

Concussion: the basics

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Outline

- Concussions
 - Brief history
 - Definition
 - Pathophysiology
 - Signs and symptoms
- Management
 - Acute
 - Clinical evaluation
 - Behavioral Management
- Risk Factors
 - Post-traumatic and premorbid
- When to ask for help


A brief history of concussion

The timeline shows the evolution of concussion understanding from ancient times to the present. Key milestones include: 3000 bce (ancient warfare), 415 bce (Hippocrates), 1600s (1700s-1800s) (scientific studies), 20th century (modern research), 1700 bce (ancient medicine), 1st century (Hippocrates), 1700s-1800s (scientific studies), and present (modern research).

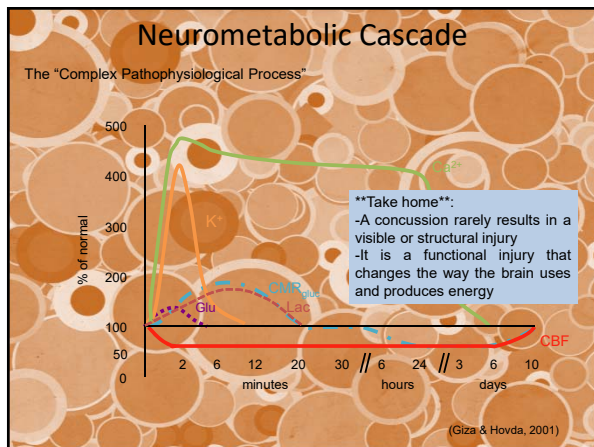
What is a concussion?

According to the CDC:

- A **complex pathophysiological process affecting the brain**, induced by traumatic biomechanical forces secondary to direct or indirect forces to the head. Disturbance of brain function is related to **neurometabolic dysfunction**, rather than structural brain injury, and is typically associated with normal structural imaging findings (CT Scan, MRI).

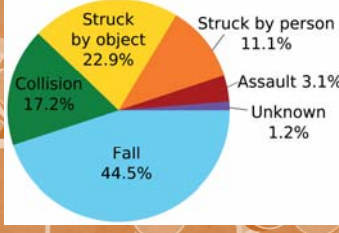


- Concussion may or may not involve a loss of consciousness.
- Concussion results in a constellation of physical, cognitive, emotional, and sleep-related symptoms.** Recovery is a sequential process and symptoms may last from several minutes to days, weeks, months, or even longer in some cases.



What is a concussion?

- Epidemiology**
 - 100-300/100,000 worldwide based on ER admissions only
 - Total estimates are 600/100,000
 - Holm et al., 2005
 - More likely in those who have already been concussed*
 - Quigley, 1945; Thorndike, 1952



Kozlowski et al., 2007

Signs

- Immediate markers (signs)
 - Loss of Consciousness
 - Retrograde Amnesia
 - Anterograde Amnesia
 - Disorientation/ Confusion



Symptoms

Factor Analysis, Post-Concussion Symptom Scale (Kontos et al., 2012; Pardini et al. 2004)

NEUROPSYCHIATRIC

- Increased lability
- Sadness
- Nervousness/Anxiety
- Irritability

MIGRAINE (PHYSICAL SX)

- Headaches
- Visual Problems
- Dizziness
- Noise/Light Sensitivity
- Nausea

COGNITIVE SYMPTOMS

- Attention Problems
- Memory dysfunction
- "Fogginess"
- Fatigue
- Cognitive slowing

SLEEP DISTURBANCE

- Difficulty falling asleep
- Sleeping less than usual

N=15,000 High School and University Athletes within 24-72 hours of concussion
 N=327, High School and University Athletes Within 7 Days of Concussion

Commonly Reported Symptoms

High School and College Athletes (within 3 days of injury)

#1	Headache	71%
#2	Feeling Slowed Down	58%
#3	Difficulty concentrating	57%
#4	Dizziness	55%
#5	Fogginess	53%
#6	Fatigue	50%
#7	Visual Changes (double/blurring)	49%
#8	Light Sensitivity	47%
#9	Memory Dysfunction	43%
#10	Balance Problems	43%

Lovell, Collins et al., 2004, N = 215

Why should a mental health practitioner care?

