Assessment, Management and Treatment for Concussion and mTBI

Effective Strategies to Improve Pain, Balance and Function

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Learning Objectives

• Identify the current state of concussion research, statistics and management.
• Interpret common red flags and impairments that warrant referral to alternative health care providers.
• Evaluate common concussion assessments, goal setting and trajectories.
• Demonstrate assessment and treatment components of oculomotor and vestibular impairments.
• Demonstrate assessment and treatment components of cervical impairments.
• Identify the key components of a return to play/activity protocol to fully test the vestibular system and ensure complete concussion recovery prior to return to play in the athletic populations.
Who am I?

• Graduated from JMU with degree in Athletic Training  2003
• Graduated from VCU PT school with DPT in 2006
• 12 years clinical experience – emphasis on pediatrics and neurologic physical therapy with specific focus on concussion management for the last 8 years.
• Lead Concussion Clinician for Total Concussion Care Program at Sheltering Arms and lead author of a comprehensive and interdisciplinary clinical practice guideline that is used to guide treatment of concussion
• Entire clinical practice is composed of patients diagnosed with a concussion.
Disclosures

• No financial disclosures to report
• Relationship with Bioness in regards to product research related to use of the BITS with patients who have had a concussion.
Overview

What is the injury?
Why Concussion?

•CONSTANTLY evolving and developing area of practice

•Wide spread media attention
Why Concussion?

Inconsistent spectrum of care and recommendations across the healthcare community
What is a concussion?

- Complex pathophysiologic process affecting the brain
- Induced by traumatic biomechanical forces 2° direct or indirect forces to the head.
- Constellation of physical, cognitive, emotional or sleep-related symptoms, +/- LOC.
- Duration of symptoms is highly variable
“Neurometabolic Cascade”

Trauma/Concussion $\rightarrow$ Axonal stretching $\rightarrow$ ↑ Excitatory neurotransmitters
$\rightarrow$ Efflux of K+ & Influx of Ca++ $\rightarrow$ Neurons attempt to stabilize membrane potential
$\downarrow$
$\rightarrow$ ↑ Glucose metabolism
$\downarrow$
Mitochondrial dysfunction over time
$\downarrow$
Decrease in cerebral glucose metabolism
$\downarrow$
Altered cerebral autoregulation & blood flow
$\downarrow$
Energy/Metabolic crisis = supply and demand mismatch
$\downarrow$
Concussion

(Giza & Hovda, 2001)
Imaging

- Neuroimaging
  - Diffuse tensor imaging (DTI)
  - fMRI (task based)
  - EEG/quantitative EEG
  - Magnetic resonance spectroscopy (MRS)
  - Resting state fMRI

- Fluid biomarker studies
  - Blood (plasma or serum) biomarkers
  - Salivia
  - CSF
  - AMPAR, s100B, total tau ...

- Genetic Testing

- Research vs. Clinical Practices

(McCrea M, et al. 2017)
Definition

Post concussion Syndrome (PCS)

*collection of symptoms that occur after a concussion, symptoms that persist longer than 3 weeks*

- Two clinical criteria
  - International Classification of Diseases (ICD-10)
  - DSM-IV
- Persistent post concussion symptoms - > 4 weeks as defined by new Berlin guidelines

ICD-10 Criteria for Post Concussion Syndrome

- History of TBI

- Presence of 3 or more of the following 8 symptoms:
  - (1) headache
  - (2) dizziness
  - (3) fatigue
  - (4) irritability
  - (5) insomnia
  - (6) concentration
  - (7) memory difficulty
  - (8) intolerance of stress, emotion, or alcohol
Epidemiology

Concussion Incidence and Injury Rate
Epidemiology

• In 2013, about 2.8 million TBI-related emergency department (ED) visits, hospitalizations, and deaths occurred in the United States.

• In 2012, an estimated 329,290 children (age 19 or younger) were treated in U.S. EDs for sports and recreation-related injuries that included a diagnosis of concussion or TBI.

  • From 2001 to 2012, the rate of ED visits for sports and recreation-related injuries with a diagnosis of concussion or TBI, alone or in combination with other injuries, more than doubled among children (age 19 or younger).

CDC website: www.cdc.gov
Epidemiology - causes

• In 2013, falls were the leading cause of TBI. Falls accounted for 47% of all TBI-related ED visits, hospitalizations, and deaths in the United States. Falls disproportionately affect the youngest and oldest age groups:
  • More than half (54%) of TBI-related ED visits hospitalizations, and deaths among children 0 to 14 years were caused by falls.
  • Nearly 4 in 5 (79%) TBI-related ED visits, hospitalizations, and deaths in adults aged 65 and older were caused by falls.

• Being struck by or against an object was the second leading cause of TBI, accounting for about 15% of TBI-related ED visits, hospitalizations, and deaths in the United States in 2013.
  • Over 1 in 5 (22%) TBI-related ED visits, hospitalizations, and deaths in children less than 15 years of age were caused by being struck by or against an object.

• Among all age groups, motor vehicle crashes were the third overall leading cause of TBI-related ED visits, hospitalizations, and deaths (14%). When looking at just TBI-related deaths, motor vehicle crashes were the third leading cause (19%) in 2013.

• Intentional self-harm was the second leading cause of TBI-related deaths (33%) in 2013.

CDC website: www.cdc.gov
Epidemiology

• 38 million children and adolescents participate in organized sports in the United States.

• 170 million adults participate in physical activities, including sports.

• 1.6 to 3.8 million concussions occur in sports and recreational activities, annually.

• Vastly underestimated with so many underreported.

