

Concussion Management for the Physical Therapist: From Pediatrics to the Older Adult

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LEARNING OBJECTIVES

By the end of the course, participants will be able to do the following:

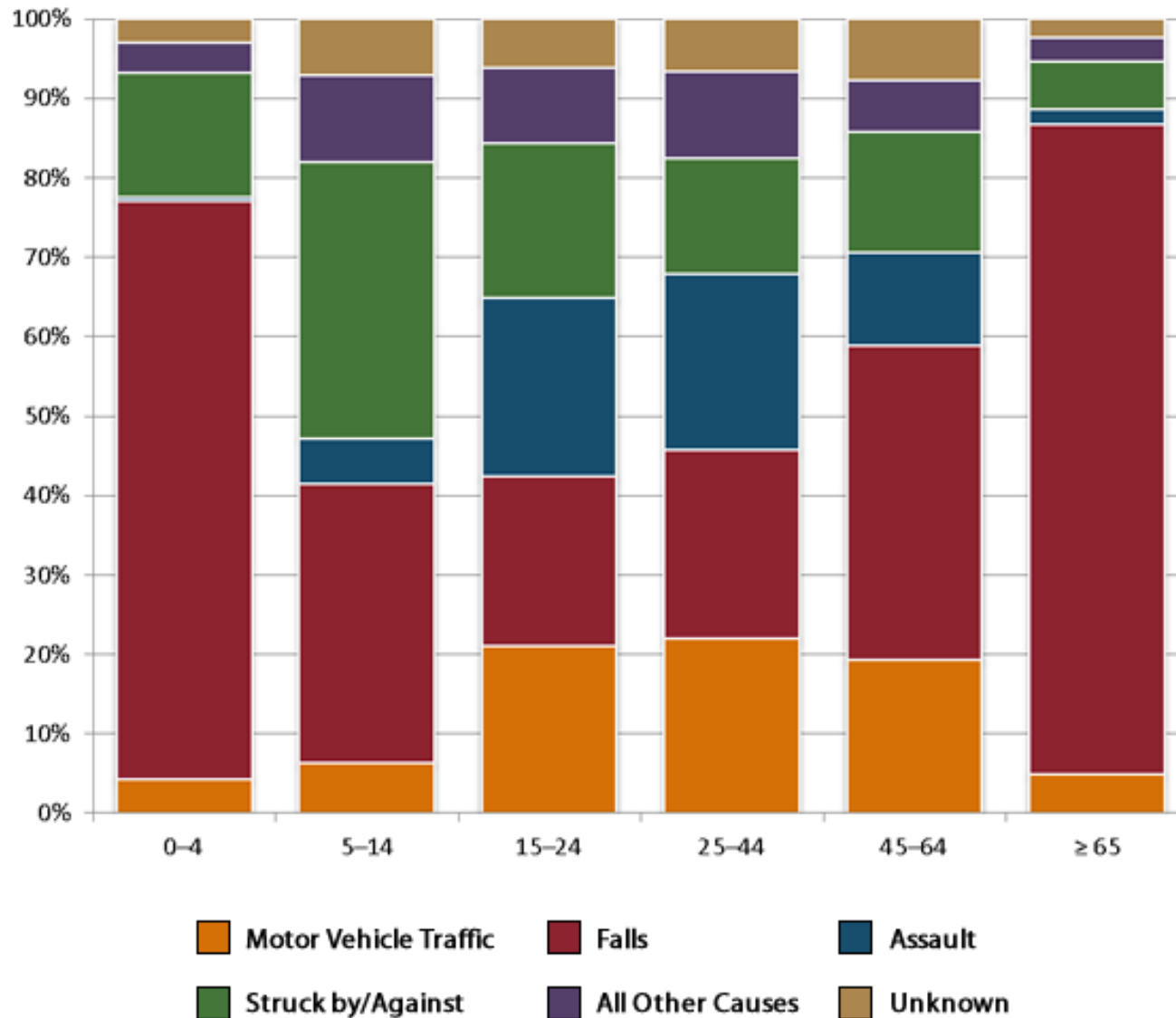
1. Describe the pathophysiology, common clinical presentations, & foundational concepts behind concussion management.
2. Identify risk factors for determining prognosis and outcomes following a concussion.
3. Perform common test & measures for evaluation & treatment of individuals with post-concussive syndrome.
4. Develop a plan of care & specific interventions when provided with case examples of a person recovering from a mild TBI

FOUNDATIONAL CONCEPTS

Statistics

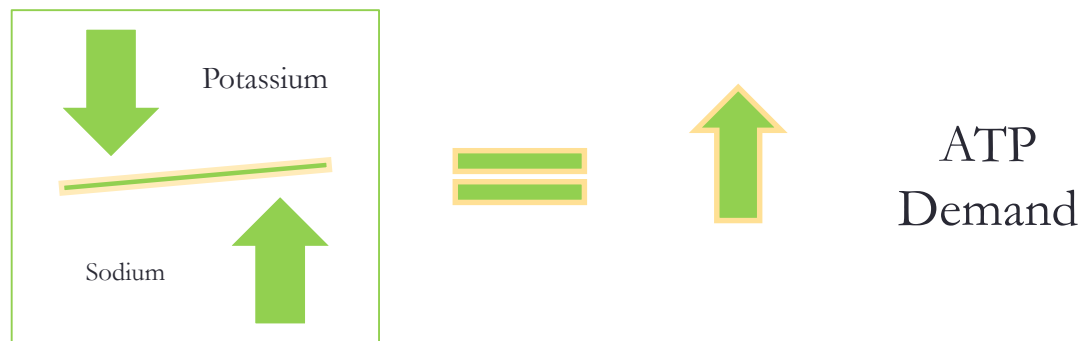
- 2.5 million concussions documented/year in US alone (Voss, 2015)
- 1.6-3.8 million sports related concussion/year (Voss, 2015)
- 15% troops deployed to the Iraq reported symptoms of mTBI (Voss, 2015)
- By 2050, estimates that >40% of acute trauma cases will be over the age of 65 years of age (Mercier, 2016)
- 80% of TBI in older adults are mild TBI (Papa, 2012)
- Rate of mTBI is increasing in older adult population (Harvey, 2012; Albrecht, 2016)

Percent Distributions of TBI-related Emergency Department Visits by Age Group and Injury Mechanism — United States, 2006–2010

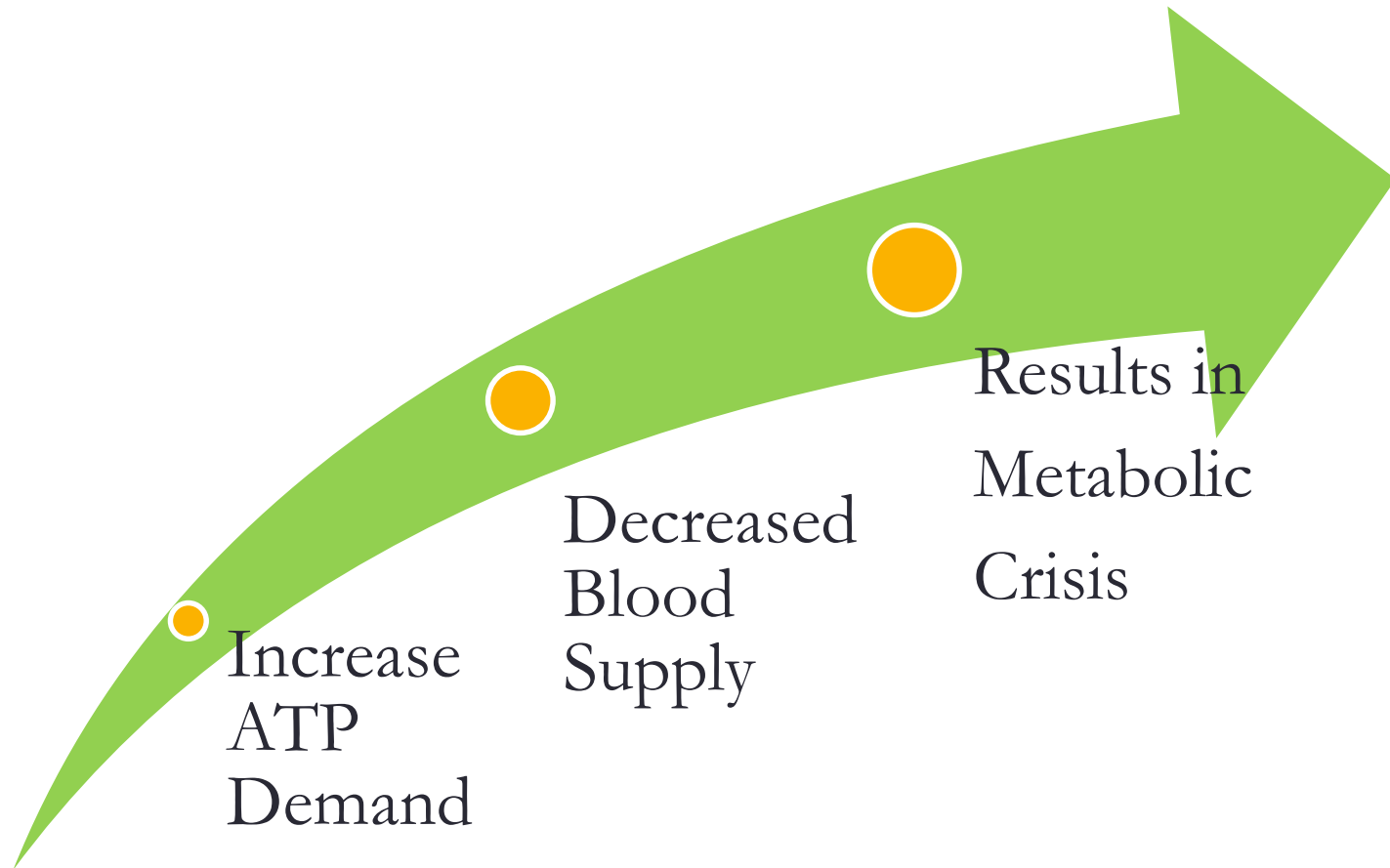


Pathophysiology(Giza,2014)

- Diffuse axonal injury
- Functional vs microstructural damage
- Increase in neurotransmitters (glutamate) results in large neuronal depolarization
- Efflux of potassium and influx of sodium
- Need to restore balance = increased need for ATP



Concussion



Concussion Video

- How do you anticipate a person with a concussion might present?
- What signs and symptoms would you look for?

Signs/Symptoms of Acute Concussion

Concussion Signs Observed

- Can't recall events *prior to* or *after* a hit or fall.
- Appears dazed or stunned.
- Forgets an instruction, is confused about an assignment or position, or is unsure of the game, score, or opponent.
- Moves clumsily.
- Answers questions slowly.
- Loses consciousness (*even briefly*).
- Shows mood, behavior, or personality changes.

Concussion Symptoms Reported

- Headache or "pressure" in head.
- Nausea or vomiting.
- Balance problems or dizziness, or double or blurry vision.
- Bothered by light or noise.
- Feeling sluggish, hazy, foggy, or groggy.
- Confusion, or concentration or memory problems.
- Just not "feeling right," or "feeling down".

Emergent Signs/Symptoms

Dangerous Signs & Symptoms of a Concussion

- One pupil larger than the other.
- Drowsiness or inability to wake up.
- A headache that gets worse and does not go away.
- Slurred speech, weakness, numbness, or decreased coordination.
- Repeated vomiting or nausea, convulsions or seizures (shaking or twitching).
- Unusual behavior, increased confusion, restlessness, or agitation.
- Loss of consciousness (passed out/knocked out). Even a brief loss of consciousness should be taken seriously.

Dangerous Signs & Symptoms of a Concussion for Toddlers and Infants

- Any of the signs and symptoms listed in the Danger Signs & Symptoms of a Concussion list.
- Will not stop crying and cannot be consoled.
- Will not nurse or eat.

Videos – Pupillary Reflex

- <https://www.youtube.com/watch?v=cr6WciCNXV0>
- <https://www.youtube.com/watch?v=K3hjJtRjFK0>
- Normal versus abnormal findings

Diagnosis of Acute Concussion

- Standard Medical Imaging = **Negative**
- CT utilized acutely to rule out other diagnosis
- Based off patient's reporting of signs/symptoms
- May order observation for 24 hours



https://www.nbcnews.com/health/health-news/fda-approves-new-blood-test-detect-concussions-n848131?cid=sm_npd_nn_fb_ma

What does the message tell the public?