- Summary of Mental Health Sequelae of TBI
 - Patients with TBI have higher rates of depression, substance abuse, aggression, and impulsivity prior to injury.
 - TBI associated with 2-4 increased risk for suicide attempts, suicide, and psychiatric disorder
 - Highest risk for suicide and attempt in those with both TBI and psychiatric disorder
 - Role of worthlessness, hopelessness, belonging, support, perception of functional impairment
 - Inter-relationship of sleep, HA, depression, PTSD, and suicidality
 - Multiple concussions increase risk for depression and suicidality
 - Associated with neurocognitive impairment in memory, executive function, inhibition

Why should a mental health practitioner care?

- mTBI + adolescence = the perfect storm?
 - **Distress:** headache, depression, reaction to school difficulties, and loss of activity
 - **Disinhibition:** difficulty with prefrontal cortical activity to inhibition action, negative emotion
 - **Development:** On top of developmentally immature brain with increase drive for reward relative to capacity to inhibit

Why should a mental health practitioner care?

- Long term...
 - CTE diagnostic criteria now include suicide and suicidality as core diagnostic features

Now What?

HOW TO HELP THE CONCUSSED ADOLESCENT

Concussion Management

- *Most aware of negative effect of premature physical exertion, but fewer are aware of problems that cognitive exertion can cause*
- Cognitive Exertion (Thinking) and the added stimulation of the school environment can significantly increase symptoms throughout recovery
- Research has demonstrated generalized hyperactivation with concussion that is likely related to symptom increases when returning to school
- Obvious Means: testing, group work, movies, shop class, overhead lighting
- Subtle Causes: background noise (cafeteria, movement during and between classes), taking notes (especially off of a projector), sustained attention
- Psychosocial Stressors: relationships with peers, teachers; pressure to perform

Symptom Evaluation/Clinical Interview: What is Asymptomatic?

- NEUROPSYCHIATRIC**
 - Increased lability
 - Sadness
 - Nervousness/Anxiety
 - Irritability
- MIGRAINE (PHYSICAL SX)**
 - Headaches
 - Visual Problems
 - Dizziness
 - Noise/Light Sensitivity
 - Nausea
- COGNITIVE SYMPTOMS**
 - Attention Problems
 - Memory dysfunction
 - "Fogginess"
 - Fatigue
 - Cognitive slowing
- SLEEP DISTURBANCE**
 - Difficulty falling asleep
 - Sleeping less than usual

Concussion Management

The old mentality:

- Rest is the best treatment
 - Symptom provocation is a sign of continued impairment
 - Symptoms are treated with rest:
 - Physical: complete rest
 - Cognitive: no/minimal school

Why the change?

- Rest seems to work initially (first 3-5 days) post-injury
 - The effects thereafter plateau
 - Patients with *either* very low or very high levels of activity have more persistent symptoms
 - Majerske et al., 2008
 - Total rest is actually harmful
 - de Kruijk et al., 2002
 - Allen et al., 1999

Concussion Management

- Symptom Management
 - Symptoms are a part of recovery
 - Managing symptoms is crucial to recovery
 - When is it okay to push and when is it time to rest?
 - Using a pain scale

Concussion Management

- Over-stimulation has the most profound effect in the acute-subacute post-injury phase
- Little/No stimulation does not bode well for neuropsychological recovery either
- Balance between symptom provocation and rest is difficult, but necessary

Concussion Management

Treatment Model

- What treatments work in other pathologies?
 - Graded exposure works
 - Anxiety
 - Chronic pain
 - Migraine
 - Approach-Confront strategies are effective in symptom management and treatment
 - Martin, 2010

In mTBI?

