



**HEADS**  
**UP**

WEBINAR SERIES

# Physical Therapy Evaluation and Intervention in Concussion and Post Concussion Syndrome

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# Objectives

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1. Define concussion and typical course of recovery
2. Describe post concussion syndrome and potential risk factors
3. Discuss current diagnosis of concussion
4. Identify current consensus on rest vs. exercise and return to play/activity
5. Discuss physical therapy evaluation and evidence for intervention in concussion and post concussion syndrome

# Concussion

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- A complex pathophysiologic process affecting the brain, induced by traumatic biomechanical forces secondary to direct or indirect forces to the head
- A jolt to the head OR BODY that disrupts function of the brain
- A mild traumatic brain injury (mTBI)
- Functional disturbance rather than structural injury
  - Complex cascade of ionic, metabolic, and physiologic events (neurometabolic cascade)
  - Microscopic axonal dysfunction
    - Axon stretching and shearing occurs
  - Typically normal structural neuroimaging

# Brain on Concussion

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- Damage during concussion
  - Brain is like JELLO
  - Direction of hit may matter
    - Lateral vs. anterior/posterior
- What happened to this player's brain?

# Concussion continued

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- May or may not involve loss of consciousness
- General Classification System for mTBI:
  - Duration of unconsciousness: < 30 minutes
  - Glasgow Coma Scale: 13-15
  - Posttraumatic Amnesia: < 24 hours
  - Duration of symptoms is variable from several minutes, days, weeks, months or even longer in some cases
    - Typical recovery is within 7-10 days with longer end up to 6 weeks

# Symptoms

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- Headache (94%)
- Balance and/or dizziness (75-79%)
- Blurry vision
- Neck pain
- Sensitivity to light and noise
- Fogginess
- Concentration/memory issues (79%)
- Confusion
- Nausea and/or vomiting
- Sleep disturbance
- Slowed processing
- Irritability
- Nervousness/anxiety
- Sadness/Depression
- Fatigue/low energy

# Post Concussion Syndrome (PCS)

- Persistent, nonspecific symptoms following a mild TBI/concussion (one or three months post-injury) that persist beyond the normal window of recovery
- No current, clear understanding of the evolution, duration, & resolution of symptoms
- Estimated 10%-20% develop PCS
- PCS is not synonymous with concussion.
- PCS can persist for over one year following injury
- PCS symptoms found in those without injury (Donnell et al, 2012)

# Post Concussion Syndrome



Symptoms are similar to concussion and could overlap/mimic:

- Physical illness: Cervical pathology, Migraine, Peripheral vestibular involvement, chronic pain
- Psychological/Emotional Disorder/Acute Stress
- Extreme Fatigue
- Autonomic dysregulation has been identified in many of these conditions

General population experiences PCS symptoms in daily life

- 15-39% of non-injured controls endorsed post-concussive symptoms (Lange et al., 2010)

# Risk Factors for Prolonged Recovery

- History of anxiety/depression
- Headaches/migraines (Morgan, et al., 2014)
- Autoimmune diseases
- Learning disability or ADHD
- Pending litigation

## At time of injury:

- Post-traumatic migraine (headache with nausea and light/sound sensitivity)
- Immediate dizziness (>6x more likely; >21 days; Lau 2011), amnesia, headache, slowness, imbalance, and numbness

# Risk Factors for Prolonged Recovery

- Most cited reasons for persistent complaints
  - Persistent central nervous system pathology
  - Malingering
  - Expectation effects
  - Psychological conditions either preceding or subsequent to the injury
  - Posttraumatic anxiety responses
  - Pituitary Dysfunction
  - **Vestibular or oculomotor dysfunction**
  - **Chronic pain and/or comorbid injuries to the cervical spine**

(Pertab, L et al., 2018)