Diagnosis

- Concussion = Mild TBI
 - Glasgow Coma Score (13-15 points)
 - Time for LOC (<30 minutes)
 - Time for PTA (<24 hours)
- Standard Care: 1-2 days general rest with gradual return to activity(Pfister, 2016)

Traumatic Brain Injury Glasgow Coma Scale



test	score	condition
Eye Opening	4	the patient can open his eyes spontaneously
	3	the patient can open his eyes on verbal command
	2	the patient opens his eyes only in response to painful stimuli
	1	the patient does not open his eyes in response to any stimulus
Best Verbal Response	5	the patient is oriented and can speak coherently
	4	the patient is disoriented but can speak coherently
	3	the patient uses inappropriate words or incoherent language
	2	the patient makes incomprehensible sounds
	1	the patient gives no verbal response at all
Best Motor Response	6	the patient can move his arms and legs in response to verbal commands
	2-5	the patient shows movement in response to a variety of stimuli, including pain
	1	the patient shows no movement in response to stimuli

The results of the three tests are added up to determine the patient's overall condition

Total score	scale
13-15	mild head injury
9-12	moderate head injury
3-8	severe head injury

General Prognosis (Henry, 2016)

- 80-90% resolve in 7-10 days
- Adolescent Sports Related Concussion recovery window 3-4 weeks (McCrory 2013)
- Younger age = longer recovery
- Loss of consciousness > 1 minute
- Depression
- Female may affect risk and severity of injury (Snedaker, 2016)
- Avoid risk of second impact syndrome

“When in doubt, sit them out” - CDC

Nebraska Concussion Awareness Act

- Went into effect July 2012
- Athletes 19 years and younger
- 3 primary components
 1. Education to schools/organizations and athletes/parents
 2. Removal of Athlete
 3. Written and signed consent to return to play by licensed professional and athlete's parent/guardian

Nebraska Concussion Awareness Act

Licensed Health Care Professional in NE

1. Physician or licensed practitioner under the direct supervision of a physician, e.g. physician assistant (PA-C) or nurse practitioner (APRN); a neuropsychologist, an athletic trainer (ATC)

OR

2. **a)** provide health care services where doing so falls within one's scope of practice in Nebraska, **AND (b)** is trained in the evaluation and management of traumatic brain injury among a pediatric population.

Challenges

- Identification
 - Cultural norms in sports(Henry, 2016)
 - Baseline cognition vs medical delirium vs mTBI (Mercier, 2016)
- Injury Prevention(Henry, 2016)
 - Preventative equipment
 - Rule changes to high risk sports
 - Risk compensation associated with protective gear
- Adherence to recommendations

Diagnosis of Post Concussion Syndrome (PCS)

- **ICD 10:** Demonstrates 3 symptoms show in table (WHO, 2009)
- **Diagnostic and Statistical Manual of Mental Disorders IV (DSM-IV):** abnormalities on neuropsychiatric testing or quantified cognitive assessment of attention and memory OR 3 additional symptoms lasting > 3 months
- **DSM – V:** Uses minor neurocognitive disorder due to TBI as diagnosis

Table 1

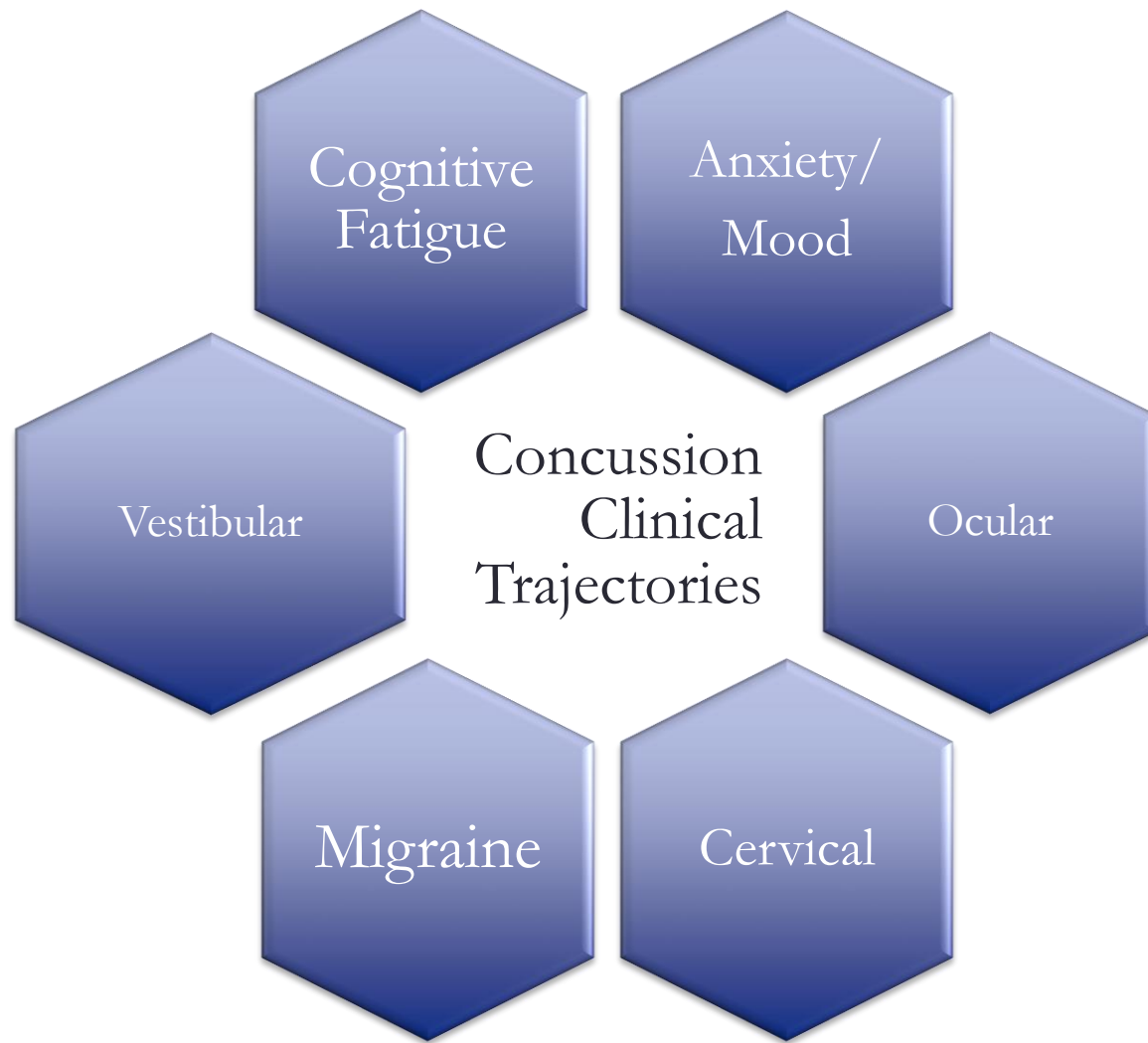
Comparison of the symptoms described by the different definitions of post-concussion syndromes (Note: mild neurocognitive disorder due to traumatic brain injury is used for DSM-5).

PCS symptom	PCS definition		
	ICD-10	DSM-IV	DSM-5
Headache	+	+	–
Dizziness	+	+	–
Fatigue	+	+	–
Irritability	+	+	–
Sleep problems	+	+	–
Concentration problems	+	+	–
Memory problems	+	+	–
Problems tolerating stress/emotion/alcohol	+	–	–
Affect changes, anxiety, or depression	–	+	–
Changes in personality	–	+	–
Apathy	–	+	–
Impaired cognitive function	–	–	+

(Rathbone ATL, Tharmaradinam S, Jiang S, et al, 2015)

Post Concussion Syndrome (PCS)

- Still trying to figure out why certain people end up with PCS
- Metabolic changes still occurring up to 30 days post injury in adolescents that are symptom free
(Vagnozzi , 2008)
- Abnormal blood flow (Maugans, 2012; Chen, 2004)
- fMRI revealed abnormal functional connectivity
(Zhang X, 2017)



Collins MW, Kontos AP, Reynolds E, Murawski CD, Fu FH. A comprehensive, targeted approach to the clinical care of athletes following sport related concussion. *Knee Surg Sports Traumatol Arthrosc.* 2014;22:235-246.

Clinical Trajectories



Cognitive Fatigue

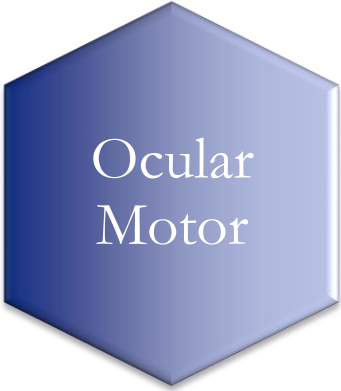
- Symptoms increase throughout the day
- Decreased energy levels
- Headache increase with cognitive load
- Difficulty concentrating and delayed processing



Vestibular

- Dizziness, fogginess, feeling of detachment, nausea
- Complaints of increased symptoms in complex environments
- Behavioral responses in relation to overstimulation

Clinical Trajectories



Ocular Motor

- Frontal headaches or behind the eyes
- Difficulty with reading or screen time
- Difficulty at work/school with a decrease in symptoms on weekend
- Difficulty with encoding information, not memory retention



Anxiety/ Mood

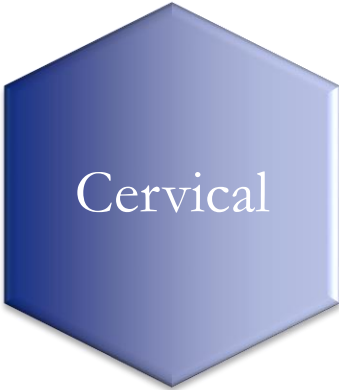
- Anxiety manifesting through other symptoms (headache, fogginess, fatigue)
- Hypervigilance, overwhelmed, feeling sad
- Vague symptoms

Clinical Trajectories

A blue hexagon with a gradient and a drop shadow, containing the word "Migraine" in white serif font.

Migraine

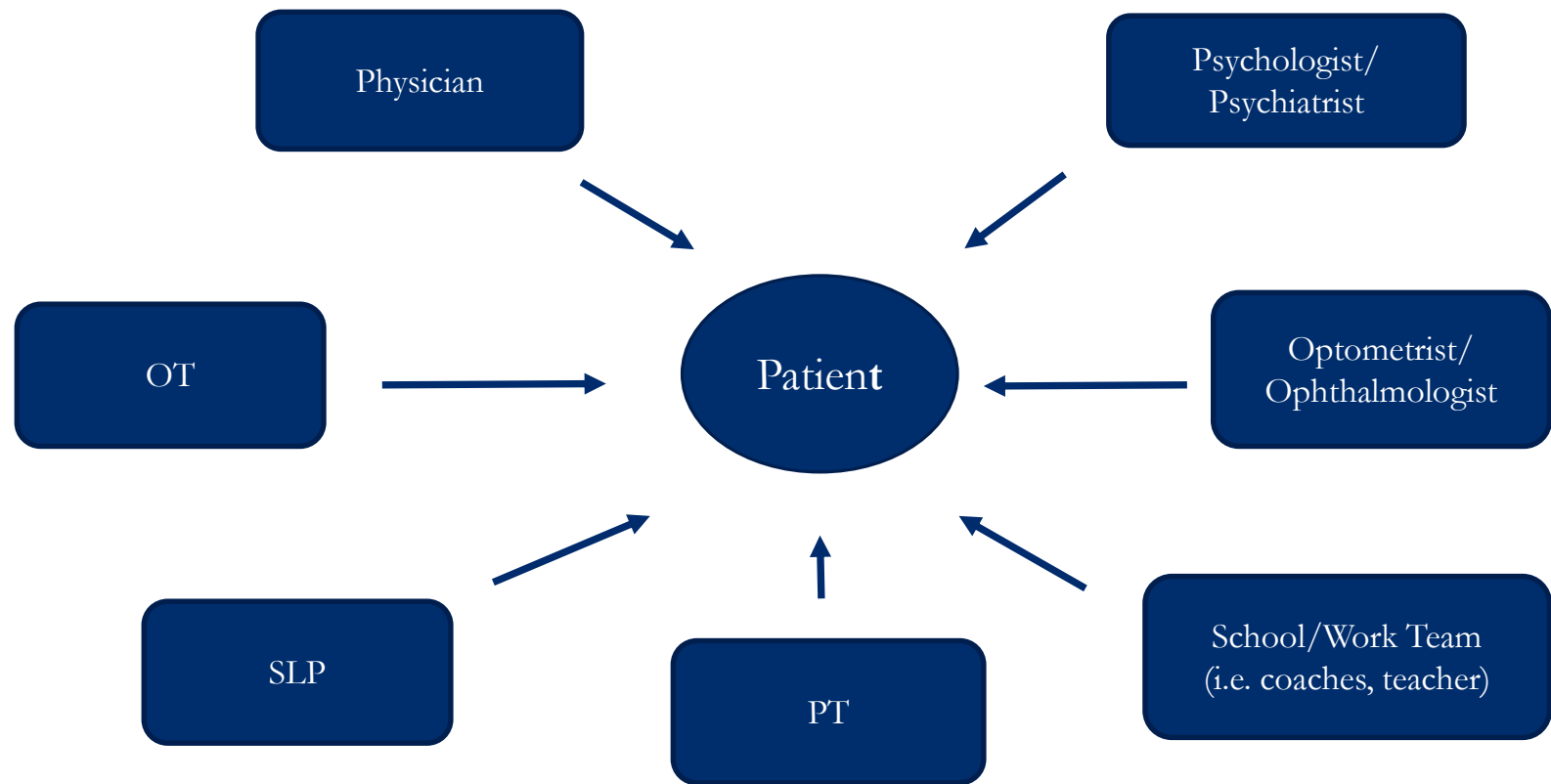
- Unilateral, pulsating headache
- Exacerbated by photosensitivity or phonosensitivity
- Exacerbated by activity

A blue hexagon with a gradient and a drop shadow, containing the word "Cervical" in white serif font.

Cervical

- Cervical stiffness, pain, radiating numbness/tingling
- Dull, throbbing, ache for headache

Interdisciplinary Approach



Collins MW, Kontos AP, Reynolds E, Murawski CD, Fu FH. A comprehensive, targeted approach to the clinical care of athletes following sport related concussion. *Knee Surg Sports Traumatol Arthrosc.* 2014;22:235-246.

Key Points

- **Grading activity** → pushing into the symptoms, but working just within the patient's limits of tolerance
- **Attention to signs of over stimulation:**
 - Worsening of signs/symptoms (headache dizziness, nausea)
 - Decreased quality of movement
 - Increased behavioral issues
- **Providing patient education**
 - Gradual return to activities
 - Self regulation

??? Questions ???