- The research is limited, but...
 - Modified CBT protocols works in chronic cases (adult samples)
 - Potter & Brown, 2012
 - Ferguson & Mittenberg, 1996
 - Miller & Mittenberg, 1998
 - Leonard & Tucker, 2004
 - Physical activity is also beneficial
 - Silverberg & Iverson, 2012
 - Iverson et al., 2012
 - Leddy et al., 2012

Concussion Management

1. Regular sleep patterns
2. Regular Diet
3. Regular Hydration
4. Physical Exercise
5. Stress Management

Increased stress
Lack of exercise
Poor diet
Dysregulated sleep
Dehydration
Concussion


Migraine Threshold
Personal history of headaches/migraines
Family history of headaches/migraines
No Headaches

Influencing recovery:

RISK FACTORS


Risk Factors: Incidence

- Injury History
 - The single largest factor in recovery and future incidence
 - Those with prior injuries are more like to be injured in the future
 - Lowered threshold?
 - Personality factors?




Risk Factors: Incidence

- Gender
 - Females are more likely to sustain injuries when looking at equivalent activities
 - Males sustain more head injuries overall
 - Risk taking behaviors
 - Sports



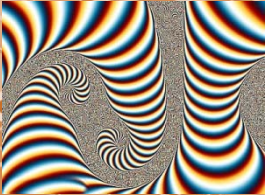
Risk Factors: Incidence

- Age
 - More common in males, teenagers and young adults
 - Children and adolescents make up a larger portion of ER visits
 - Ultimately, the data is inconclusive



Risk Factors: Prolonged Recovery

- Signs/Symptoms
 - Post-traumatic amnesia
 - On field dizziness
 - Subacute “fogginess”
 - Initial impaired neurocognitive performance
 - More severe symptom report
 - LoC is *not* predictive of prolonged recovery



Risk Factors: Prolonged Recovery

- Premorbid Conditions
 - Migraines
 - High overlap between
 - Gordon et al., 2006
 - ADHD/Learning Disability
 - Alosco et al., 2014
 - Hutchinson et al., 2014
 - Depression/Anxiety
 - Hutchinson et al., 2014
- Demographic Factors
 - Age
 - Younger take longer
 - Gender
 - Females take longer

Involving other disciplines:

WHEN TO ASK FOR HELP


Coordinating Care

- Not every patient recovers with time and proper management alone
- Depending on the presenting symptoms, consider adjunct therapies
 - Medications
 - Physical Therapies
 - Psychotherapy



Coordinating Care

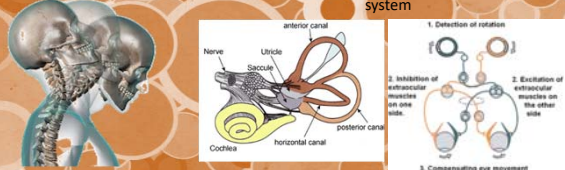
- Medication
 - Useful in addressing
 - Chronic headache
 - Fatigue
 - Insomnia
 - Mood & Anxiety
 - Cognitive issues
 - Typically mostly used for brief periods
 - Maximizing the effort
 - Medications affecting change in multiple systems



Coordinating Care

- Physical Therapy
 - Consider musculoskeletal PT where neck and back pain are presenting problems
 - can be addressed within days post injury

- Vestibular Therapy
 - Consider this where dizziness-imbalance & mental fogginess are persistent
 - Deficits may be to central or peripheral vestibular system



Coordinating Care

- Psychotherapy
 - Changes in mood/anxiety may be
 - Premorbid
 - Direct result of the injury
 - Resulting from psychosocial factors that may or may not be related to the injury
 - Discuss with patient his/her primary symptoms
 - What to expect
 - Who to involve
 - Do not ignore the psychosocial factors
 - Symptoms are rarely exclusive to a single cluster
 - Create/foster a supportive environment