Epidemiology

• Rate of concussion has been increasing steadily over the past two decades
• 5 of 10 concussions go unreported or undetected.
• 2 in 10 high-school athletes who play contact sports — including soccer and lacrosse — will suffer a concussion this year.
• Girls' soccer sees the second-most concussions of all high school sports.
  • Girls’ basketball sees the third most.

http://www.upmc.com/Services/sports-medicine/services/concussion
Why are they all so different?

Risk factors
Why are they all so different?

- Mechanism of injury
- Sex
- Physiology
- Risk Factors/PMH
- Complicating injuries – BPPV, cervical spine involvement
- Psychological/Social affects
Mechanism of Injury

• There are many different head motions that can occur during the injury

• These complex variety of responses makes each mechanism of injury nearly unique

• 2 types of forces – inertial and contact
  • Both occur during impact loading
  • Only inertial forces happen from impulsive head motions (absence of head striking an object)

Meaney et al., 2011
Mechanism of injury
Mechanism of Injury
Concussion mechanism

Whiplash mechanism
<table>
<thead>
<tr>
<th>Concussion</th>
<th>Whiplash</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Headache</td>
<td>• Neck pain/stiffness</td>
</tr>
<tr>
<td>• Dizziness</td>
<td>• Dizziness</td>
</tr>
<tr>
<td>• Sensitivity to noise, light</td>
<td>• Headaches</td>
</tr>
<tr>
<td>• Balance problems</td>
<td>• Unsteadiness</td>
</tr>
<tr>
<td>• Fatigue</td>
<td>• Fatigue</td>
</tr>
<tr>
<td>• Concentration and memory problems</td>
<td>• Concentration and memory problems</td>
</tr>
<tr>
<td>• Irritable, sad, anxious</td>
<td>• PTSD</td>
</tr>
</tbody>
</table>
Gender

• High school females took twice as long to recovery on symptoms compared to males (Baker et al. 2016)
• Females had vestibular-ocular decrements at 2 and 4 weeks post-concussion compared to males (Henry et al. 2016)
• Other researchers have found no sex differences on cognitive recovery between males and females (Zuckerman et al. 2012)

Adapted from Sex Differences in Sports Related Concussion by Tara Covassin PhD from AAN SCC 2017
Injury Rate: Risk by Sport

Per 100,00 athletic exposures

- Football: 64 - 76.8
- Boys' ice hockey: 54
- Boys' lacrosse: 40 - 46.6
- Boys' soccer: 19 - 19.2
- Boys' wrestling: 22 - 23.9
- Boys' basketball: 16 - 21.2
- Boys' baseball: Between 4.6 - 5
- Girl's soccer: 33
- Girls' lacrosse: 31 - 35
- Girls' basketball: 18.6 - 21
- Girls' softball: 16 - 16.3
- Girls' field hockey: 22 - 24.9
- Cheerleading: 11.5 to 14
- Girls' volleyball: 6 - 8.6
- Girls' gymnastics: 7

Adapted from Sex Differences in Sports Related Concussion by Tara Covassin PhD from AAN SCC 2017
High School vs. College

High school
- Soccer: 2.0
- Basketball: 1.8
- Base/Soft: 2.2
- Cross Country: 1.1
- Track & Field: 1.5
- Swim & Dive: 1.7
Total: 1.9

NCAA
- Soccer: 1.8
- Basketball: 1.5
- Base/Soft: 3.7
- Cross Country: n/a
- Track & Field: 1.1
- Swim & Dive: 0.6
- Tennis: 3.2
Total: 1.9

**Women 1.9 times more likely to get a concussion as compared to men**
Physiology

• We all have unique components to brain development and physiology
• Levels of hydration, rest and nutrition at time of injury
• Genetic markers
• Level of exercise at time of injury – increase oxygen and blood flow to the brain
Past Medical History

• Migraines
  • Moderate risk for symptoms > 1 month

• ADD/ADHD/Learning disability
  • Different considerations for overall management but not necessarily at increased risk for symptoms > 1 month

• Anxiety/Depression
  • Moderate risk for symptoms > 1 month

Co-existing injuries

- Co-existing injuries
  - Cervical spine strain
  - BPPV
  - Other orthopedic injury
Psychological/Social Factors

• Psychological/Social Factors
  • Their role on the team
  • Time of season – big games coming up?
  • Finals/SOL testing during school
  • How do their friends/peer react to injury?
  • How do coaches react to injury?
  • How do parents/family react to injury?
  • What is their perception of the injury?
Age-Specific Considerations

- Now estimate that there are 1.1-1.9 million SRC 0-18 occurring annually
  - Including those not seeking medical care
- 180-190,000 occurring in 6-13 year olds.

- This age group requires clear guidelines for:
  - *activity modifications*
  - academic accommodations

- Goal: Return to previous levels of activity
  - However, with athletes in particular, it is essential to take them through a *progressive, stepwise return to play protocol* to ensure safe return to play.
Age- Specific Considerations

• On the other end of the spectrum
• Management of adults with concussion is very different and presents it own set of challenges
  • Return to work
  • Management of family responsibilities
  • Life stress
  • More likely to have comorbidities
Prior to the injury

Baseline Testing
Current Recommendations

- Berlin recommendations
  - Good but not necessary
  - No baseline testing <12 years old secondary to how much they change
- SCAT-5
- King Devick
- Vestibular Oculomotor Screen (VOMS)
- Computerized neurocognitive testing
- Symptom questionnaires
- Clinical Reaction Time

Symptom Questionnaires

- Symptom questionnaires –
  - PCSS, SCAT-5, Post concussion symptom inventory (PCSI)
- Research (Asken 2017)
  - Analyzed 738 collegiate athletes at baseline
  - 16.3% met criteria for ICD-10 classification of post concussion syndrome
  - Women 1.7 times more likely to meet criteria
  - Those that completed the SCAT-3 were 1.5 times more likely to qualify as compared to PCSS
  - On average those that met criteria at baseline experienced a longer recovery from concussion
Vestibular Oculomotor Screen (VOMS)