Assessment

2017 Consensus Statement on Concussion in Sport (Berlin Consensus Statement)

- 5th International Conference on Concussion in Sport
- Build on principles in previous statements
- Further development of conceptual understanding of Sport Related Concussion
- Added **rehab** for the first time
- **Stage 1:**
 - (old): No Activity: complete physical and cognitive rest
 - (new): Symptom limited activity

CSIG's 11 'R's of SRC

Management- Berlin Statement

- Recognize
- Remove
- Re-evaluate
- Rest
- Rehabilitation
- Refer
- Recover
- Return to sport
- Reconsider
- Residual effects and sequelae
- Risk reduction

Immediate Management



Recognize and Remove

- Suspect a concussion → remove from play, **have assessment by a licensed healthcare provider**
- Diagnosed w/ concussion → can't return to play that day
- After first aid issues addressed, assess concussion with SCAT5 or other diagnostic tool
- Do not leave athlete alone, needs serial evaluation over next several hours

Importance of Removal

- **8x more likely** to have prolonged recovery if remain in play
(Elbin et al 2016)
 - >3 weeks to recover

Common Signs and Symptoms

Thinking/ Remembering	Physical	Emotional/ Mood	Sleep
Difficulty thinking clearly	Headache Fuzzy or blurry vision	Irritability	Sleeping more than usual
Feeling slowed down	Nausea or vomiting (early on) Dizziness	Sadness	Sleep less than usual
Difficulty concentrating	Sensitivity to noise or light Balance problems	More emotional	Trouble falling asleep
Difficulty remembering new information	Feeling tired, having no energy	Nervousness or anxiety	

CSIG's Berlin Statement

- “Players manifesting clear on-field signs of SRC (eg, loss of consciousness, tonic posturing, balance disturbance) should **immediately be removed from sporting participation**. Players with a suspected SRC following a significant head impact or with symptoms can proceed to sideline screening using appropriate assessment tools—for example, SCAT5. Both groups can then proceed to a more thorough diagnostic evaluation, which should be performed in a distraction-free environment (eg, locker room, medical room) rather than on the sideline.”

Immediate Management

SCAT-5

- Standardized tool for evaluating concussions
- SCAT 5 → 13 y/o and older
- Child SCAT 5 → 5-12 y/o
- Brief neuropsychological test with immediate or on-field assessment section and off-field or office assessment
- Useful to assess immediately after injury
 - **Not useful after 3-5 days post-injury**
 - Symptom checklist useful throughout to track recovery
- Sideline measures useful for concussion diagnosis, but poor prognostic ability (Sufrinko et al. 2017)

Immediate Management- Neurocognitive Testing

- Common Neurocognitive tests
 - ImPACT
 - Axon
 - ANAM (Automated Neuropsychological Assessment Metrics)
 - CNS Vital Signs
 - Headminder
- Previously described by the CISG as a “cornerstone” of management
- Preseason or Baseline Testing → no longer thought to be necessary
- Neurocognitive testing alone does not determine return to play
- **“It must be emphasized, however, that NP assessment should not be the sole basis of management decisions” – Berlin Statement**
 - “Provides an aid”

“Old Belief”



Current Recommendations

- No immediate return to sport or vigorous activity
- Relative rest 24-48hrs
 - Limited physical and cognitive activity (don't cocoon)
- Gradually resume light physical activity, household chores, school, and work
 - Mild symptoms → OK
 - Avoid high risk activities early
- No activity → poor outcome
- Too rigorous activity → poor outcome

So What Can We Do?

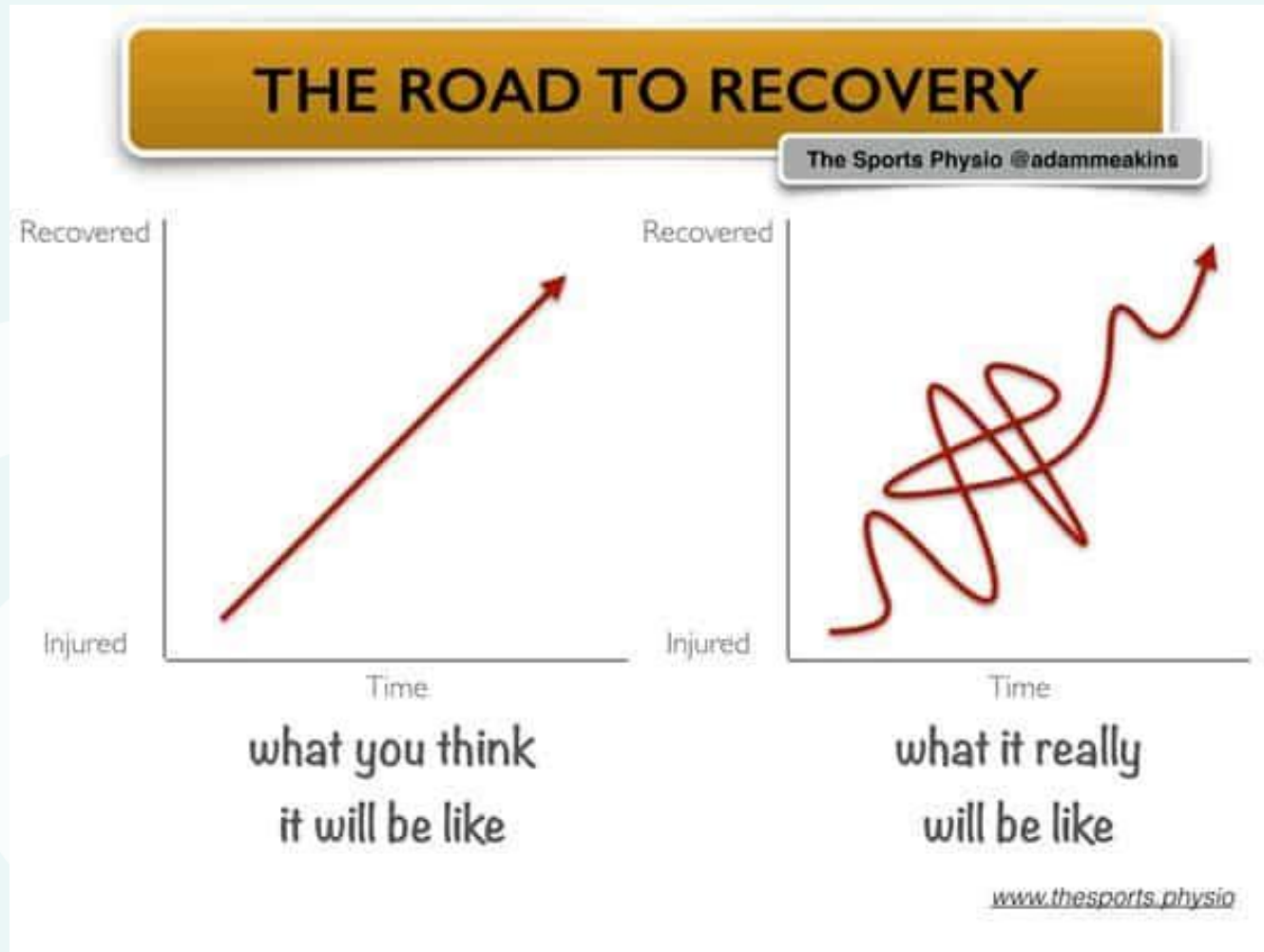
• Education!!!

- #1 reason reported by college athletes on hiding concussion symptoms → think they can **“Tough it out”** (Conway et. al 2018)
- #3 reason → fear of losing future playing time
 - Need to educate coaches/players
- Staying in increased risk 8-fold of prolonged recovery (Elbin et al 2016)
- Delayed removal 2.2x more likely prolonged recovery >8 days) (Asken et. Al 2016)

TABLE 3. Reasons for Hiding Symptoms (ranked from most to least endorsed)

Reason	% of Athletes
They think they CAN just “tough it out.”	91.7
They do not want to be pulled out of the game or practice.	90.4
They are afraid they will lose future playing time.	86.5
They do not want to let down their teammates and coaches.	84.6
They do not think it is serious enough.	84.0
They do not know they have a concussion.	83.3
They do not want to appear weak.	80.8
They think they SHOULD just “tough it out.”	79.5
They are afraid they will lose their spot on the team.	75.6
They are afraid the coach will be mad.	64.1
They are afraid their teammates will be mad.	58.3
They think getting concussions is just part of the game.	44.2
They do not believe that their coaches want them to report it.	30.1

Importance of Education



Not just a “brain” injury

- Musculoskeletal system
- Vestibular system
- Oculomotor system
- Sensorimotor processing
- Motor coordination
- Exertional/autonomic adaptation

These are just the
systems PTs are most
involved with

All about the symptoms?

- Can't just go off of symptoms
 - Symptoms common in non-concussed individuals (Hunt AW J of Ath Train 2016)
- Downplay/Embellish:
 - Desire to play in next game
 - Social pressure
 - Desire to rest/not participate in school/athletics/social events
 - Desire to avoid school

Iverson et al, 2015

- 19% boys, 28% girls → symptoms resembling PCS (no concussion hx)
 - Prior tx psychiatric disorder
 - Hx of migraines
 - Substance abuse
 - ADHD

Comprehensive Examination

- **Detailed Clinical Interview**→ Let their story guide your exam
- Vestibular-Ocular Screening (and more extensive evaluation if indicated)
- Balance Assessment
- Cervical Screen/Exam (if indicated)
- Computerized Neurocognitive Testing (if available)
- Exertion Evaluation

Helps Establish:

Diagnosis and prognosis

- Clinical and treatment trajectories
- Treatment and rehabilitation plan
- Academic considerations
- Exertion level (type, duration, intensity)
- Return to play expectation and plan

Components of the PT Exam

- Subjective
 - Health and injury history
 - General system screens
 - Patient-specific goals and needs
 - Self-report outcome measures/Quality of Life
 - Post-Concussion Symptom Scales
- Basic Clinical Exam (HR, BP, etc)
- Musculoskeletal Involvement
 - Posture, cervical and scapular ROM, strength, mobility, biomechanics, kinesthetic awareness, TMJ assessment
- Vestibular/Oculomotor
 - Near point convergence distance, smooth pursuits, saccades, spontaneous nystagmus, gaze holding, VOR, VOR cancellation, head thrust, motion sensitivity
 - Vestibular/Oculomotor Screen (VOMS)
 - BPPV Assessment
 - Dix Hallpike (posterior/anterior)
 - Roll Test (lateral)

Components of the PT Exam

- Exertional Testing

- Treadmill tests (Buffalo Protocol)
- Stationary bike

- Functional Assessments

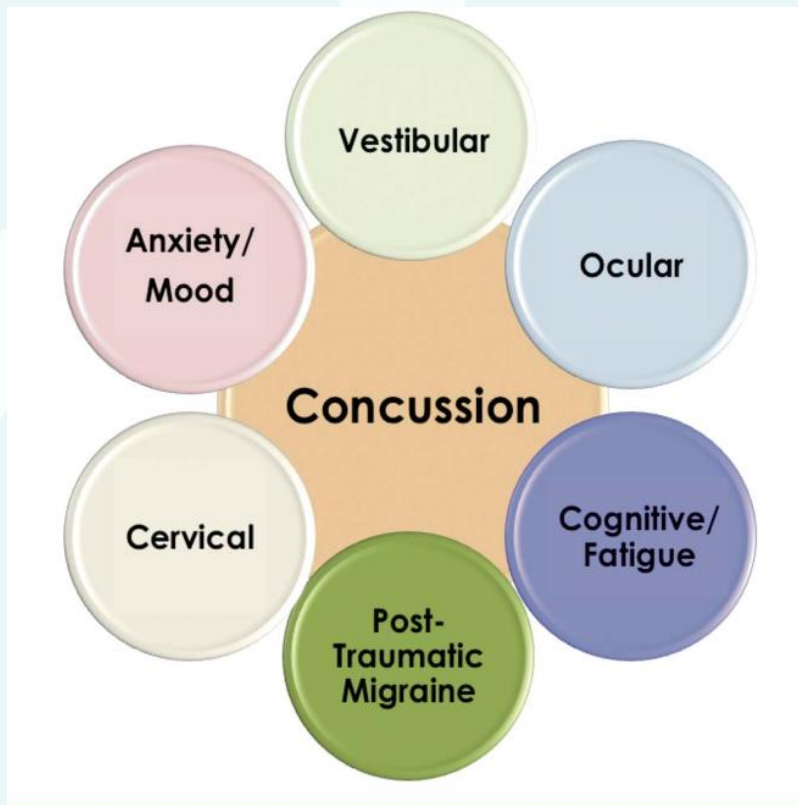
- Balance/Postural Control
- Coordination
- Gait
- Quality of Movement
- Dual Tasking

Outcome Measures

- Post Concussive Symptom Scale (PCSS)
- Post-Concussion Symptom Inventory (PCSI)
 - Ages 5-7 (13 items)
 - Ages 8-12 (25 items)
 - Ages 13-18 (26 items)
 - Parent report form ages 5-18
- Neck Disability Index (NDI)
- Dizziness Handicap Inventory (DHI)
- Activity Specific Balance Confidence Scale (ABC)
- Motion Sensitivity Quotient