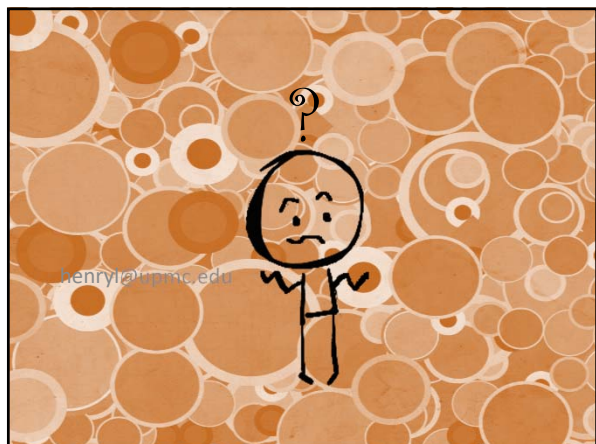


Summary

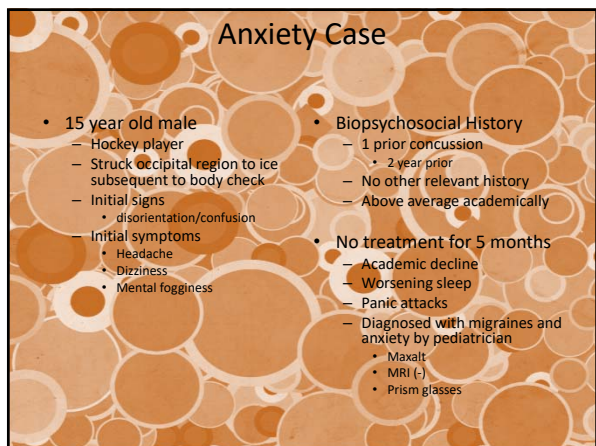
- Concussions are a neurometabolic injury
 - Energy production and use is impaired
- Presentation and intensity varies
 - HUGE individual differences
 - Incidence and Recovery times are influenced by several factors
- Balance between rest and exposure
 - Over- *and* under-stimulation can be harmful
- In cases of protracted recovery, coordinating care across professionals is necessary

Concussion Resources: CDC Tool Kit

- Three kits with information for physicians, parents, and coaches
- Information on High School and Youth Management of Concussion
- Link to order tool kit:
<http://wwwn.cdc.gov/pubs/ncipc.aspx>







Anxiety Case

- Presenting Symptoms
 - Headache
 - Photo/phonosensitivity
 - Blurred vision
 - Nausea
 - Numbness & tingling
 - Mentally foggy
 - Memory & attention dysfunction
 - Anxious
 - Mood symptoms
- Treatment Recommendations
 - Homebound instruction
 - Vestibular and Vision Therapies
 - Referred for medications
 - Behavioral management
 - Sleep was much improved

Composite Scores	Percentile scores	
Memory composite (verbal)	74	22%
Memory composite (visual)	77	57%
Visual motor speed composite	42.22	85%
Reaction time composite	0.5	92%
Impulse control composite	12	
Total Symptom Score	52	

- Vestibular exam was highly provocative for symptoms
- Near point convergence measured at 29 cm

Anxiety Case

Follow-up #1

- Presenting Symptoms
 - Headache
 - Photo/phonosensitivity
 - Dizziness
 - Dysregulated sleep
 - Difficulty falling and staying asleep
 - Memory & attention dysfunction
 - Anxiety
 - Poor mood
- Treatment Recommendations
 - Return to school
 - Modified schedule
 - Continue vestibular therapy
 - Placed on Klonopin & Zoloft
 - Light physical activity

Composite Scores	Percentile scores if available are listed			
Memory composite (verbal)	74	22%	78	32%
Memory composite (visual)	77	57%	76	54%
Visual motor speed composite	42.22	85%	42.35	85%
Reaction time composite	0.5	92%	0.52	87%
Impulse control composite	12		5	
Total Symptom Score	52		62	

- Vestibular exam was still provocative for symptoms
- Near point convergence measured at 12 cm