• Clinical assessment used at time of initial evaluation as well as on re-evaluations/discharges as needed

• Symptoms measured at baseline and with testing:
  • Headache
  • Dizziness
  • Nausea
  • Fogginess

• Testing
  • Smooth pursuit
  • Saccades
  • Convergence
  • VOR x 1
  • Visual motion sensitivity (VOR cancellation)
Balance Error Scoring System (BESS)

• Full version and modified
• Full includes conditions for both eyes open (EO) and eyes closed (EC): modified just EC
• 3 foot positions
  • Feet together
  • Tandem stance
  • Single leg stance (SLS)
• Firm vs. Foam Surface
• # of errors counted for each trial of 20 seconds
Computerized Neurocognitive Testing (CNT)

- 3 NCT tools – ANAM, DANA and ImPACT
- Assessed those with mTBI from a level 1 trauma center as compared to matched trauma patients without mTBI
  - Tested at 72 hours, 15 days and 45 days post injury
- Did not yield significant differences between patients with mTBI versus other injuries.
- Symptom scores better differentiated groups than CNTs, with effect sizes weaker than those reported in sport-related concussion studies.

***One tool to use – sole RTP decisions should not be made on these results alone***
CNT

• Widespread routine use in children and adolescents not recommended
  • Reliability over time
  • Insufficient evidence of diagnostic/prognostic value
• Should not be sole factor in diagnosing or making RTP decisions

(Davis GA, Br J Sports Med. 2017) and adapted from presentation Bootcamp: Baseline testing by Meeryo Choe MD from AAN SCC 2017
Why do it?

• Can be useful in detecting those with premorbid conditions
• Identify those with risk factors for more complicated recovery from concussion
• Better identification of change in function/impairments after concussion
The Impact. The injury. Now what?

Concussion
Current Sideline Assessments

Concussion
Sideline Assessment

• Evolving injury in the acute phase with rapidly changing clinical presentation in the acute phase

• No perfect diagnostic test or marker that clinicians can rely on for an immediate diagnosis of SRC in the sporting environment.

• Sideline evaluation of cognitive function is an essential component in the assessment of this injury.

• Standard orientation questions (eg, time, place, person) are unreliable in the sporting situation when compared with memory assessment.

• Ask – “Do you know what happened?” instead of “Are you ok?”

Sideline Assessment

• Purpose – rapid screening for SRC not a definitive diagnosis

• Evolving and delayed-onset symptoms of SRC are well documented

• Consider follow-up serial evaluation after a suspected SRC regardless of a negative sideline screening test or normal early evaluation.
Sideline Assessments

- According to the Consensus Statement on Concussion In Sport, sideline assessment is an essential component of treatment of concussion.
- Sideline assessments should be performed immediately following any needed first aid assessment.

- Some examples include the following:
  - King Devick Test
  - SCAT-5
  - SAC
  - Military Acute Concussion Evaluation
  - Balance Error Scoring System (BESS)
  - Clinical Reaction Time
Multiple Assessments – Berlin Guidelines

• Abbreviated testing paradigms are meant to be used for a rapid screen but do not replace a formal neurological evaluation

• Sideline assessments should not be used as a standalone tool for ongoing management

• Recommend a quick sideline screen and then transition to a more controlled environment (locker room, medical room) for diagnostic testing
SCAT-5

• Standardized assessment
  - SCAT-5 for ages >13 years old
  - Child SCAT-5: ages 5-12
  - Designed to be done by a medical professional
  - 8 items

• Comprised of the following categories
  • Symptom score
  • Cognitive assessment
  • Neck evaluation
  • Balance Assessment
  • Coordination Examination
  • Delayed recall

According to the Consensus Statement on Concussion In Sport:

• The recognition of suspected SRC is best approached using multidimensional testing guided via expert consensus. The SCAT5 currently represents the most well-established and rigorously developed instrument available for sideline assessment.
SCAT-5

• Useful immediately after injury in differentiating concussed from non-concussed athletes,
• Utility appears to decrease significantly 3–5 days after injury.
• Symptom checklist does demonstrate clinical usefulness in tracking recovery.
• Baseline testing
  • Useful but not necessary for interpreting post-injury scores.
• Additional domains that may improve use of the SCAT tool include:
  • clinical reaction time
  • gait/balance assessment
  • video-observable signs
  • oculomotor screening.
Probable/Definite Concussion?

• Removal from play considerations
  • Prospective, repeated measures design study comparing those who were pulled from play vs continued to play
  • Those who returned to play took longer to recover than those who were removed from play
  • Those who returned to play were 8.80 more times likely to experience a protracted (>21 days) recovery
Next Steps?

- Identification
- Pull from play/activity/work
- Education
- Rest recommendations?
- School/work recommendations
- MD/ER visit

- Imaging
  - CT scan/MRI (Functional MRI)
  - Typically negative
- Medications
  - OTC, prescription
- Activity Accommodations
Rest? ??

• Study in Journal of Pediatrics looked at the benefits for strict rest after concussion

• Randomized controlled trial
  • 99 pts age 11-22 that presented to ED within 24 hours of concussion
  • Completed neurocognitive, balance and symptom assessment in ED

• Results
  • No clinically significant difference on neurocognitive and balance assessments
  • *Intervention group reported more daily postconcussive symptoms (over 10 days total score 187.9 vs. 131.9) and slower symptom resolution*

• Conclusion
  • Recommending strict rest after concussion for 5 days added NO benefit to concussion recovery as compared to the usual care

Thomas et al. 2014
Rest???