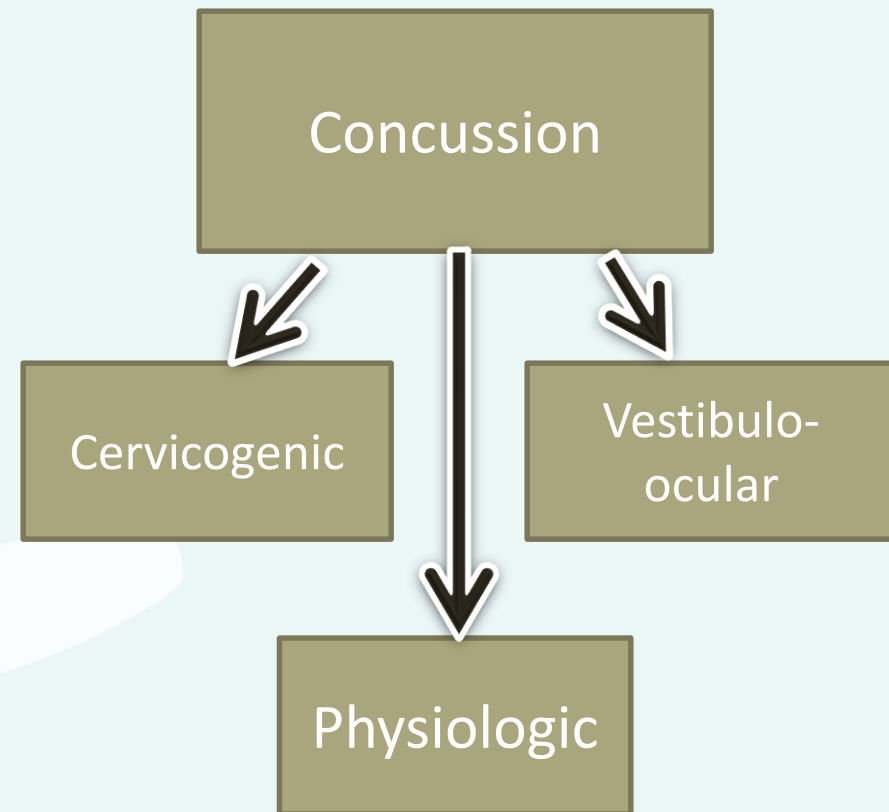
Classification Systems/Clinical Trajectory Profiles

University of Pittsburgh



(Reynolds et al 2014)

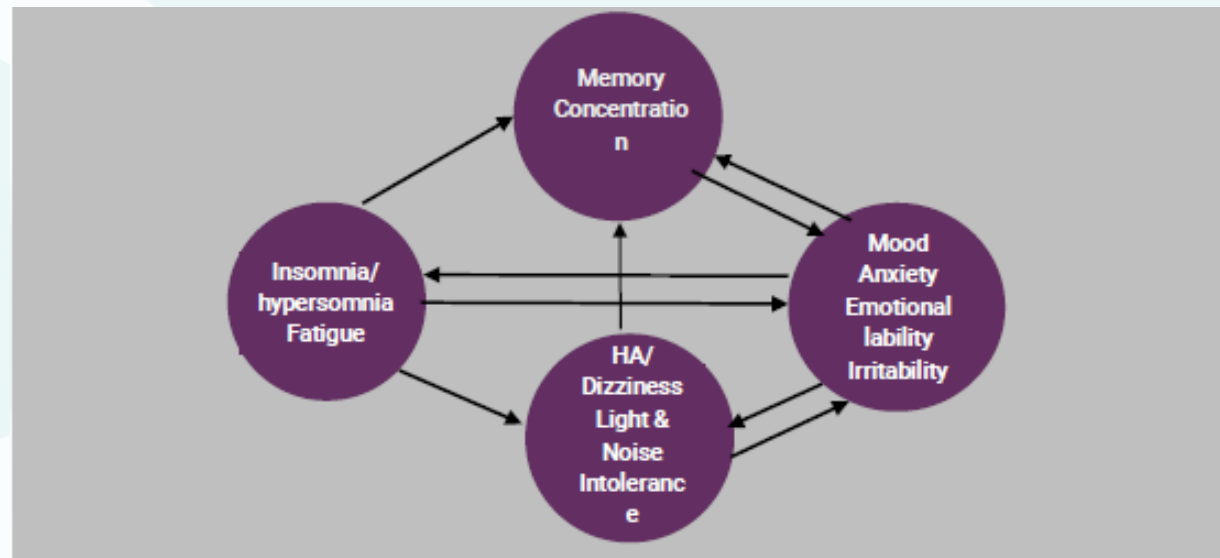
University of Buffalo



(Ellis et al. 2015)

Which is the driver?

- Individuals will likely present with impairments in multiple domains
- Need to address all deficits, but prioritize which is most impactful/symptom provoking for the individual



Role of Physical Therapy

Need to wear multiple hats

- Exertional/sports therapist
- Vestibular therapist
- Orthopedic/manual
- Patient Advocate and support system
- Also need to know when to refer



Where is the PT most involved?

- Vestibular Therapy
- Oculomotor Retraining
- Cervical
- Exertion Therapy/Physical Activity



Vestibular Profile

- 61-81% of youth and adolescents report vestibular abnormality following concussion. (Corwin, et al, 2015; Mucha, et al, 2014)
- Children w/ vestibular deficits → significantly longer recovery time (Corwin 2015)
 - Return to School: median 59 days vs 6 days
 - Fully Cleared: median 106 days vs 29 days
- Vestibulo-Ocular dysfunction was a significant risk factor for the subsequent development of PCS in pediatric sport related concussion (Ellis 2015)

Vestibular Profile

Symptoms:

- Dizziness
- Headache
- “fogginess”
- “One step behind”
- Impaired balance (esp. in dark)
- Blurry Vision, Difficulty Focusing
- Motion discomfort, height phobia
- Difficulty in busy visual environments

Predisposing Factor:

- Hx of Car Sickness/Motion Sensitivity



Vestibular Profile



Horizontal & Vertical Pursuits



Horizontal & Vertical Saccades



Near Point Convergence



Horizontal & Vertical VOR



Visual Motion Sensitivity

UPMC Vestibular/Ocular Motor Screening Form (VOMS) 5 minute physical exam

UPMC Vestibular/Ocular-Motor Screening (VOMS) for Concussion

Vestibular/Ocular Motor Test:	Not Tested	Headache 0-10	Dizziness 0-10	Nausea 0-10	Fogginess 0-10	Comments
BASELINE SYMPTOMS:	N/A					
Smooth Pursuits						
Saccades – Horizontal						
Saccades – Vertical						
Convergence (Near Point)						(Near Point in cm): Measure 1: _____ Measure 2: _____ Measure 3: _____
VOR – Horizontal						
VOR – Vertical						
Visual Motion Sensitivity Test						

Mucha, Collins, Elbin, Furman, Troutman-Enseki, DeWolf, Kontos. *AJSM*, 2014.

Symptoms Reported By Patient on 0-10 Point Scale

Positive findings on VOMS (NPC $\geq$ 5cm or >2 sx provocation) identifies concussion

Mucha et al, 2014

Vestibular Profile

Vestibular Assessment Beyond VOMS

Dynamic Visual Acuity

- Assess difference between static and dynamic visual acuity when head passively moved at 2Hz
- >2 line difference on eye chart= ABNORMAL
- <https://www.youtube.com/watch?v=AfghWx3IInE>

Head Thrust Test

- Most sensitive VOR test
- Low amplitude/high acceleration rotation of head
- Corrective Saccade= ABNORMAL
- <https://www.youtube.com/watch?v=KYI7eHhwhwk>

Vestibular Profile

Impaired Balance

- Common acutely and sub-acutely (Geurts 1996, Guskiewicz 1997, 2000, Kontos 2012)
- Abnormal sensory organization

3 Sensory Inputs:

- Vision
- Somatosensation
- Vestibular
 - Perceives head motion/orients head to vertical
 - Controls center of mass
 - Stabilizes head during postural movements



Vestibulo-Ocular Reflex (VOR) → stabilizes vision while head moves

Vestibulospinal Reflex (VSR) → Balance control

- Most active when vision and somatosensation reduced
- Balance impairment tends to resolve quicker than other post-concussive symptoms (Catena 2011)
- **VOMS and BESS unrelated (need to assess balance and vestibular-ocular separately)** (Mucha et al, 2014)

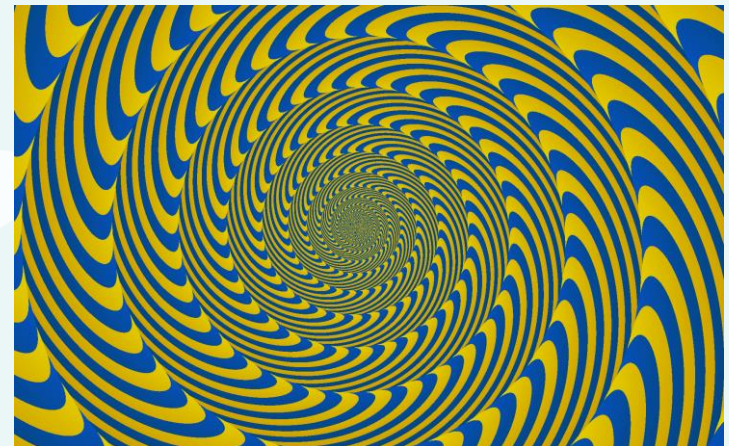
Vestibular Profile

Visual Motion Sensitivity

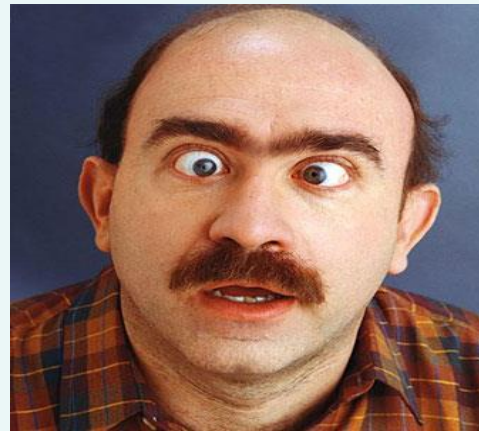
- Heightened awareness of normal visual motion
- Abnormal sensitivity with visual/vestibular interaction
- Often w/ Migraine and/or Anxiety

How do they tolerate busy environments?

- Walking in supermarkets, school/work hallways, crowded places?
- Wide open spaces?



Ocular/Visual Profile



- -42-69% of concussed adolescents experience oculomotor symptoms following concussion (Pearce, et al., *in press*; Master, et al, 2015)
- Some Questions to Ask
 - “Do you feel a frontal pressure in your head /behind eyes when reading/computer work/taking notes in class?”
 - “Do you have blurred or double vision while reading or difficulty reading?”
 - “Are you having more significant difficulty in Math and/or Science?”
 - “Are you excessively fatigued after a lot of schoolwork?” (Collins MW, KontosA, et al, KSST, 2014)
- Characteristics: HA, eye strain, blurriness, diplopia, oscillopsia, frontal HA, difficulty attending
- Neurocognitive Testing
 - Deficits with Visual Memory, Reaction Time
 - Deficits with encoding rather than retrieval

Ocular/Visual Profile

Ocular Assessment Beyond VOMS

Accommodation:

- Monocular
- ability of eyes to focus at near target
- Normal: <15cm (individuals <30 y/o); increases as we age
-must wear glasses/contacts if have them

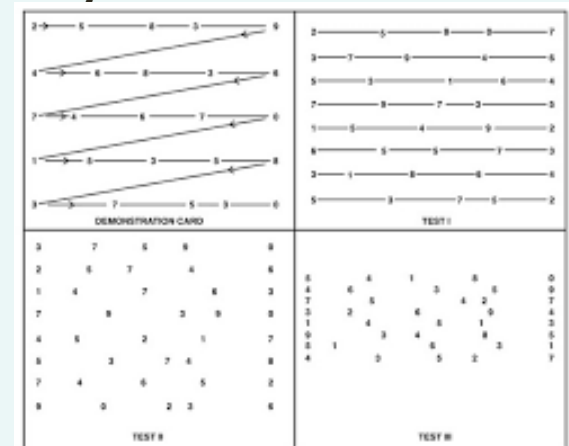
Convergence/Recovery

- Near point convergence= “double” or when one eye deviates
- Recovery= regain single image

Saccadic Function and Fixation

Timed Tests:

- King Devick Test
 - Norms for 13+ years old
- Development Eye Movement Test
 - Norms for ≤13 years old



Cervical Profile

- Rule out more serious cervical injury
 - Ligamentous Testing
- Rule in/out cervical symptoms vs concussion
- Mechanism of injury may help identify structures involved
- **Symptoms:**
 - “Stiff neck”
 - Neck pain
 - Pain with Cervical ROM
 - Cervical paraspinal tenderness
 - HA that radiates from upper cervical spine to occiput, temporal, frontal
- Pain precipitated or aggravated by specific neck movements or sustained neck posture.
 - Vestibular-Ocular Screening (VOMS) → Often normal
 - Neurocognitive Testing → Often Normal

Cervical Profile

- Upper Quarter Screen
 - Movement Restrictions
 - AROM
 - Max Open/Close
 - Upper cervical mobility
 - OA
 - AA
 - (C1-2) Flex/Rotation test
 - Cervicogenic HA and C1-2 dysfunction correlate
 - Lower Cervical Spine Mobility (C2-C7)
 - Soft Tissue Assessment
- Differentiating Cervical Involvement:
 - Paraspinal and sub-occipital muscle tenderness
 - Impaired head-neck position sense
 - Painful ROM
 - Graded treadmill tests:
 - Typically reach maximal exertion without triggering cervicogenic symptoms

Cervical Profile

Patients with whiplash injuries:

- Demonstrate impairments of the CNS
- Demonstrate impairments of the vestibular system
 - Central and Peripheral

Diagnostic Challenge: Symptoms

Concussion

- Headache
- Dizziness
- Sensitivity to noise, light
- Balance problems
- Fatigue
- Concentration and memory problems
- Irritable, sad, anxious

Whiplash

- Neck pain/stiffness
- Dizziness
- Headaches
- Unsteadiness
- Fatigue
- Concentration and memory problems
- PTSD

✓ [cdc.gov/concussion/signs_symptoms.html](https://www.cdc.gov/concussion/signs_symptoms.html)

✓ Merrick D, BMC Res Notes. 2010; 3: 190.