Anxiety Case

Follow-up #2

- Presenting Symptoms
 - Headache
 - Photo/phonosensitivity
 - Dizziness
 - Numbness & tingling
 - Memory & attention dysfunction
 - Anxiety
 - Mood
 - **symptoms reduced with physical activity
- Treatment Recommendations
 - Continued modified school schedule
 - Discharged from vestibular therapy
 - PT's progress notes indicated large functional gains despite symptom report
 - Increase physical activity
 - Psychotherapy

Composite Scores	Percentile scores if available are listed in small type					
Memory composite (verbal)	74	22%	78	32%	91	80%
Memory composite (visual)	77	57%	76	54%	78	60%
Visual motor speed composite	42.22	85%	42.35	85%	43.43	88%
Reaction time composite	0.5	92%	0.52	87%	0.51	90%
Impulse control composite	12		5		9	
Total Symptom Score	52		62		58	

- Vestibular exam was mildly provocative for symptoms
- Near point convergence measured at 6 cm

Anxiety Case

Follow-up #3

- Presenting Symptoms
 - Headache
 - Photo/phonosensitivity
 - Dizziness
 - Numbness & tingling
 - Memory & attention dysfunction
 - Anxiety
 - * Hypervigilance, ruminating
 - Mood
- Treatment Recommendations
 - Continued modified schedule
 - * Extremely resistant to full return
 - Finish Vestibular Therapy
 - Increase physical activity
 - Psychotherapy

Composite Scores	Percentile scores if available are listed in small type							
Memory composite (verbal)	74	22%	78	32%	91	80%	74	22%
Memory composite (visual)	77	57%	76	54%	78	60%	83	75%
Visual motor speed composite	42.22	85%	42.35	85%	43.43	88%	48.8	99%
Reaction time composite	0.5	92%	0.52	87%	0.51	90%	0.46	98%
Impulse control composite	12		5		9		8	
Total Symptom Score	52		62		58		56	

Anxiety Case

Follow-up #4

- Presenting Symptoms
 - Headache
 - Photo/phonosensitivity
 - Dizziness
 - Numbness & tingling
 - Memory & attention dysfunction
 - Anxiety
 - * Hypervigilance, ruminating
 - Mood
- Treatment Recommendations
 - Full days at school
 - Discharged from vestibular therapy
 - All other therapies/evaluations successfully completed/passed
 - Psychotherapy

Composite Scores	Percentile scores if available are listed in small type									
Memory composite (verbal)	74	22%	78	32%	91	80%	74	22%	86	64%
Memory composite (visual)	77	57%	76	54%	78	60%	83	75%	64	21%
Visual motor speed composite	42.22	85%	42.35	85%	43.43	88%	48.8	99%	45.15	92%
Reaction time composite	0.5	92%	0.52	87%	0.51	90%	0.46	98%	0.47	97%
Impulse control composite	12		5		9		8		18	
Total Symptom Score	52		62		58		56		70	

Anxiety Case

Headache	5	3	5	5	2	4	1	1	4	3
Nausea	2	0	2	2	0	0	0	0	2	0
Vomiting	0	0	0	0	0	0	0	0	0	0
Balance Problems	1	0	2	3	9	0	0	0	1	0
Dizziness	4	2	1	1	2	1	0	0	1	0
Fatigue	2	1	3	3	2	3	2	2	1	1
Trouble falling asleep	5	N/A	2	N/A	3	N/A	3	N/A	4	N/A
Sleeping more than usual	3	N/A	3	N/A	0	N/A	2	N/A	4	N/A
Sleeping less than usual	3	N/A	1	N/A	3	N/A	3	N/A	2	N/A
Drowsiness	2	1	4	3	3	3	2	3	3	3
Sensitivity to light	2	2	4	4	5	4	3	4	3	5
Sensitivity to noise	3	1	4	3	1	1	1	0	1	1
Irritability	2	1	3	3	4	4	4	3	4	3
Sadness	2	1	2	4	3	2	3	3	4	3
Nervousness	2	0	2	2	3	2	4	3	3	3
Feeling more emotional	1	0	1	1	1	2	3	2	4	2
Numbness or tingling	1	1	2	3	4	2	3	1	4	3
Feeling slowed down	2	2	5	5	4	6	4	6	4	6
Feeling mentally foggy	2	2	5	4	6	4	6	4	6	4
Difficulty concentrating	3	2	4	5	5	5	5	5	6	5
Difficulty remembering	2	1	4	4	3	3	4	2	4	3
Visual problems	3	2	3	4	4	4	3	4	5	5
Total Symptom Score	52	22	62	59	58	90	56	43	70	50