• 2 additional resources regarding rest:
  • Howell, 2016: What is the relationship between rest and recovery?
    • Initial PCSS score and female sex were independently associated with symptom duration, activity levels were not
    • Ages 13-18 – increased physical activity associated with shorter symptom duration
  • Grool, 2016: Is activity within 7 days of injury associated with lower rates of persistent symptoms than conservative rest?
    • Proportion of those with postconcussive symptoms at day 28 was 28.7% in those with participation in physical activity, versus 40.1% in those with conservative rest
    • Participation in physical activity within one week of injury may benefit children and adolescents compared with no activity
Management

Concussion
Symptoms and Management

- Concussion management & recovery
  - Focused on symptom management throughout

- Symptoms
  - Predictors of outcomes and overall prognosis.

- Early stages of concussion recovery
  - Monitor symptom progression, resolution and variability.
Team Approach

- Interdisciplinary/Multimodal
  - Primary care/Pediatrician/ER initial diagnosis
  - ATC for sideline assessment and RTP
  - PT/OT – Vestibular/Cervical eval & rehab, RTP protocol
  - Medical psychologist/Neuropsychologist – neurocognitive testing and supportive counseling/psychotherapy
  - SLP – cognitive, attention and memory impairments
- Medical management
  - No FDA approved medications
  - “start low, go slow”
  - Ongoing research but still limited evidence
Team Approach

• Overall, the evidence points towards an interdisciplinary approach to manage ongoing symptoms.
• There is limited evidence to support pharmacotherapy.
• Physical therapy and cognitive behavioral therapy each have a role in aiding those with persistent symptoms.

*We know that the team approach is necessary in so many cases to truly optimize patient outcomes!*

Use of psychology services:

- Stress Reduction/Coping Skill Training
  - Diaphragmatic Breathing
  - Progressive Muscle Relaxation
  - Compensatory Strategy Training (using a notebook and/or calendar, adding structure to support prioritization and recommended limitations e.g., proactive rest).
- Mindfulness-based interventions (e.g., meditation)
Concussion Management – Role of SLP

• Management of Persistent Cognitive Symptoms After Sport-Related Concussion
  • Case review
  • Treatment approaches fell into 4 broad categories:
    • 83% of clients achieved self selected functional goals.
  • Findings from this case series suggest that SLPs can deliver individualized interventions that lead to positive clinical outcomes

Sohlberg et al. 2016
APTA Position Statement

• The American Physical Therapy Association recognizes that physical therapists are part of the multidisciplinary team of licensed health care providers that provides concussion management, which includes:
  • Education and prevention to minimize risk and increase awareness
  • Examination and evaluation to establish a diagnosis, treatment overall plan of care, including clearance and safe return to all previous activities

• The VA state law does not have PTs listed as part of that team.
Evaluation - PT

- Detailed history
- Cervical ROM/Strength – screen for additional impairments
- Oculomotor exam
- Vestibular testing
- Balance
- Gait
- Education on concussion symptoms and activity modifications
Concussion Management - Role of Occupational Therapy

• Occupational therapy practitioners focus on:
  • affording clients the ability to perform everyday tasks, including
    • self-care, cooking, cleaning,
    • parenting,
    • driving,
    • returning to work,
    • managing depressive symptoms.
  • assisting in managing the transition for a client to return to work or school
EVALUATION - OT

• MoCA
  • Assess overall cognition and executive functioning
• Robnett Kitchen Safety Screen,
• Kettle Test, and/or
• Executive Function Performance Test for IADLs
• Motor Free Vision Perception Test based on reported deficits after oculomotor testing
• For driving assessment
  • Snellgrove Maze
  • Trailmaking A
  • Trailmaking B

*There are specific cut offs as recommended by DMV for the above tests as well as the MoCA.
Evaluation – Subjective

- There are four key areas to investigate in the subjective portion:
  - (1) mechanism of injury
  - (2) symptom reporting and management
  - (3) PMH
  - (4) pain

Use of the clinical history specific questions to obtain this information.
Specific Clinical Questionnaire

• Are you having any ear ringing?
• What triggers your symptoms? Movements? Certain environments?
• Do you have a pressure that increases as the day goes on? When you are concentrating? Do you wake up with the headache?
• Are you more sensitive to lights and noises than normal?
• Are you more tired than normal at the end of the day?
• Do you have blurred/fuzzy vision while reading or difficulty reading?
• Do you feel more distracted? Do you feel foggy?
• Any difficulty falling or staying asleep?
• Do you feel more irritable than normal?
Sleep cycle dysfunction
- Trouble falling asleep
- Too much/little sleep
- Fragmented sleep

Somatic Symptoms
- Headache
- Dizziness/ balance
- Nausea
- Light /noise sensitivity
- Tired, low energy
- Blurred vision

Cognitive symptoms
- Concentration
- Memory
- Fogginess
- Cognitive fatigue/slowing

Mood Disruption
- Irritability
- Sadness
- Anxiety/nervousness
- Emotional lability

Evaluation – Red Flags

- REFER TO NEUROLOGY IF YOU SEE ANY OF THE BELOW AS A NEW SYMPTOM:
  * visual field cuts
  * hyper/hypo deviations with cover/uncover test
  * dysconjugate eye movements
  * significant memory loss – persistent
  * significant one sided weakness
  * seizures – new onset

- REFER TO ENT FOR:
  * one sided hearing loss or significant ringing or aural symptoms
Evaluation – Red Flags

- REFER TO ORTHO OR NEED FOR FURTHER WORK UP:
  * for persistent neck complaints and/or report of numbness or tingling

- REFER TO PM&R FOR BELOW:
  * significant difficulty with sleep regulation
  * persistent headaches
  * significant difficulty with concentration
  * guidance with school and/or work accommodations
  * when issues are not resolving with PT for further recommendations or specialist referrals
What is Predictive of Prolonged Recovery