Cervical Profile

Impairment	Manifestation
Postural Control	Increased Sway
Cervical Kinesthetic Ability	Increased Joint Position Error (JPE) Head position control/accuracy
Occulomotor Function	Impaired Smooth Pursuit
Cervical Muscle Function	Decreased strength, control, endurance
Hypersensitivity to Temperature	
Post-traumatic Stress	

Cervical Profile

Schneider et al (2014)

N=29 pts (mean age 15 yo) with persistent headaches, dizziness, and/or neck pain after SRC

- 100% had + cervical findings (JPE, + cervical flexor endurance, palpation/joint mobility)

Grabowski et al (2017)

N=25 pts (mean age 15 yo) with SRC

- 44% diagnosed as cervicogenic or mixed (including cervicogenic)

Reneker et al (2018)

N= 41 patients (mean age 16.2 yo) with SRC

- 76% + CCFT
- 27% diagnosed with CG dizziness (dizziness reproduced by palpation/joint mobility assessment)

Cervical Profile

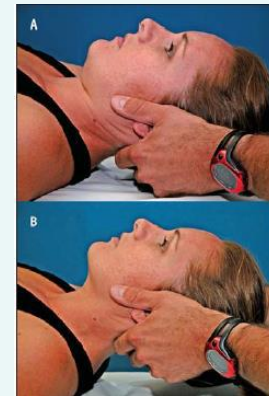
Ligamentous Testing

(Especially if trauma suspected and/or no prior imaging)

Alar Ligament (SB and/or Rotation)



Transverse Ligament Stress Test



Distraction Test for Tectorial Membrane

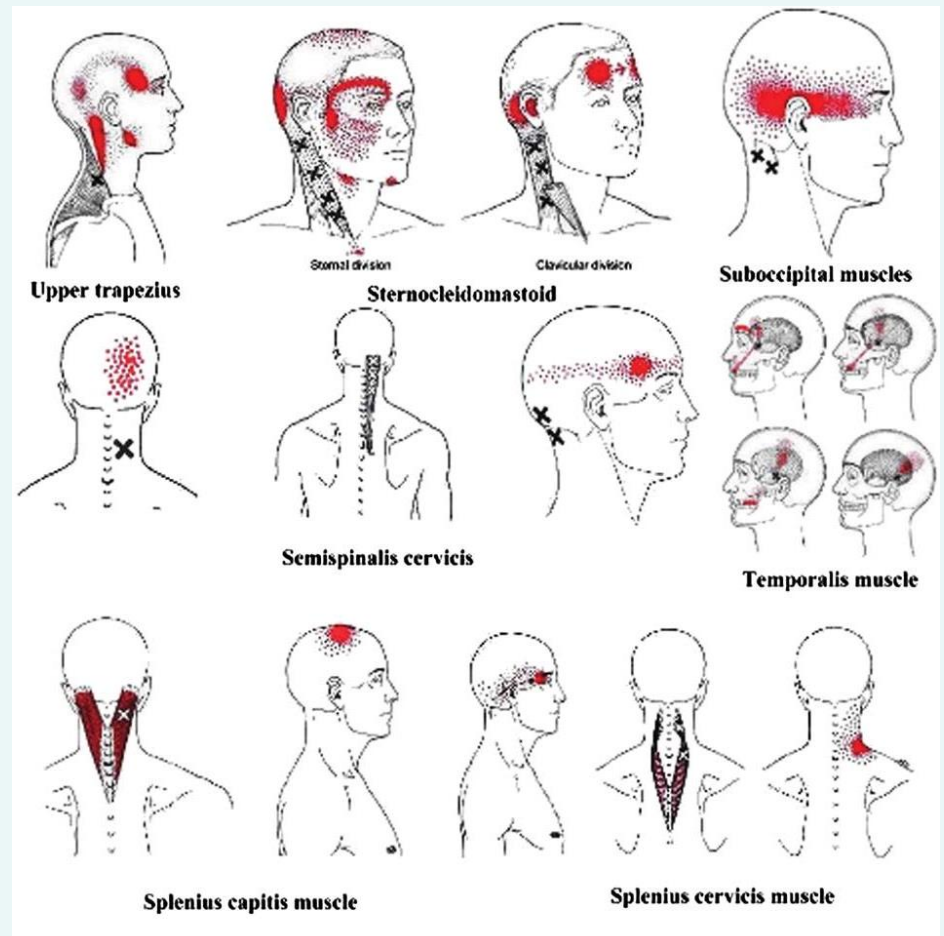
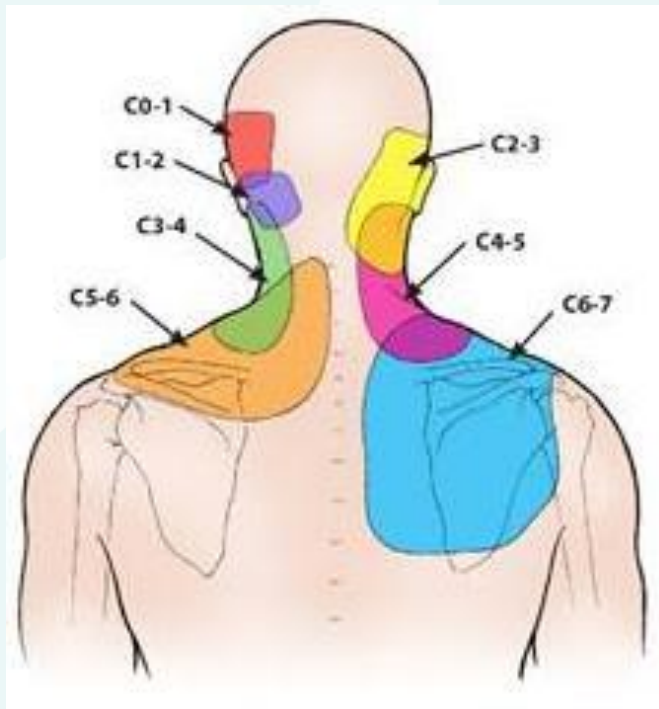


Sharp-Purser



Cervical Profile

Referral Patterns

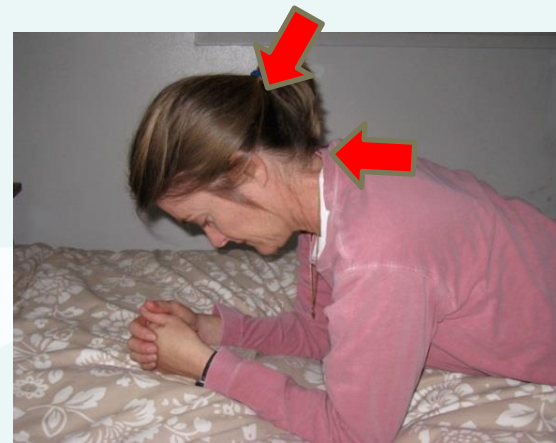


Cervical Profile

Assessing Muscle Function



(O'Leary et al., J Orthop Sports Phys Ther 2007;37(1):3---9).

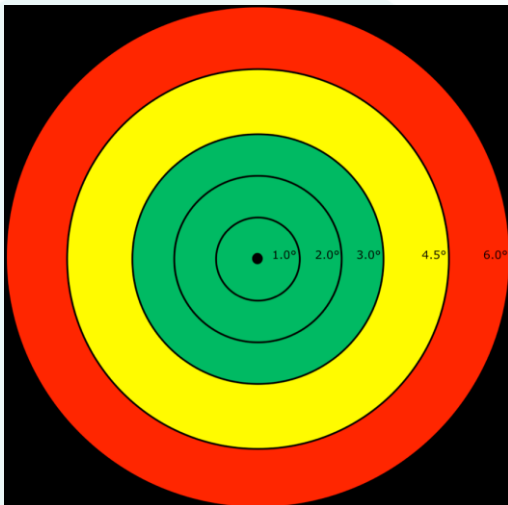


Cervical Profile

Sensorimotor Deficits

- Disturbance in Head-Neck Awareness
- Patient complains of:
 - Wobbling head
 - Spacey
 - Floating
 - Lightheaded but not pre-syncope

Joint Position Error Assessment



Post-Traumatic Migraine Profile

- 40% of adolescents report experiencing post-traumatic migraines following concussion (Kontos, et al, 2013)
- Personal/familial hx of migraine → Predispose?
- Symptoms:
 - Variable headache and intermittently severe
 - Nausea with Photo and/or phono-sensitivity
 - Stress, anxiety, lack of exercise, dysregulation
 - May present with vestibular-migraine symptoms
- VOMS Screening may be normal



(Collins MW, KontosA, et al, KSST, 2014)

Anxiety Profile

Characteristics:

- Hypervigilance, rumination
- Overwhelmed (poor tolerance of busy environments)
- Difficulty initiating sleep (unable to turn thoughts off)
- Difficulty maintaining sleep
- Excessive focus on/inventory of symptoms
- Limited socialization



Rest and Exertion Following Concussion

Strict Rest vs Early Physical Activity

Thomas et al. 2015 → strict rest (5 days) had ↑# of symptoms and longer symptom duration

- Strict rest > 48 hours offered no added benefit

Grool et al. 2016 → activity to tolerance was better than strict rest or forced high intensity exercise early on

- Less likely to experience persistent symptoms at 28 days post-concussion
- Returning to activity can reduce stress/anxiety, decrease symptom rumination, and allow social interaction

Autonomic Dysfunction

- Sleep Disturbance
- Exercise Intolerance
- Light-headed/Dizziness
- Headache
- Fatigue
- Nausea
- Brain Fog
- Elevated HR
 - Resting
 - With exercise
- + Orthostatic vital signs
- Abnormal graded exercise test

Patients with concussion and TBI demonstrate ↑sympathetic nervous system output than controls

- ↑resting HR
- ↑ HR during cognitive and physical exercise
- ↓ Heart Rate Variability (HRV)
- Altered cerebrovascular reactivity after concussion
- Aerobic exercise promotes healthy ANS function
- ↑parasympathetic nervous system activity
- ↓ sympathetic nervous system activity
- ↑CBF

Graded Exertional Assessment

- Assess exercise tolerance
- Identify physiological variables associated with symptom exacerbation
- Allows for appropriate dosing following concussion
- Progressive increase in intensity using symptoms, to determine physiologic response
 - Establishes symptom threshold
- Bike test may be more appropriate
 - Strong oculomotor, vestibular component?
 - Kids?
 - Motion sensitivity?



Graded Exertional Assessment

Sx at rest:

Baseline Perceived Exertion (6/20):

Initial Parameters:

3.3 mph at 0% incline

[Can be adjusted for height and athletic ability (Range: 2.5 mph - 3.8 mph)]

Test progression:

Increase grade 1.0% after 1 minute

Once at 15% grade, ↑ speed 0.4 mph each minute until exhaustion.

Test Cessation:

-symptoms increase >3 points

-appears faint/unsteady

-patient fatigues and needs to stop

Baseline:	3.3mph, 0% incline,	bpm,	/20 borg,	/10 sx rating
1min:	3.3mph, 1% incline,	bpm,	/20borg,	/10 sx rating
2min:	3.3mph, 2% incline,	bpm,	/20borg,	/10 sx rating
3min:	3.3mph, 3% incline,	bpm,	/20borg,	/10 sx rating
4min:	3.3mph, 4% incline,	bpm,	/20borg,	/10 sx rating
5min:	3.3mph, 5% incline,	bpm,	/20borg,	/10sx rating
6min:	3.3mph, 6% incline,	bpm,	/20borg,	/10sx rating
7min:	3.3mph, 7% incline,	bpm,	/20borg,	/10sx rating
8min:	3.3mph, 8% incline,	bpm,	/20borg,	/10sx rating
9min:	3.3mph, 9% incline,	bpm,	/20borg,	/10sx rating
10min:	3.3mph, 10% incline,	bpm,	/20borg,	/10sx rating
11min:	3.3mph, 11% incline,	bpm,	/20borg,	/10sx rating
12min:	3.3mph, 12% incline,	bpm,	/20borg,	/10sx rating
13min:	3.3mph, 13% incline,	bpm,	/20borg,	/10sx rating
14min:	3.3mph, 14% incline,	bpm,	/20borg,	/10sx rating
15min:	3.3mph, 15% incline,	bpm,	/20borg,	/10sx rating
16min:	3.7mph, 15% incline,	bpm,	/20borg,	/10sx rating
17min:	4.1mph, 15% incline,	bpm,	/20borg,	/10sx rating
18min:	4.4mph, 15% incline,	bpm,	/20borg,	/10sx rating
19min:	4.8mph, 15% incline,	bpm,	/20borg,	/10sx rating
20min:	5.2mph, 15% incline,	bpm,	/20borg,	/10sx rating

Test Termination:

0min:	2.5mph, 0% incline	bpm,	/10sx rating
1min:	2.5mph, 0% incline	bpm,	/10sx rating
2min:	2.5mph, 0% incline	bpm,	/10sx rating

BP pre = HR pre =

BP post = HR post =

Questions



Clinical Pearls Across the Life Span

Pediatrics and Athletes

- Typical Recovery: 3-4 weeks (longer than previously described)
- School Cognitive Demands
 - School accommodations
- Head impact is required to sustain a concussion
 - Can be direct or indirect impact (whiplash event)
- Even if neck pain absent, screen cervical spine!
 - Cervical HA referral common
- Delayed start to therapy may result in increased associated symptoms
 - Falling behind in school
 - Increased depression or anxiety
 - Social withdrawal
 - Deconditioning
- Following a concussion, complete rest should be implemented until symptoms subside
 - Physical and cognitive rest → 2-3 days
 - Gradual return to activity

Older Adults

- Aging process and PLOF may impact tolerance to some tests (Furman, 2010)
 - Cervical ROM
 - Pain
 - Alteration in sensory systems
 - Medical comorbidities
 - Activity level at baseline

Older Adults

- More likely to have physical deficits requiring inpatient stay (Mosenthal, 2004)
- Consider impact of medication induced delirium on assessment
- Screen all older adults post fall for concussive symptoms (Furman, 2010)
- Consider impact of age on concussion specific balance tests
 - BESS
 - HiMAT

Acute Care/Inpatient Settings

- Screen individuals with traumatic injuries for signs/symptoms of concussion (Mosenthal, 2004)
- Consider timing of signs/symptoms and exertional factors in people who are deconditioned or post trauma
- Educate early on regarding the positive prognosis associated with concussion
- Early referrals to interdisciplinary team

Lab on Assessment Techniques

Developing and Implementing the Plan of Care

Does Everyone Recover The Same?