# Diagnosing Concussion

- Neuroimaging
  - Diffusion Tensor Imaging (DTI)
    - MRI based that can identify microstructural changes which can estimate location, orientation, and anisotropy of white matter tracts
      - Fractional anisotropy: lower value = more damage to the neuron
  - Susceptibility Weighted Imaging
    - Useful in detecting blood products and can identify microvascular injury and tearing between white/gray matter
  - Blood Oxygen Level Dependent (BOLD)
    - Can assess blood flow during a specific task
  - Need more objective measures

# Current Activity Recommendations

- Concussion in Sport Group (CISG, Berlin, 2017)
  - Initial period of rest during first 24-48 hours followed by gradual return to school and social activities (prior to contact sports) in a manner that does not result in a significant exacerbation of symptoms and that “further research evaluation rest and active treatments should be performed”
- Transient rest may be advantageous in expediting recovery
  - Avoid contact sports and vigorous play
- 5th International Conference on Concussion in Sport
  - “The exact amount and duration of rest is not yet well defined in the literature and requires further study”
- Strict rest beyond 2 days prolonged symptom recovery and can be detrimental to mental health (Leddy et al., 2018; Lennon et al, 2019)



# When is Physical Therapy a good idea?

- Currently in the literature
  - PT can be or may be initiated after 2 weeks for adults, after 4 weeks for children
  - Most studies include those that are at least 3 weeks post concussion
  - Research aimed at determining if earlier intervention (maybe after 7 days?) is better or does this impact natural recovery?
    - Could it potentially decrease risk for prolonged symptoms - is prolonged rest a factor?
- Lennon et al, 2019
  - Multimodal, impairment-based PT is likely safe, regardless of the timing of initiation
  - PT interventions can improve individuals symptoms, irrespective of how early or late initiation of PT occurs
  - Feasible and safe even within the first few weeks after injury to help facilitate prompt recovery and mitigate onset of secondary effects from delayed treatment.

# Recommendations for Post Concussive Rehab



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1. Start with building awareness and psychoeducation
  2. Get a solid history and symptom profile.
  3. Encourage stepwise return to normal activities, work, school in order to decrease maladjustment.
  4. Graded exercise, daily routine/schedule, relaxation and meditation
  5. Treatment for cervical strain, mobility, and pain (Pertab et al., 2018)
  6. Consider possible Autonomic Nervous System involvement
  7. Build a concussion management team with collaborative effort: neuropsychologist, athletic trainer, physical therapist, physician, family members, etc.; Refer out as needed.

# Physical Therapy Intervention

- Physical Intervention

- Facilitates neuroplasticity

- Induction of factors that promote neuron growth and repair

- May lead to improved cerebral blood flow (CBF)

- Low sensitivity to arterial CO<sub>2</sub> causing relative hypoventilation = raises exercise CBF out of proportion to exercise intensity increasing headache and dizziness (Leddy et al, 2018)

- Small improvements in cognition with aerobic training

- Reduce cervical pain, cervicogenic headache, and dizziness

- When symptoms persist: “ There is preliminary evidence supporting the use of:...a targeted physical therapy program in patients with cervical spine and vestibular dysfunction...” (2017 Consensus statement on concussion and sport)

- Need to be addressed and evaluated for individualized treatment interventions; PT treatment in these areas has been shown to be effective (Kvan der walt, et al, 2019; Schneider et al., 2014)

# Physical Therapy Evaluation

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- Strength and range of motion of Upper extremity/lower extremity/cervical spine
  - Posture, pain, joint mobility, soft tissue assessment, neck endurance and strength testing, and proprioception of cervical spine
- Coordination and motor control of Upper extremity/lower extremity
- Vestibular screen
  - Peripheral system, vestibular ocular reflex
- Oculomotor screen
  - Smooth pursuit, saccades, ocular alignment, convergence
- Balance and functional gait
- Endurance
  - Buffalo Concussion Treadmill Test