• Most consistently – the presentation and severity of acute and subacute symptom levels
• Subacute problems with headache and depression – likely risk for symptoms longer than 1 month
• Hx of mental health problems – greater risk for persistent symptoms
• ADHD/learning disability does not appear to have a substantially greater risk
• Teenage years – high school – may have a slight increased risk
  • Especially girls > boys

Iverson, 2017
Prognosis and Recovery with Concussion

- Concussion recovery can be highly variable
  - Treatment is time sensitive secondary to the scope of functioning

- People post-concussion report that everything is affected
  - Ability to sleep
  - Ability to think clearly
  - Ability to concentrate
  - Ability to interact with a variety of environments

- According to research
  - Old research (Collins et al 2006, Neurosurgery)
    - 80% of all concussion recovery within 21 days
  - New research (Henry LC et al, 2016, Neurosurgery)
    - When the recommended "comprehensive" approach is used for concussion assessment, recovery time for SRC is approximately 3 to 4 weeks, which is longer than the commonly reported 7 to 14 days
Clinical Trajectories
Concussion
Risk Factors

Concussion Clinical Trajectories
- Vestibular
- Ocular
- Cognitive
- Migraine
- Anxiety/Mood
- Cervical

Treatment and Rehab Pathways
- Medication management
- Vestibular Therapy
- Vision therapy
- Exercise prescription
- Manual therapy
- Speech Therapy
- Psychology
- **Vestibular**
  - Unstable vision
  - Difficulty with balance and motion

- **Ocular**
  - Trouble with visual tasks
  - Difficulty with tracking motion

- **Cognitive/fatigue**
  - Trouble with extended and/or intricate mental tasks
Migraine
- Changes in routine
- Headaches with sensitivity to light and noise
- Nausea

Anxiety/Mood
- Excessively worried
- Irritable
- Turning thoughts off

Cervical
- Any stress or pattern of pressure on neck/spine or spinal cord
- Pattern of headache/waking up with headache
Cognitive/Fatigue Trajectory

Concussion
Impairments

- Difficulty with extended mental tasks
- Difficulty with intricate mental tasks
- Difficulty with concentration
- Divided attention
- Memory difficulty
What do they tell you?

• I can’t concentrate
• I can’t remember anything
• I am really tired
• I am having a really hard time in.... Math, spanish etc...
• I am really distracted
• I am having a hard time focusing
• I am just feel really foggy and/or out of it
What do you see?

• This is a little trickier....
• They look tired
• Their eyes are dim/dull
• They get distracted by every noise, person, shiny object that goes by
• They ask you to repeat your question
Sleep Cycle Dysregulation

Etiology in TBI

- Anxiety-depression
- Environmental – stimuli from music, phone, tv etc
- Neurophysiologic injury
- Pain
- Pharmacologic effects
- h/o sleep disorder
Sleep Cycle Dysregulation

Adverse Effects

- ↓ QOL
- ↑ risk of accidents
- ↑ rate of chronic pain
- Difficulty concentrating
- Mood changes
- Independent risk factor for poor physical and mental health (Walsh JK, J Clin Psychiatry 2004)
Sleep Cycle Dysregulation: Nonpharmacologic Rx

- Proper sleep hygiene
  - no electronics (TV, computer, phone, music) at bedtime
  - avoid caffeine, EtOH, nicotine 4-6 hrs before bedtime
  - consistent bedtime & wake-up schedule
  - no daytime naps
  - sleep restriction 7-9 hrs

- Relaxation tx
  - Smart phone apps
    - Concussion coach
    - CBT-I
    - Headspace, Calm, Insight Timer
Sleep Cycle Dysregulation: Pharmaceutical Intervention

• Melatonin: 3-5 mg
• Anti-depressants
  ▪ Amitriptyline: titrate, 30 mg
  ▪ Trazodone: 100 mg
• Non-benzodiazepine hypnotics – short term x 1 week, to reset cycle
  ▪ Zolpidem (Ambien): 5-10 mg, 12.5 mg XR
  ▪ Ezopiclone (Lunesta): 2-3 mg
• Zaleplon (Sonata): 5-10 mg
• Anti-histamines
  ▪ Hydroxyzine (Vistaril): Kids 12.5-25 mg, adults 50-100 mg

- Benzodiazepines: caution
Cognitive Symptoms

- Neurocognitive testing
  - objective data utilizing reliable & valid tests
- Moderate to severe TBI, cognitive deficits improve with neurostimulants
- In postconcussion syndrome
  - No RCT
  - Anecdotal reports of benefit
  - More widely used
Cognitive Symptoms

- Pharmacologic Rx
  - Amantadine: 100 mg BID
  - Methylphenidate: 10-60 mg/day, divided 2-3 x/day
  - Atomoxetine: 40 mg/day
  - Modafinil: 100-200/day

- Speech Tx: learning compensatory strategies
Return to Learn

Concussion
Academic Accommodations

- Common Accommodations:
  - *Proactive Rest with structured reintegration to previous activities*
    - reduced work
    - tinted lenses
    - reduced computer time
    - structured breaks

- Factors to consider:
  - severity of symptoms and impairments,
  - time from injury
  - support from environment they are returning to
  - additional stressors
Common Return to Learn Recommendations

• Modified day
  • Attending for a few ‘blocks’ → ½ day → full day with breaks → full day no breaks
  • Can start anywhere in this process

• Break schedule
  • ½ way through class, or at class changes
    • If taken at a class change, can avoid busy environment

• Testing
  • Extra time, quiet environment, spread out across multiple sessions, adapted format

• Reduce computer time – work on paper as much as possible
Return to Learn - Research

• Study of 276 children post concussion (5-18 years old)
  • Reporting 3 or more concussion related symptoms at 10 days post injury
  • Academic difficulty – 29%
  • Vision impairments – 46%

• Vision impairments, hearing related symptoms and concentration difficulty associated with academic difficulty

• Those with symptoms > 30 days only vision impairments and concentration impairments were related to academic difficulty

(Swanson et al. Optometry and Vision Science, 2017)
Migraine/headaches

Concussion
What do they tell you?