Established Predictors of Prolonged Recovery

- Hx of previous concussion
- Younger Age (Field, Lovell, Collins et al. J of Pediatrics, 2003)
- Migraine History (Kontos, Collins, Elbin, French, Simenski, AJSM, 2013)
 - Personal
 - Familial
- Previously diagnosed learning disability (Kontos, Elbin, Collins, Brain, 2013)
- Female Gender (Colvin, Lovell, Pardini, Mullin, Collins, AJSM, 2009)
- Hx of Motion Sickness or Ocular Dysfunction
- On-field Dizziness/Dizziness at time of initial injury (Lau, Collins, Kontos et al, AJSM 2012)
 - ***Only on-field symptom predictor of prolonged recovery
 - >6x more likely to have prolonged symptoms
- Not removing from play
 - ***8x risk of prolonged recovery (Elbin et al. 2016)

Removal From Play

Elbin et al.

- Prospective study; 13-19 y/o athletes
 - 35 Removed from play
 - 34 Continued to play (avg. 24 minutes longer)
- Continuing to play **DOUBLED** recovery time

	Removed (n=32)	Continued to Play (n=30)
Days to Medical Clearance	21.97 +18.68 Days	44.37 +36.03 Days

- Continuing to play → **8.80x more likely** protracted recovery (>21 days)

Removal From Play

- **Asken et al.**

- 97 Collegiate (NCAA division 1) athletes with concussion
 - Immediate Removed (48.5%)
 - Delayed Removal (51.5%)
- **Delayed Removal → 4.9 more days missed**
- **2.2x more likely** for prolonged recover (>1 week)

(Asken et al, 2016)

Gender

• Females

- 2x ↑ prevalence
- Tend to have longer course of recovery than males
- Tend to report more symptoms and higher symptom intensity
- Post-injury profile is often worse

- Some research beginning to dispute prevalence of males versus females



Age

- Typical Recovery Timeframes:
 - Adults: 10-14 days
 - Adolescents: 3-4 weeks
- Younger aged athletes tend to take longer to recover
- Non-athletes: older age seems to be risk factor for poorer outcome (Lannssjo 2013; Field 2003)



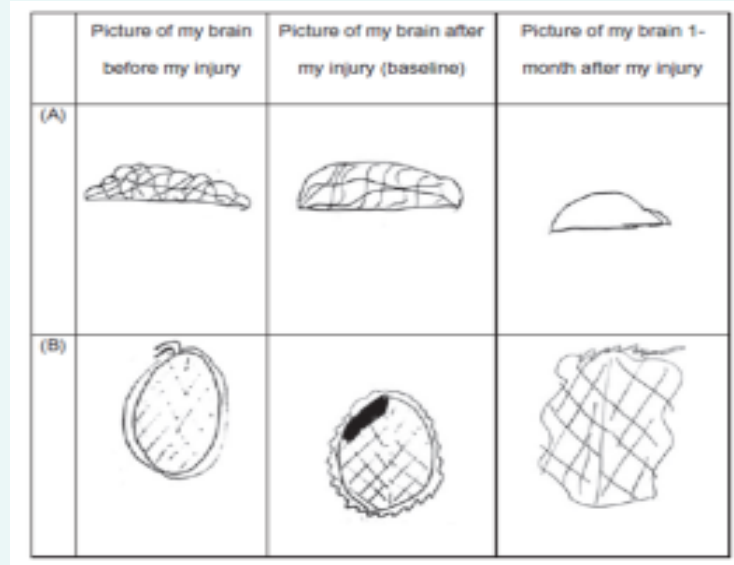
External Risk Factors

- Negative media/society perceptions
 - Fear mongering
- Approach of treating clinician(s)
 - Attitudes/beliefs
 - Evidence based?
 - Up to date?
- Multiple clinicians w/ differing viewpoints
 - Importance of cohesive, multidisciplinary team

Injury Perceptions

- Brain Drawings

(Jones KM, Psychology & Health, 2016)



- People who drew more damage, reported more symptoms
- Poor outcome at 3 months:
 - Stronger beliefs about injury identity
 - Emotional impact
 - Higher educational attainment
- Promote gradual return to activity, minimize withdrawal

Importance of Wording

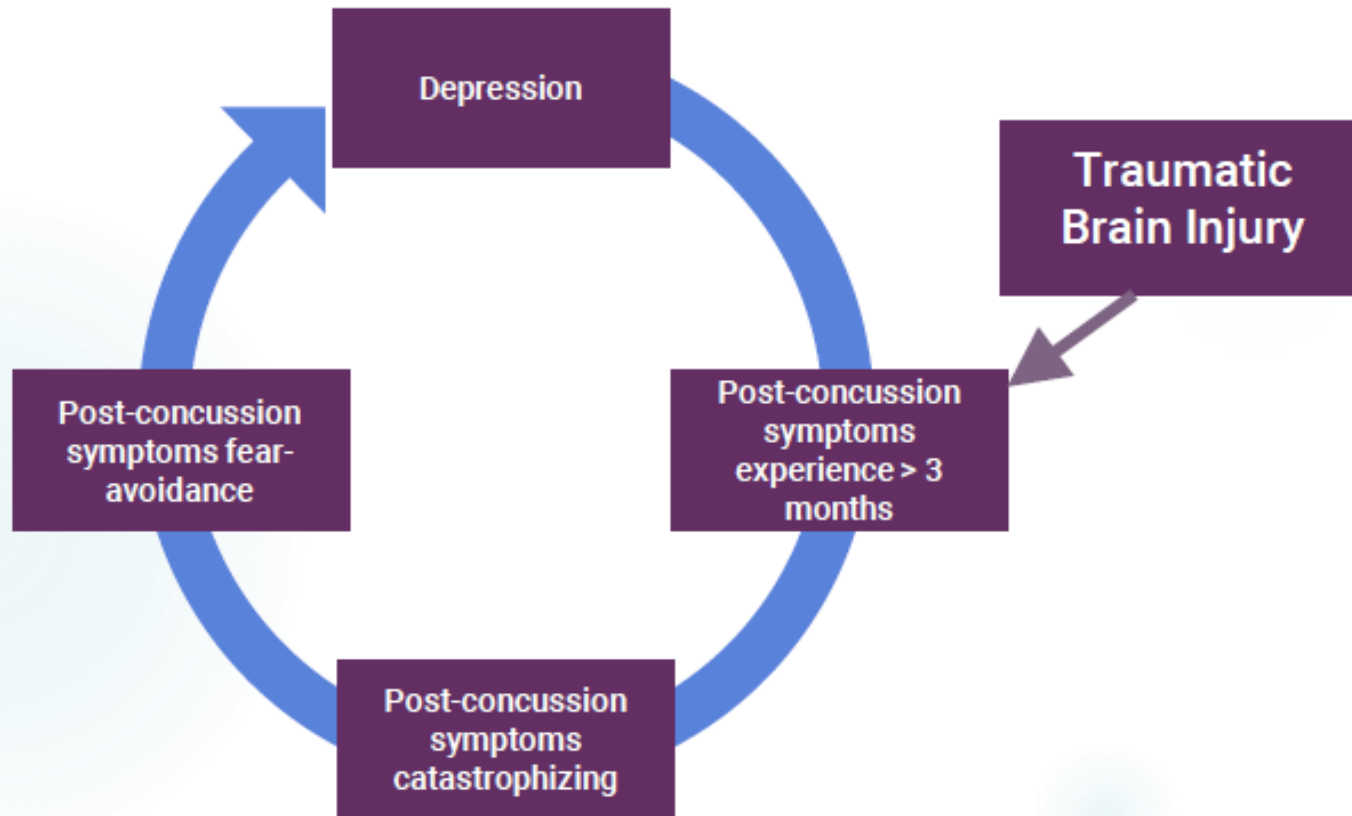
- Post Concussive Syndrome vs Post Concussive Symptoms

Journal of the International Neuropsychological Society (2014), 20, 157–167.
Copyright © INS. Published by Cambridge University Press, 2013.
doi:10.1017/S1355617713001264

Influence of Negative Stereotypes and Beliefs on Neuropsychological Test Performance in a Traumatic Brain Injury Population

- Individuals who were told they would likely do poorly on a cognitive test due to their concussion did poorly
- Individuals who were told they would do well on a cognitive test due to their recovery did well

Fear Avoidance Model

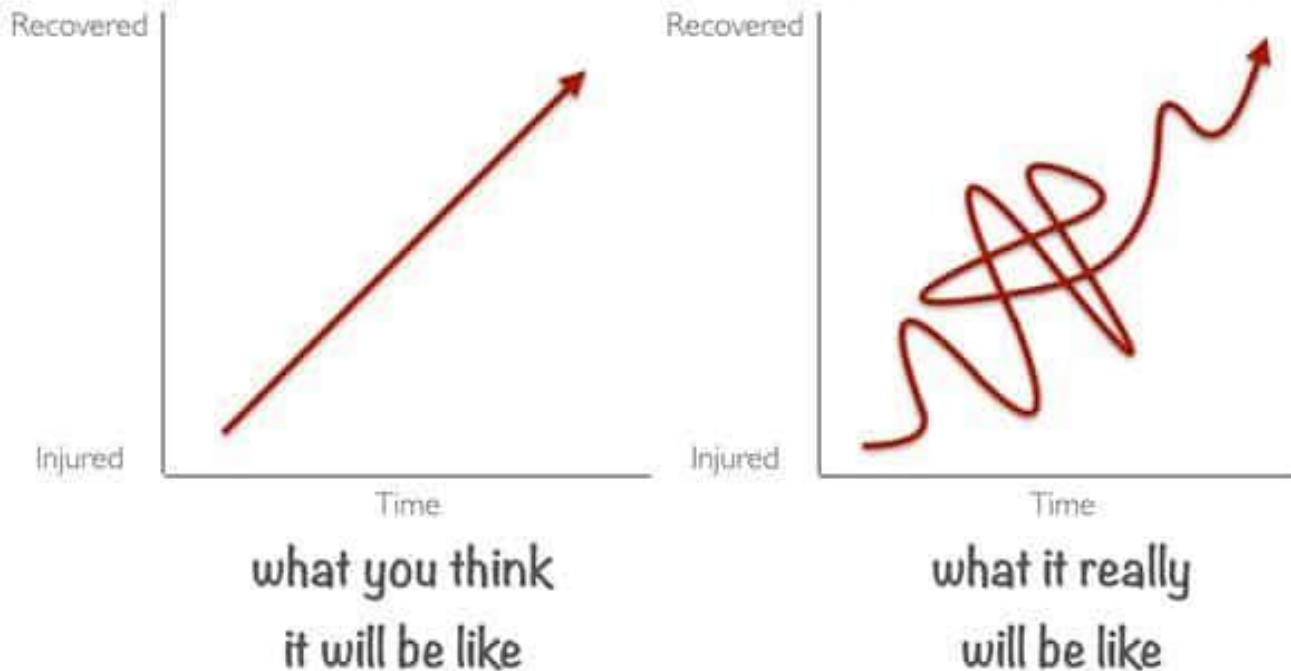


(Wijenbergh MLM, Brain Injury, 2017)

Importance of Education

THE ROAD TO RECOVERY

The Sports Physio @adammeakins



www.thesportsphysio.com

Intervention Planning

Intervention Planning

Impairment	Intervention
Impaired visual signs	Oculomotor exercises
Impaired DVA/VOR	Adaptation/Gaze stability exercises
Positive Positional Testing for BPPV	Perform Canalith Repositioning
Impaired Postural Stability	Sensory integration activities, gradual progression of balance activities integrating the vestibulo-ocular system and dual tasking
Motion Sensitivity and Phobias	Habituation exercises to provoking activities, Education
Exertional Rehab	Guided aerobic conditioning
Cervical Dysfunction	Interventions to address musculoskeletal domain

Key Points

- **Grading activity** → pushing into the symptoms, but working just within the patient's limits of tolerance
- **Attention to signs of over stimulation:**
 - Worsening of symptoms (headache dizziness, nausea)
 - Decreased quality of exercises/movement
 - Increased behavioral issues
- **Providing patient education**
 - Gradual return to activities
 - Self regulation

Oculomotor Exercises

- Consider Referrals
- Tracking
- Saccades
- Pencil Push-ups

Adaptation (Gaze Stability) Exercises

➤ VOR x 1 Viewing

- Stable target with head moving

➤ VOR x 2 Viewing

- Target moves in the opposite direction of the head

*Can progress within each of these categories by:

Adaptation (Gaze Stability) Exercises

- VOR cervical adaptation exercises
- Imaginary Target

Habituation Exercises (Herdman, 2014)

- Desensitize the system through repeated exposure to the thing that causes onset of symptoms
 - Frequent approach for central impairments and motion sensitivity
 - Start with 5 reps of the activity that causes issues 2-3 x/day
 - Patient should wait for symptoms to return to baseline in between each repetition of the movement

Balance Training

- Prescriptive balance assessments to target specific deficits
- Sensory Re-organization
 - **Alter visual input:** close eyes, dark room, sunglasses, busy vs calm background, visual tracking during balance task
 - **Alter somatosensory input:** foam, grass, ramps, gravel, wobble boards
 - **Alter vestibular demand:** integrating head turn in all direction, frequent position changes, trampoline, moving backgrounds

Balance Training

- Increase cognitive load during balance activities
 - Specific sequencing
 - Integrate tasks requiring mental flexibility on top of balance exercise
- Balance reactions
 - Vary speed



<http://yourtherapysource.blogspot.com>

Cervical: Brain or Strain?