# Categorizing Symptoms of Concussion

- Cervical, Migraine, Ocular, Vestibular, Cognitive/Fatigue, and Anxiety/Mood
- Developed to allow for more individualized treatment plans and greater targeted strategies
- Many will present with overlapping subtypes
- (Collins et al 2014)



Fig. 2 Clinical trajectories for sport-related concussion

# Vestibular



- Vestibular system has important role in balance function and maintaining upright position in space
  - Sensory information from each inner ear is used to make adjustments to eye movements and reactions of head and body to maintain upright positioning and balance
  - Can involve peripheral or central structures
    - Peripheral - Benign Paroxysmal positional vertigo (BPPV)
  - Can result in imbalance and usually dizziness, vertigo, blurred vision, difficulty in busy environments, and nausea

# Vestibular Evaluation

- Symptoms can include:
  - Dizziness, fogginess, nausea, feeling of being detached, anxiety, and overstimulation in more complex environments
  - “One step behind”
  - Increase in symptoms in busier environments (grocery stores)
  - Rapid head/body movements may increase symptoms
  - Imbalance
- Vestibular Oculomotor Screening:
  - Evaluate movement of eyes and ability of eyes to move together
    - Increased symptoms with horizontal and/or vertical gaze stability
  - Increased visual motion sensitivity
- Cognition:
  - Deficits with visual motor speed, reaction time

# Vestibular Intervention

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- Targeted treatment
  - Vestibular therapy
    - Treatment of peripheral issues (BPPV)
    - Any issues with gaze stability
      - Ability to maintain focus when head is in movement using Vestibular ocular reflex (VOR)
      - Treatment through adaptation

# Vestibular Intervention

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- Visual motion sensitivity
  - Disorientation, dizziness, or imbalance in busy environments
  - Visually dependent
    - Treatment through gradual exposure to provocative environments
- Some may experience emotional changes and anxiety
- Some may experience migraines and poor sleep
  - Consider medical intervention

# Ocular

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- Symptoms can include:
  - Localized, frontal headaches that worsen with visual demands
  - Fatigue, distractibility
  - Pressure behind eyes
  - Difficulties with focus
  - Difficulties with reading
  - Blurry vision, double vision
  - Imbalance
- Vestibular Oculomotor Screening
  - Difficulties with smooth pursuits and saccades
  - Abnormal near point convergence
- Ocular alignment
- Cognition
  - Visual memory and reaction time
  - Deficits with encoding rather than retrieval

# Ocular Intervention

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- Vestibular therapist are able to evaluate and begin treatment
  - Convergence insufficiency and other oculomotor deficits
  - Balance training
- Consider referral for vision therapy provider
  - Alignment issues, unresolved convergence

# Cervical

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- Symptoms may include:
  - Neck pain/soreness
  - Headache (occipital)
  - Symptoms worsen with prolonged sitting/reading postures
  - May c/o dizziness and visual symptoms related to cervical motion or posture
  - Imbalance
- Vestibular Ocular motor screening:
  - Negative
  - Vestibular ocular reflex screen may aggravate symptoms due to head movements
  - Balance testing may be impaired
- Cognitive:
  - Minor to no findings

# Cervical Intervention

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- Targeted treatment:
  - Physical therapy
    - Cervical strengthening
    - Retraining proprioception and balance
- Pharmacological intervention from referring physician
  - Pain control, anti-inflammatories, and muscle relaxers

# Post-Traumatic Migraine

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- Symptoms may include:
  - Unilateral headache of varying intensity, intermittent
  - Nausea
  - Photosensitivity
  - Exacerbated by stress, sleep dysregulation, anxiety or emotional changes, and dietary triggers
  - Sleep dysregulation
- Vestibular Oculomotor screening
  - Normal
- Cognitive:
  - Verbal and visual memory deficits

# Post -Traumatic Migraine

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- Targeted treatment

- Increased cardiovascular activity
  - Initiation of supervised exertion protocol
  - Regulated schedule
- No evidence of long term benefit of physical therapies for migraine and tension-type headache
- Positive evidence for cervicogenic headache
- Pharmacological intervention is likely necessary