• I have a headache....
• It is the worst in the morning or I am waking up with it
• It gets worse as the day goes on
• It is really bad when I am reading
• I get a headache when I try to exercise
• I just have headache all the time
• I have headaches and I will get sick to my stomach and the light bothers me
• When I get a headache I have to go lie down in a dark room
What do you do?

• Ask about the pattern of their headache
  • First thing in the morning or as the day goes on
• Does the headache move or is it always in the same spot
  • Cervical/MSK vs. concussion pressure
• How are you sleeping?
• Palpate their neck or look at ROM
• Look at eye movements
• What makes it worse or better?
• Does it change depending on environment?
• Do you feel like you have a pressure in your head that gets worse as the days goes on?
Migraine/Headaches

- Myofascial/Musculoskeletal/Tension headache
  - Medications: NSAIDs, analgesics, muscle relaxants
  - Trigger point injections
  - Greater occipital nerve blocks
  - PT: myofascial release, muscle energy techniques, massage, modalities, TENS
  - Acupuncture
  - Relaxation and meditation techniques
  - Biofeedback & behavior modification
Migraine/ Headaches

- Migraine
  - Abortives
    - Sumatriptan (Imitrex) 25-100mg/dose, max 200 mg/day, oral/inhaled
    - Rizatriptan (Maxalt) 5-10mg/dose, max 20 mg/day
  - Prevention/Treatment
    - Antidepressants
      - Amitriptyline (Elavil) 30-50 mg
      - Escitalopram (Celexa) 20-40 mg
      - Sertaline (Zoloft) 25-100 mg
      - Venlafaxine (Effexor) 25-100 mg, XR 37.5 – 150 mg
Migraine/ Headaches

- Migraine
  - Anticonvulsants
    - Topiramate (Topamax) - 25 mg/day x 1 week, 25 mg BID, increase 25 mg/day weekly
    - Valproic acid – 250 mg BID
    - Gabapentin – 300 mg/d, inc to TID prn, non-FDA approved indication
  - Beta blockers – propranolol
Migraine/Headaches

- Rebound headache
  - Increased incidence in patients with chronic PTH
  - Most common: opioids, butalbital-containing combination analgesics & ASA/APAP/caffeine combinations
  - Opiates: risk of transformation from episodic HA to chronic, greater in men & use 8 days/month
  - APAP greater risk than NSAIDS & triptans
Migraine/ Headaches

- Concussion “supplements”
  - Chronic supplementation (3-6 months) may decrease frequency & severity of primary HA, not studied in PTH
    - Alpha lipoic acid – 400-600 mg/d
    - Coenzyme Q-10 = 300 mg/d
    - Magnesium oxide = 500 mg/d
    - Omega-3 fish oils = 3-4 gm/d
    - Vitamin B2 (riboflavin) – 200-400mg/d
Anxiety/Mood

Concussion
Impairments/Concerns

- Excessively worried
- Unable to turn their thoughts off
- Risk factor for prolonged recovery
- Psychosocial factors contributing?
What do they tell you?

• Sometimes it is not in what they tell you but in how they are telling you...
• I can’t fall asleep at night
• I am missing all this work or school
• I have all these tests coming up
• I am taking really hard classes and a lot of them....
• My job is really stressful
What do you do?

• Watch them .... How are they communicating and what is their overall tone
• What are the parents doing and what are they telling you?
• Ask – how did you handle stress/anxiety before?
• Did they use exercise?
• If they are explaining all their stress and their symptoms get worse...
Mood Disruption

- Emotional disturbances
  - frustration, anxiety - from prolonged cognitive, somatic and sleep-related symptoms
  - isolation - cognitive & physical rest, limitations on activities (school, work, athletics)
  - PTSD

- Worsen perception of cognitive impairment and pain

- Interfere with recovery

- Rx:
  - Medical psychologist &/or psychiatrist referral
  - SSRI, TCA
    - no RCTs in concussion treatment
    - caution in adolescents: ↑ suicide risk
Vestibular/Ocular Trajectory

Concussion
Vestibular System: Terminology

• Dizziness
  • “faint”
  • “unsteady”
  • “spinning”
  • “weakness”
  • “mentally confused”
Vestibular System: Terminology

• Vertigo — inappropriate perception of motion
• Oscillopsia — ocular instability
• Imbalance — observable unsteadiness
• Disequilibrium — subjective sense of imbalance or unsteadiness, but not observable
• Lightheadedness/Presyncope — feeling faint
Figure 2: The Vestibular System - semicircular canals and otolith organs
Vestibular System

• Components
  • Semicircular canal system (rotational movements)
  • Otoliths (linear acceleration)

• Connections
  • CN VIII
  • Brainstem vestibular nuclei
  • Cerebellar pathways

• Reflexes
  • Vestibulo-ocular reflex (VOR)
  • Vestibulocollic reflex (VCR)
  • Vestibulospinal reflex (VSR)
Visual
Vestibular
Proprioceptive

Sensory Input

Central Processing
- Primary Processor (Vestibular Nuclear Complex)
- Adaptive Processor (Cerebellum)

Motor Output
- Motor Neurons (resulting in)
- Eye Movements
- Positional Movements
Vestibular System – Motor

• Motor
  • Control of eye movement to permit clear visual image of surrounds
  • Maintenance of equilibrium and desired posture

• Oculomotor system
  • Smooth pursuits
  • Saccades
  • Convergence
  • Gaze holding
Back to Concussion...

Vestibular/Ocular Trajectory
What do they tell you?