Anxiety Case #2

- 17 year old female
 - Soccer player
 - Fell and struck back of head to the ground
 - Initial signs
 - Anterograde amnesia
 - Disorientation/confusion
 - Initial symptoms
 - Headache
 - Nausea
 - Dizziness
 - Mental fogginess
- Biopsychosocial History
 - Psychotherapy for “adjustment disorder” after parents’ divorce
 - No other relevant history
 - Above average academically
- Seen 1 week after injury
 - Struggling academically
 - Panic attacks
 - PCP referred to concussion clinic

Anxiety Case #2

- Presenting Symptoms
 - Headache
 - Photo/phonosensitivity
 - Blurred vision
 - Nausea
 - Mentally foggy
 - Memory & attention dysfunction
 - Denied feeling anxious
 - Denied mood change
- Treatment Recommendations
 - Modified Academic Schedule
 - Vestibular Therapy
 - Behavioral management
 - Referred for medications
 - Behavioral management
 - Sleep was much improved

Composite Scores	Percentile scores if	
Memory composite (verbal)	82	35%
Memory composite (visual)	67	31%
Visual motor speed composite	28.58	1%
Reaction time composite	0.68	8%
Impulse control composite	0	
Total Symptom Score	60	

- Vestibular exam was highly provocative for symptoms
- Near point convergence measured at 2 cm

Anxiety Case #2

Follow-up #1

- Presenting Symptoms
 - Headache
 - Dizziness
 - Dysregulated sleep
 - Difficulty falling and staying asleep
 - Memory & attention dysfunction
 - Anxiety was increasing
 - Attributed to school stress
 - Denied mood symptoms
- Treatment Recommendations
 - Continued modified schedule, but increased hours
 - Continued vestibular therapy
 - Light physical activity
 - Recommended psychotherapy

Composite Scores	Percentile scores if available are listed			
Memory composite (verbal)	82	35%	88	51%
Memory composite (visual)	67	31%	75	54%
Visual motor speed composite	28.58	1%	30.65	7%
Reaction time composite	0.68	8%	0.57	44%
Impulse control composite	0		0	
Total Symptom Score	60		74	

- Vestibular exam was still provocative for symptoms
- Near point convergence measured at 2 cm

Anxiety Case #2

Follow-up #2

- Presenting Symptoms
 - Headache
 - Photo/phonosensitivity
 - Dizziness
 - Memory & attention dysfunction
 - Anxiety
 - Mood
- Treatment Recommendations
 - Return to full school schedule
 - Discharged from vestibular therapy
 - Increase physical activity
 - Psychotherapy

Composite Scores	Percentile scores if available are listed in small type.					
Memory composite (verbal)	82	35%	88	51%	85	44%
Memory composite (visual)	67	31%	75	54%	78	63%
Visual motor speed composite	28.58	1%	30.65	7%	36.95	36%
Reaction time composite	0.68	8%	0.57	44%	0.57	44%
Impulse control composite	0		0		5	
Total Symptom Score	60		74		69	

• Vestibular exam was nonprovocative

Anxiety Case #2

Follow-up #3

- Presenting Symptoms
 - Moderate Headache
 - Mild Photo/phonosensitivity
 - Mild Dizziness
 - Memory & attention dysfunction
 - Anxiety
 - Improving
 - Mood
 - Improving
- Treatment Recommendations
 - Continued full schedule
 - Increase physical activity
 - Psychotherapy