Symptoms

- “Stiff neck”
- Neck pain
- Pain with Cervical ROM
- Cervical paraspinal tenderness
- HA that radiates from upper cervical spine to occiput
- Pain precipitated or aggravated by specific neck movements or sustained neck posture.

Diagnostic Challenge: Symptoms

Concussion

- Headache
- Dizziness
- Sensitivity to noise, light
- Balance problems
- Fatigue
- Concentration and memory problems
- Irritable, sad, anxious

Whiplash

- Neck pain/stiffness
- Dizziness
- Headaches
- Unsteadiness
- Fatigue
- Concentration and memory problems
- PTSD

✓ [cdc.gov/concussion/signs_symptoms.html](https://www.cdc.gov/concussion/signs_symptoms.html)

✓ Merrick D, BMC Res Notes. 2010; 3: 190.

Cervical

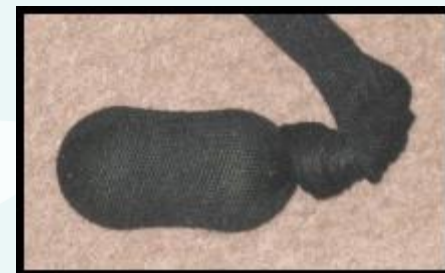
- Soft Tissue Flexibility
- Manual Therapy Interventions
 - Soft tissue
 - Mobilization/Manipulation
- Neck Flexor and Extensor Training
 - Strength
 - Endurance
- Joint Position Sense
- Scapulothoracic muscle strength
- Posture education

Cervicovestibular rehabilitation in sport-related concussion: a randomised controlled trial

Kathryn J Schneider,^{1,2} Willem H Meeuwisse,^{1,3} Alberto Nettel-Aguirre,^{2,3,4} Karen Barlow,² Lara Boyd,⁵ Jian Kang,¹ Carolyn A Emery^{1,2,3}

Conclusions A combination of cervical and vestibular physiotherapy decreased time to medical clearance to return to sport in youth and young adults with persistent symptoms of dizziness, neck pain and/or headaches following a sport-related concussion.

Cervical- ROM/Flexibility



Progression: combine with manual therapy

Cervical- Manual Therapy

Manual Therapy Goal: Decrease pain to normalize afferent input

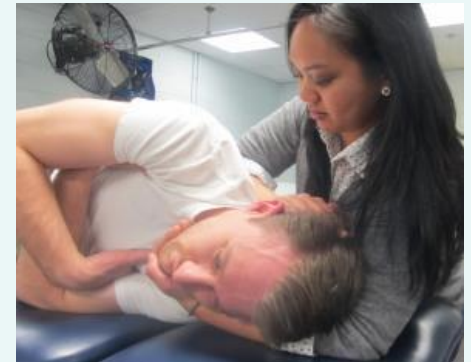
OA Region Hold–Relax Technique



Upper Cervical Mobilizations through Jaw



Side-lying OA Traction Manipulation



AA Region Hold–Relax Technique



Cervical Side glide, Down glide



Seated Mid Thoracic Distraction Thrust



Cervical and Scapulothoracic Strengthening



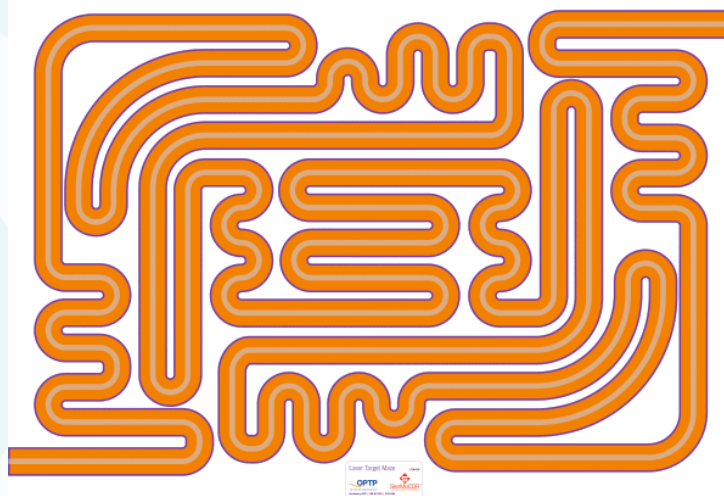
Progression: Incorporate w/ vestibulo-ocular exercises; circuit training, incorporate w/ joint position retraining

Cervical

Cervical proprioception training

Exercise Examples:

- Using target for head turns
- Wall drawing/tracing
- Mazes



Progression: incorporate into balance activities, perturbations to head, body, surface

Post-Traumatic Migraine

- Treatment:
 - **“Behavior Management”/Regulation**
 - Regulated Sleep
 - Hydration
 - Regulated diet
 - Reduce Stress
 - Exercise
 - **Physical Activity!!!!**
 - **Pharmacological Tx** (Worthington et al, 2013)
 - Tricyclic Antidepressants
 - Amitriptyline
 - Anticonvulsants
 - **Migraine abortives**
 - **Imitrex, Maxalt**



Cognitive Fatigue

- Risk Factor → previous learning disability or ADHD

- **Symptoms:**

- Fatigue
- general headache
- “end of day” symptoms
- may have sleep deficits



http://www.sott.net/images/8/175712/full/man_yawning.jpg

- **VOMS** → often normal or only mildly provocative
- **Treatment:**
 - Cognitive/Physical rest breaks throughout day
 - **Monitored exertional progression**
 - Cognitive therapy (e.g. speech therapy)

Anxiety/Mood

- Psychotherapy (Cooper et al., 2015)
- Expose/Recovery Treatment Model (Abramowitz et al., 2012)
- **Supervised Exertional Therapy** (Gagnon et al., 2015)
 - Be Aggressive!
- **Behavioral Regulation**
 - Regulated sleep-no naps, exercise, diet, hydration, reduced stress
- Pharmacological:
 - Antidepressants
 - SSRIs
 - Benzodiazepines
 - Clonazepam



[illegible]

- Discourage hypervigilance and catastrophic thinking
- Encouragement throughout the process
 - Emphasize improvement
- Ensure patient is involved in treatment process
 - What are their stress relievers?

Somatization

- “the generation of physical symptoms of a psychiatric condition such as anxiety” (wikipedia)
- “tendency to experience and communicate psychological distress in form of somatic symptoms”
- Be aware of pre-existing stress/anxiety

PT Approach:

- Active approach- avoid passive tx
- Participation/activity/life goals rather than symptom goals
- Accountability from patient regarding improvement
- Confront unrealistic expectations
- Stress management!!!
 - Prevent overload
 - Minimize anxiety
- “Facilitate and Help” Be their coach

Hypersensitive Patient

- Usually coexists w/ anxiety and migraine profiles
- Treat w/ Expose-Recover model → habituation/improve tolerance
- Avoid shutting down, cocooning them
 - Avoid removing from school, work, etc
 - Accommodations as necessary
- Encourage normal social interaction
- AVOID frequent symptom inventory
 - “symptom-free” not necessarily the goal
- Limit/avoid use of aides to filter stimuli; unless absolutely necessary



GOAL: Function and Participation!!!!

Active Intervention

- SRC Clinical Profiles: (Sandel et al 2017, Collins et al 2014, Leddy et al 2016)
 - Mood and Anxiety
 - Post-Traumatic Migraines
 - Oculomotor Deficits
 - Vestibular Deficits
 - Cognitive Fatigue
 - Cervical Spine Deficits
 - Physical Deconditioning
 - Autonomic Instability

**Pretty much
everyone!**

Exertion/Physical Activity

- Use caution if vestibulo-ocular sx still present when initiating activities with head/eye movement (e.g. elliptical/jogging)
- Functional/sport/task specific → incorporating areas of deficit
 - e.g. backbends and jumps for a cheerleader
- Ensure individual (especially athletes) can succeed with challenges to multiple sensory, motor and cognitive systems
 - e.g. skater bounds w/ head turns for hockey player
- Incorporate tasks to challenge executive function, gaze stability, pursuit tracking, dynamic stability, exertion, etc.
 - Exercises targeting multiple systems (e.g. squats w/ VOR and number counting)

Monitoring Physical Activity



Physical Activity Prescription:

- 20 min/day
- 5-6days/week
- Sub-symptom Threshold
(approximately 80% threshold HR)
- Increase 5-10bpm every 2 weeks

Rating	Perceived Exertion
6	No exertion
7	Extremely light
8	
9	Very light
10	
11	Light
12	
13	Somewhat hard
14	
15	Hard
16	
17	Very hard
18	
19	Extremely hard
20	Maximal exertion

rating	description
0	NOTHING AT ALL
0.5	VERY, VERY LIGHT
1	VERY LIGHT
2	FAIRLY LIGHT
3	MODERATE
4	SOMEWHAT HARD
5	HARD
6	
7	VERY HARD
8	
9	
10	VERY VERY HARD (MAXIMAL)

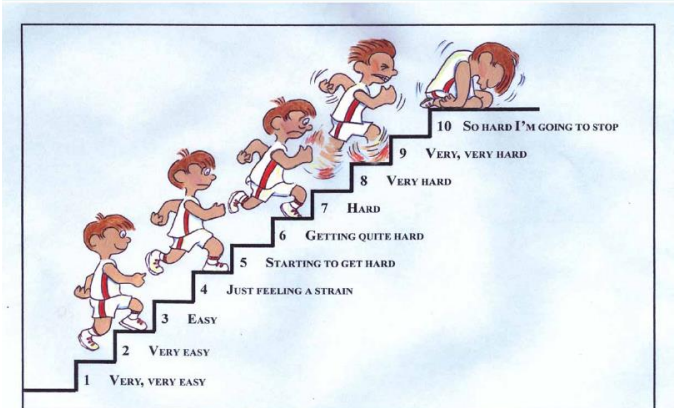


Table 1. The Borg Rating of Perceived Exertion Scale

Exertion Therapy Progression

Stage 1

- Limited head movement, impact, noise, position changes, dual tasking

Stage 2

- Incorporate head movement, positional changes, busier environments, low impact
- Low level dual tasking

Stage 3

- More aggressive intensity (resistance training), higher impact, concentration challenges
- Addressing strength, conditioning, coordination

Stage 4

- Maximum exertion, sport specific activities
- No contact

Stage 5

- Sport specific, Full Impact and Contact

We know children.

- Date:

[illegible]

Importance of Compliance

Recent study b
found that thos
w/ symptoms @
non-compliant v



Recovery Endpoint?

- The endpoint of recovery from a concussive injury is multifaceted

Example of Criteria:

- return of neurocognitive functioning to preinjury levels,
- return of balance function to preinjury levels,
- absence of symptoms (or return to preinjury levels) at rest
- absence of symptoms when engaged in physical or cognitive activity.

(Sady et al, Phys Med Rehabil Clin N Am. 2011)

- Neurobiological recovery might extend beyond clinical recovery in some athletes
-

Recovery Endpoint?

Can we expect to be symptom-free?

Concussion-Like Symptoms in Child and Youth Athletes at Baseline: What Is “Typical”?

Anne Williams Hunt, PhD*; Melissa Paniccia, MSc†; Nick Reed, PhD*; Michelle Keightley, PhD*

Key Points

- Up to 67% of healthy child and youth athletes experienced mild to moderate symptoms at baseline, including fatigue, nervousness, and drowsiness.
- In youths, more symptoms were reported with increasing age and number of previous concussions.
- In the absence of preinjury baseline data, complete symptom resolution after concussion should not necessarily be expected, particularly regarding fatigue-related symptoms.

- Fatigue (50% boys, 67% girls)
- Headaches, drowsiness, difficulty concentrating (25% ea)
- Nervousness (32%)
- Sleepier than usual (30% boys, 24% girls)
- 19% boys, 28% girls → symptoms resembling PCS (no concussion hx) (Iverson et al 2015)

Recovery Endpoint?