- I am dizzy
- I feel off balance
- I have difficulty with reading
- I can’t concentrate
- I don’t like to move my head fast
- I have blurry vision
- I just feel off
- I am getting car sick
What do you see?

• They are squinting or blinking a lot
• There eyes look dim/dull or irritated
• They are walking with a wide base of support or slow
• They are reaching for the wall while they walk
• They do not turn their head to look around
• They turn with whole body or very slowly when changing directions
**What do you do?**

<table>
<thead>
<tr>
<th>Oculomotor exam</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convergence/divergence</td>
</tr>
<tr>
<td>smooth pursuits</td>
</tr>
<tr>
<td>saccades</td>
</tr>
<tr>
<td>gaze holding in 9 cardinal planes</td>
</tr>
<tr>
<td>VOMS</td>
</tr>
</tbody>
</table>
Vestibular Oculomotor Screen

• Clinical assessment used at time of initial evaluation as well as on re-evaluations/discharges as needed

• Symptoms measured at baseline and with testing:
  • Headache
  • Dizziness
  • Nausea
  • Fogginess

• Testing
  • Smooth pursuit
  • Saccades
  • Convergence
  • VOR x 1
  • Visual motion sensitivity (VOR cancellation)

<table>
<thead>
<tr>
<th></th>
<th>Headache (0-10)</th>
<th>Dizziness (0-10)</th>
<th>Nausea (0-10)</th>
<th>Fogginess (0-10)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smooth Pursuits (H)</td>
<td></td>
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<tr>
<td>Smooth pursuits (V)</td>
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<tr>
<td>Saccades (H)</td>
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<tr>
<td>Saccades (V)</td>
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<tr>
<td>Convergence</td>
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<td>Active VOR x 1 (H)</td>
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<tr>
<td>Active VOR x 1 (V)</td>
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<tr>
<td>VMS</td>
<td></td>
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</tbody>
</table>
VOMs – Smooth Pursuits

• Hold a fingertip at a distance of 3 ft. from the patient.

• Move the target smoothly in the horizontal direction 1.5 ft. to the right and 1.5 ft. to the left of midline.

• One repetition is complete when the target moves back and forth to the starting position, and 2 repetitions are performed.

• The target should be moved at a rate requiring approximately 2 seconds to go fully from left to right and 2 seconds to go fully from right to left.

• Ask about symptoms and record observations

• Repeat in the vertical direction
VOMS- Saccades

• Hold two single points (fingertips) horizontally at a distance of 3 ft. from the patient,
• Targets (fingertips) should be 1.5 ft. to the right and 1.5 ft. to the left of midline so that the patient must gaze 30 degrees to left and 30 degrees to the right.
• Instruct the patient to move their eyes as quickly as possible from point to point.
• One repetition is complete when the eyes move back and forth to the starting position, and 10 repetitions are performed.
• Record: Headache, Dizziness, Nausea & Fogginess ratings after the test.
• Repeat in the vertical direction
VOMs - Convergence

• Measure the ability to view a near target without double vision.
• The patient is seated and wearing corrective lenses (if needed).
• The examiner is seated front of the patient and observes their eye movement during this test.
• The patient focuses on a small target (approximately 14 point font size) at arm’s length and slowly brings it toward the tip of their nose.
• The patient is instructed to stop moving the target when they see two distinct images or when the examiner observes an outward deviation of one eye.
• Blurring of the image is ignored.
• The distance in cm. between target and the tip of nose is measured and recorded.
• This is repeated a total of 3 times with measures recorded each time.
• Record: Headache, Dizziness, Nausea & Fogginess ratings after the test.
• Abnormal: Near Point of convergence ≥ 6 cm from the tip of the nose.
VOMS – Active VOR x 1 Viewing

• Examiner sits 3ft in front of the patient

• The patient is asked to rotate their head horizontally while maintaining focus on the target.

• The head is moved at an amplitude of 20 degrees to each side and a metronome is used to ensure the speed of rotation is maintained at 180 beats/minute (one beat in each direction).

• One repetition is complete when the head moves back and forth to the starting position, and 10 repetitions are performed.

• Record: Headache, Dizziness, Nausea and Fogginess ratings 10 sec after the test is completed.

• Repeat in the vertical direction

• Observe the patient’s ability to complete the movement and maintain fixation
VOMs- Visual Motion Sensitivity

• The patient stands with feet shoulder width apart, facing a busy area of the clinic.

• The examiner stands next to and slightly behind the patient, so that the patient is guarded but the movement can be performed freely.

• The patient holds arm outstretched and focuses on their thumb.

• Maintaining focus on their thumb, the patient rotates, together as a unit, their head, eyes and trunk at an amplitude of 80 degrees to the right and 80 degrees to the left.

• A metronome is used to ensure the speed of rotation is maintained at 50 beats/min (one beat in each direction).

• One repetition is complete when the trunk rotates back and forth to the starting position, and 5 repetitions are performed.

• Record: Headache, Dizziness, Nausea & Fogginess ratings after the test.
VOMS

![VOMS Score Chart]

- Healthy collegiate athletes, age 18-24 y (n = 263)
- Healthy controls, age 10-17 y (n = 78) from Mucha et al\(^3\)
- Concussed sample, age 9-18 y (n = 64) from Mucha et al\(^3\)
VOMS

• 69% of adolescents after concussion were found to have one or more of the following visual impairments;
  • accommodative disorders (51%)
  • convergence insufficiency (49%)
  • saccadic dysfunction (29%)
  • 46% of patients had more than one vision diagnosis
Vestibular Exam

- VOR x 1 viewing (active) – captured in VOMs; will often do follow up testing if asymptomatic on VOMs
- Dix Hallpike if indicated (based on symptom reporting)
- Clinical Dynamic Visual Acuity
- Motion Sensitivity Quotient (MSQ)
- Visual Motion sensitivity testing with optokinetic nystagmus stimulation
Visual Motion Sensitivity