Composite Scores	Percentile scores if available are listed in small type.							
Memory composite (verbal)	82	35%	88	51%	85	44%	96	86%
Memory composite (visual)	67	31%	75	54%	78	63%	81	73%
Visual motor speed composite	28.58	1%	30.65	7%	36.95	36%	38.7	42%
Reaction time composite	0.68	8%	0.57	44%	0.57	44%	0.54	63%
Impulse control composite	0		0		5		0	
Total Symptom Score	60		74		69		26	

Anxiety Case #2

Follow-up #4

- Presenting Symptoms
 - Denying all symptoms
- Treatment Recommendations
 - Full days at school
 - Psychotherapy
 - Discharged

Composite Scores	Percentile scores if available are listed in small type.									
Memory composite (verbal)	82	35%	88	51%	85	44%	96	86%	95	80%
Memory composite (visual)	67	31%	75	54%	78	63%	81	73%	88	89%
Visual motor speed composite	28.58	1%	30.65	7%	36.95	36%	38.7	42%	40.22	49%
Reaction time composite	0.68	8%	0.57	44%	0.57	44%	0.54	63%	0.5	85%
Impulse control composite	0		0		5		0		1	
Total Symptom Score	60		74		69		26		2	

Chicken-Egg Case

Follow-up #1

- Presenting Symptoms
 - Headache
 - Fatigue
 - Dizziness
 - Bradyphrenia & attention problems
 - Denial of affective changes
 - Very emotional in clinical interview
 - "You're useless! I don't feel better! Do something!"
- Treatment Recommendations
 - Continue going to school; full days as tolerated
 - Attendance was poor
 - Heavy academic accommodations
 - Attempt vestibular therapy
 - Medication consult
 - Suggested STAR

Composite Scores	Percentile scores if available are listed		
Memory composite (verbal)	77	29%	65 4%
Memory composite (visual)	83	79%	81 17%
Visual motor speed composite	28.42	11%	28.15 10%
Reaction time composite	0.62	41%	0.63 36%
Impulse control composite	29		27
Total Symptom Score	44		37

• Vestibular exam was provocative, no change in headache presentation

Chicken-Egg Case

Follow-up #2

- Presenting Symptoms
 - Headache
 - Fatigue
 - Dizziness
 - Bradyphrenia and Attention dysfunction
 - Some acknowledgement of affective change
 - Mom very concerned over affect
 - Went to STAR
- Treatment Recommendations
 - Continue going to school; full days as tolerated
 - Attendance was poor
 - Heavy academic accommodations
 - Discontinue vestibular therapy
 - Medication consult
 - Referral to HA Clinic

Composite Scores	Percentile scores if available are listed in small type		
Memory composite (verbal)	77	29%	85 4%
Memory composite (visual)	83	79%	81 17%
Visual motor speed composite	28.42	11%	29.15 11%
Reaction time composite	0.62	41%	0.63 36%
Impulse control composite	29		27
Total Symptom Score	44		37

Chicken-Egg Case

Headache	4	5	4	5	4	4
Nausea	0	2	2	0	4	2
Vomiting	0	0	0	0	0	0
Balance Problems	2	2	3	2	3	3
Dizziness	2	2	2	1	4	3
Fatigue	5	4	4	3	3	3
Trouble falling asleep	0	N/A	0	N/A	0	N/A
Sleeping more than usual	5	N/A	4	N/A	3	N/A
Sleeping less than usual	0	N/A	0	N/A	0	N/A
Drowsiness	5	4	4	2	2	3
Sensitivity to light	6	5	3	4	4	4
Sensitivity to noise	2	1	1	0	2	1
Irritability	2	0	0	0	3	3
Sadness	0	0	0	0	0	0
Nervousness	0	0	0	0	0	0
Feeling more emotional	0	0	0	0	0	0
Numbness or tingling	0	0	0	0	0	0
Feeling slowed down	4	4	4	2	4	4
Feeling mentally foggy	3	3	4	3	4	4
Difficulty concentrating	4	3	2	3	4	4
Difficulty remembering	0	0	0	0	2	2
Visual problems	0	0	0	0	0	0
Total Symptom Score	44	35	37	25	48	42