Neurocognitive Testing:

Abeare et al. 2018

- Baseline testing (Ages 10-21)
 - 55.7% failed at least 1 of 4 validity indicator
 - 10-14 y/o → 83.6%
 - 21 y/o → 29.2%

Vestibular and Oculomotor Findings:

Corwin et al.

- Non-concussed individuals (Ages 6-18)
 - 24% failed at least one element of modified VOMS
 - 13% failed >1 testing element
 - 5% failed >2 testing elements

When Can I Return to Sports?

Berlin Consensus Statement (2017)

Table 1 Graduated return-to-sport (RTS) strategy

Stage	Aim	Activity	Goal of each step
1	Symptom-limited activity	Daily activities that do not provoke symptoms	Gradual reintroduction of work/school activities
2	Light aerobic exercise	Walking or stationary cycling at slow to medium pace. No resistance training	Increase heart rate
3	Sport-specific exercise	Running or skating drills. No head impact activities	Add movement
4	Non-contact training drills	Harder training drills, eg, passing drills. May start progressive resistance training	Exercise, coordination and increased thinking
5	Full contact practice	Following medical clearance, participate in normal training activities	Restore confidence and assess functional skills by coaching staff
6	Return to sport	Normal game play	

NOTE: An initial period of 24–48 hours of both relative physical rest and cognitive rest is recommended before beginning the RTS progression.

There should be at least 24 hours (or longer) for each step of the progression. If any symptoms worsen during exercise, the athlete should go back to the previous step.

Resistance training should be added only in the later stages (stage 3 or 4 at the earliest). If symptoms are persistent (eg, more than 10–14 days in adults or more than 1 month in children), the athlete should be referred to a healthcare professional who is an expert in the management of concussion.

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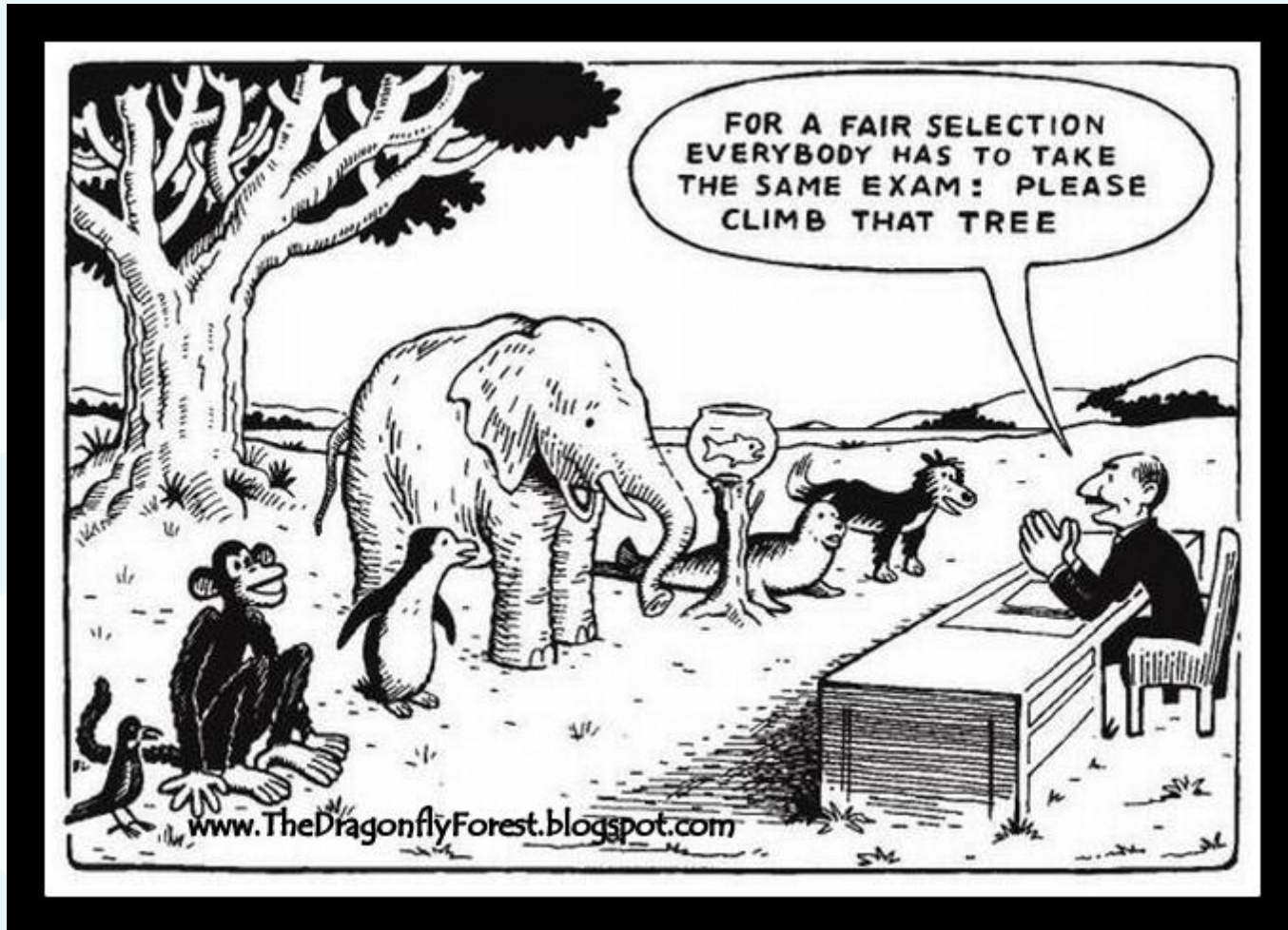
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Resistance training should be added only in the later stages (stage 3 or 4 at the earliest). If symptoms are persistent (eg, more than 10–14 days in adults or more than 1 month in children), the athlete should be referred to a healthcare professional who is an expert in the management of concussion.

Return to Play Guidelines

- Each step represents 24 period (minimum)
- Symptom onset → stopped and returned to previous step
- Licensed healthcare practitioner makes final RTP determination who has been trained in the evaluation and management of concussions
 - Dependent on each state's law
 - Nebraska → MD, DO, PA-C, APRN, Neuropsychologist, ATC

So what does this all mean?



Return to Learn (Purcell, 2018)

- Gradual return to school: 2-5 days for most students
- 45% may experience an exacerbation

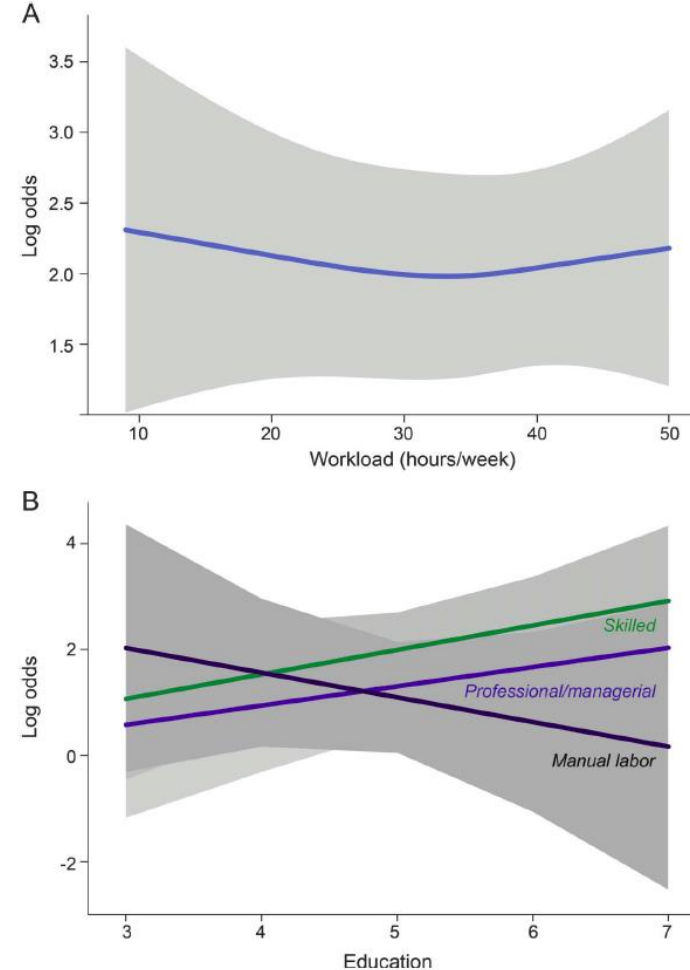
Risk Factor	Increased Risk For Missing Days
1. Symptom load/severity	More severe symptoms
2. Types of Symptoms	Headaches, visual deficits, memory deficits, difficulty concentrating, executive dysfunction
3. Duration of Symptoms	Longer duration of symptoms
4. Age or grade	After age of 13 or high school grades
5. Course Load	Math followed by reading/language classes
6. Rest following injury	Did not rest at all or took on high cognitive loads

Return to Learn

- 2014 Nebraska Legislative amendment (LB782/AM2057) to the Nebraska Concussion Awareness Act requires school to have plan for return to learn
- 504 Plan or IEP if symptoms persist
- Website has resource table with examples of accommodations

Return to Work (Koning, 2017)

- Prospective study of 1,151 people seen in the ER
- Follow up at 2 weeks, 3 months, 6 months, and 12 months
- Results:
 - 34% complete return to work at 2 weeks
 - 77% complete return to work at 1 year
 - Prior to 6 months = occupational factors
 - After 12 months = psychological distress and extracranial complaints



(Koning, 2017)

Return to Learn/Work

- Optimal time and specific accommodations have not yet been defined
- Symptom spikes may be sign of suboptimal recovery
- Examples of accommodations (Purcell, 2018)
 - Frequent breaks
 - Reduced workload
 - Initially no tests
 - Increased time
 - Preferential seating
 - Reduced visual/auditory stimulation
- GRADUAL RETURN TO WORK/SCHOOL (Irvine, 2017; Koning, 2017)

Older Adult

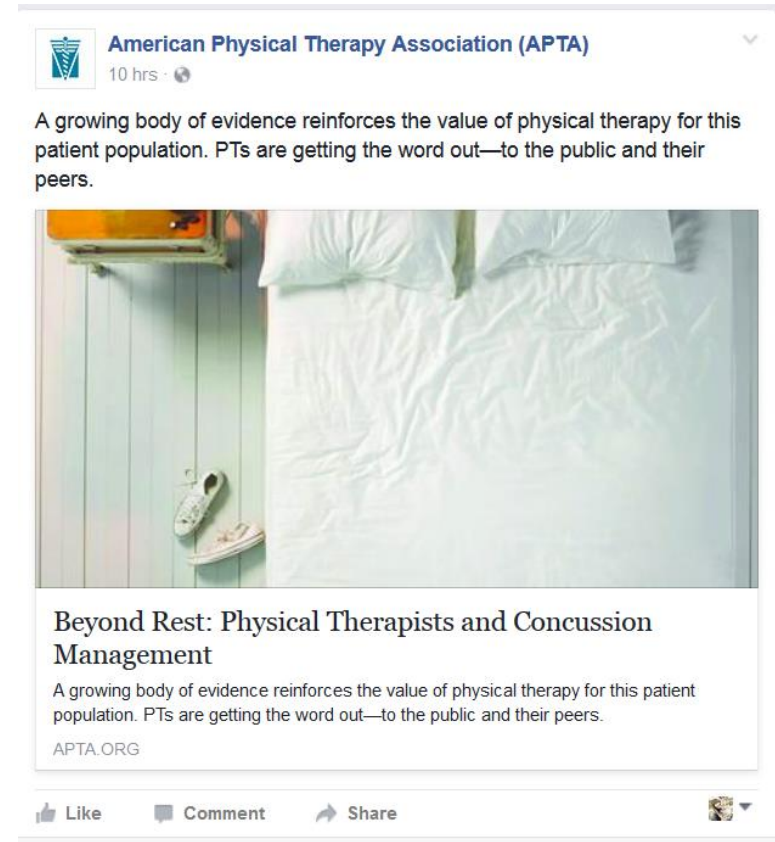
- May or may not be working
- Focus on activity limitations and participation restrictions (Mosenthal 2004; Teo, 2018))
- Integrate strategies for reducing risk for falls with specific exercises to address post concussion symptoms (Furman, 2004; Teo, 2018)

Special Considerations when Multiple Diagnosis

- Observe timing of signs and symptoms as they fluctuate
 - What type of environment is the patient in when signs/symptoms increase?
 - Is over stimulation a possible factor?
 - May not need to get on a treadmill to train exertional domain
- Need to prioritize injuries to address all of patient's needs
- **Patient/family/caregiver education** is key
 - Self regulation to manage symptoms
 - Anticipated recovery process

Clinical Pearls

- Unique pathophysiology requires close assessment of symptoms
- Awareness of signs of over-stimulation
- Consider the environment
- Emphasis on gradual return to activity and return to learn
- Patient education is key
- Developing practice area
 - Ongoing research
 - National Concussion Surveillance System (CDC)¹⁷



Clinical Pearls

- Need team approach and close communication within treatment team, family, school
- Restrain from high risk activities, but push early return to learn and low risk physical activity
- Individualized early treatment planning
 - Especially if symptoms only → get moving early
 - Signs (LOC, PTA, confusion, disorientation) → early limited prescribed rest and then get moving
- Importance of Wording
 - Post-Concussive Syndrome vs Post-Concussive Symptoms
- No two concussions are the same, not a cookie cutter approach
- Make FUN!!!

???? Questions ???

Case Studies

Concussion Management for the Physical Therapist: From Pediatrics to the Older Adult

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