(Astin et al 2002; 2000; Tuchin et al 2000; Jull et all 2002)

# Cognitive/Fatigue

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- Symptoms can include:
  - Fatigue with decreased energy levels that worsens as day goes on
  - Non-specific headache that worsens as day continues
  - Attention/concentration deficits with increase in headache with greater cognitive activity
  - Symptoms with physical activity
  - May have sleep deficits
- Vestibular/ocular motor screening
  - Normal Non-specific headache that worsens as day continues
- Cognitive
  - Global reported deficits memory, processing speed, and reaction time

(Collins et al 2014, Comprehensive Concussion Management: "Need to know" Information for Physical Therapist, 2017)



# Cognitive/Fatigue

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- Targeted treatment
  - Physical therapy
    - Exertion is a treatment focus
      - Can be combined with motion if dizziness also occurs
  - Education regarding:
    - Regulated sleep schedule with consistent bedtime and regular waking time
    - Regulate diet, hydration, stress, and exercise
  - Sleep aids may be prescribed by referring physician
  - Neuropsychology services

# Anxiety/Mood

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- Symptoms can include:
  - Increase in anxiety
  - Ruminative thoughts
  - Hypervigilance
  - Feelings of overwhelmed
  - Sadness and/or hopelessness
  - Sleep disturbance (unable to turn thoughts off)
  - Excessive focus on/inventory of symptoms
  - Limited socialization
- Vestibular Oculomotor Screening:
  - Normal or mildly provocative
- Cognitive
  - Normal

# Anxiety/Mood

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- Targeted treatment
  - Exertion is a critical treatment component
    - Emotional release as well as decrease overall arousal level
    - Daily exercise plan
      - Refocus attention to speed recovery
  - Education regarding regulated sleep schedule
    - Consistent diet, hydration, and stress management
  - Neuropsychology services



# Intervention - Acute

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- Optimal timing of initiation of intervention is unknown
- Identify risk factors for prolonged recovery and recommend additional team members as appropriate
- Treat impairments based on evaluation findings and refer when appropriate
- Monitor return of activity and provide exercise prescription based on subthreshold aerobic activity
- Assist with sports specific or work related activities in preparation for return to work/play

# Intervention - Chronic

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- Clear picture of past medical history, course of care, and team members involved in care previously/currently provided
- Treat any impairments based on evaluation findings and refer when appropriate
- Deconditioning is likely in individuals with prolonged or protracted course of recovery so assessment of endurance and exercise tolerance is important
  - Active role in plan of care/control of symptoms
  - Home exercise and walking program and reintroduction of activity into daily routine
- Often times neuropsychology treatment is recommended at same time as physical therapy



# Intervention

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- Intervention driven by subtype with individualized treatment plan
- Not effective at treatment of migraines
- Headaches and dizziness related to cervical spine
- Balance
- Vestibular dysfunction
- Best evidence for treating convergence insufficiency; some evidence for treatment of ocular motor problems
- Exercise for anxiety/mood has been shown to be beneficial

# Referral Resources

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- Neuropsychology Treatment
  - Cognitive Behavioral Therapy, ACT
  - Coinciding with PT in chronic PCS
- Occupational/Speech Therapy
- Cognitive Therapy
- Vision therapy specialist
- Neuro-optometry or ophthalmology
- Holistic Health Providers



# Take Home Points

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- Concussion is a mild brain injury that can have a myriad of cognitive and physical symptoms
- Typical recovery is within 7-10 days however some may have persistent symptoms
- Exact timing for initiating activity and physical therapy interventions is unknown
- Too much rest is detrimental and can lead to prolonged recovery
- Evidence to support categorization of symptoms and use of physical therapy intervention for cervical, balance, vestibular dysfunction, and convergence issues
- Collaboration between disciplines and having an interdisciplinary team is crucial

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