressed in adult populations.

Even in pediatric samples, evidence of feigning or exaggeration of cognitive symptoms after concussion is not uncommon.

(Kirkwood et al 2012; Kirkwood, et al 2014)

Are individual clinicians do enough to assess poor effort?

Factitious Disorder

- What are the “secondary gains”, family issues, psychosocial stressors?
- ATCs are in the best position to help sort out some of these issues!
- Somatoform disorders- Are we setting up kids with recommendations for “complete rest”?

Persistent Cognitive Complaints

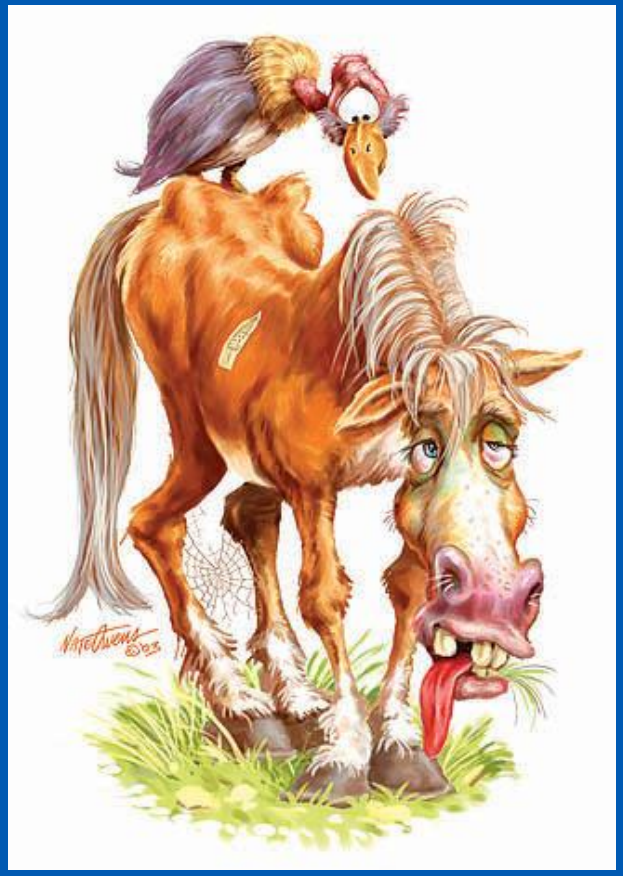
Meta-analytic data indicate:

- Mild-to-moderate neuropsychological impairment within 24 hours across domains, with large effect sizes in global functioning (d = 1.42), memory acquisition (d = 1.03), and delayed memory (d = 1.00).
- Cognitive effect is essentially zero beyond 7-10 days

(Belanger and Vanderploeg , 2005)

So why so many complaints of persistent cognitive changes?

“Cognitive Horsepower”



But please remember…

1. Concussion is a brain injury and we take all brain injuries seriously.
2. Saying a symptom may not be neurologic is not stating the patient did not have a concussion.
3. Saying a symptom may not be neurologic is not be dismissive of the seriousness of a brain injury!
4. Finding the cause of their symptoms is the goal that we all share.

Rest

"There is insufficient evidence that prescribing complete rest achieves these objectives. After a brief period of rest during the *acute phase (24-48 hours)* after injury, patients can be encouraged to become gradually and progressively more active while staying below their cognitive and physical symptom-exacerbation…. The exact amount and duration of rest is not yet well defined in the literature and requires further study."

(McCrory et al, 2017)

Recommendations in the Acute Phase

- Reducing activity, this does not mean complete rest or isolation
- No need for “dark rooms” unless person has significant photosensitivity
- Use of electronics should be reduced, if use causes symptom to increase
- Gradual increase in activity, as tolerated
- Don’t engage in activity that risks contact to the head
- Concussion should not be a punishment!

When to refer to a specialist:

- Unclear diagnosis
- History of prolonged recovery
- History of multiple concussions or high exposure
- If parents or patient have many questions
- If there are questions about retirement from a sport
- If there are sports specific questions that their PCP cannot answer
- If the PCP lacks experience with concussions

Thank you!

epieroth@northshore.org
@DrEPieroth