• Optokinetic Nystagmus
• Assess symptoms prior to viewing
• View 30 seconds in one direction and 30 seconds in another
• Reassess symptoms. Use to work to decrease sensitivity

McDevitt et al. 2016
Oculomotor Dysfunction

• Vestibular Oculomotor Dysfunction (VOD) findings at initial assessment are associated with a prolonged recovery and are independently related to the development of PCS

• Independent predictors of VOD at consultation
  • Female
  • Preinjury history of depression
  • Posttraumatic amnesia
  • Dizziness, blurred vision, or difficulty focusing at the time of injury

• Independent predictors of PCS at consultation
  • Positive VOD findings
  • Preinjury history of depression
  • Posttraumatic amnesia

*Ellis, MJ. Et al. Journal of Neurosurg Pediatrics. 2017*
Evidence Based Practice

• Retrospective review, the authors reviewed cases for all patients with acute SRC and PCS evaluated at a pediatric multidisciplinary concussion program.

• Study included 399 children.
  • 30.1% of those with acute SRC
  • 43% of those with PCS met the criteria for VOD at initial consultation.
  • 33.1% total of the included population met the clinical criteria for VOD and
  • 56 had vestibular PT. Results showed that
**VOD at initial consultation is associated with prolonged recovery and is an independent predictor of PCS.**
Median length of recovery among patients with acute SRC and VOD was 40 days compared with 20 days among patients without VOD.

Ellis et al. 2016
Vestibular Exam – Evidence Based Practice

• Feasibility of early intervention PT – patients enrolled within 10 days of injury (ages 10-23)
• Used PCS as an outcome
• Treatment for the experimental group
  • Manual therapy: cervical pain, cervicogenic HA, and cervicogenic dizziness
  • Vestibular rehabilitation
  • 2 treatment groups: one progressed based on response (individualized) and one progressed based on a protocol (standardized)
• Median amount of time for release to return to play
  • 15 days for experimental group
  • 26 days for control group

(Reneker et al, 2017.)
Evidence Based Practice

Cervicovestibular rehabilitation in sport-related concussion: a RCT

• Persistent symptoms of dizziness, neck pain and/or headaches post sports-related concussion

• Control group: postural education, ROM, cognitive and physical rest until asymptomatic then RTP

• Intervention group: cervical spine and vestibular rehab

• Conclusion: intervention group was 3.91 times more likely to be medically cleared by 8 weeks
Balance

• *Considerations:* Balance deficits are often reported in the first week after injury and typically are one of the first things to recover.
Balance Impairments and Testing

- SOT and HS-SOT
- BESS
- FGA/DHI
- SLS – EO and EC
- mCTSIB
- Community Mobility and Balance Scale
- Hi-Mat
Examples of Treatment

Concussion
Exercises – Smooth Pursuits

• Ball circles/ball toss
• Tracking marble vs. ball
• iPAD apps
• Tracking laser across card board
Exercises - Saccades

• Post it notes with “x” or advance to “busy” target
  • Minimum of 2 up to as many as want
  • Multiple configurations and directions

• Card board

• iPad apps

• Anti-saccades
  • They move their eyes in opposite direction of commands
Exercises - Convergence

- Brock strings
  - 3 beads vs. 2 beads
  - Near/far and far/near
- Pencil push ups
  - Can hold at near point
- Pencil jumps
- Convergence card – dots and letters
- Marsden ball
- iPad apps
- Convergence walks
  - Walking forward/backwards from a target
- Wall push ups
  - Target on wall
Gaze Stabilization Exercises

• Seated vs. standing vs. walking
• Plain vs. busy targets
• 3 plains
  • Horizontal
  • Vertical
  • Roll
• Offset positions
• Set speed and time
• Caution if neck is involved

Figure 2A: Look straight ahead.
Figure 2B: Turn your head 45 degrees towards the right.
Figure 2C: Turn your head 45 degrees towards the left.

Note: Business card should be positioned at eye level.
(c) T.C. Hain, 2002
Exercises – Visual Motion Sensitivity

• Optodrum watching
  • Sitting vs. standing vs. walking

• VOR cancellation
  • Sitting vs. standing

• YouTube videos
  • Karen Skop/Emory Dizziness and Balance

• iPad apps
  • Playing fast moving games while walking in a figure 8

• Disco ball
  • In an enclosed room
  • Sitting vs. standing vs. walking vs. dynamic task
Treatments

• Use of technology
  • iPAD games/apps
    • Lost in letters, Flow, Rush hour, Lumosity; Visual acuity, Eye exerciser
  • Wii and other gaming systems
    • Wii fit and Kinect
  • Virtual Reality goggles
    • Use caution based on symptom response
  • BITS, Eye tracking, FITLIGHTS
### Home Program Prescription

<table>
<thead>
<tr>
<th>Daily HEP recommendations</th>
<th>Dosing!!</th>
</tr>
</thead>
<tbody>
<tr>
<td>• 1-2x/day</td>
<td>• Pay attention to performance in session to make recommendations for HEP</td>
</tr>
<tr>
<td>• Symptom guidance</td>
<td>• Watch for more than what patient reports</td>
</tr>
<tr>
<td>• Repetitive</td>
<td>• Emphasis breaks and recovery of symptoms to baseline before repeating an exercise or progressing</td>
</tr>
<tr>
<td>• Give information on how to progress</td>
<td></td>
</tr>
<tr>
<td>• Educate on importance of HEP and role</td>
<td></td>
</tr>
<tr>
<td>• Be mindful of the amount of exercises given</td>
<td></td>
</tr>
</tbody>
</table>
Cervical Concussion
Concussion Mechanism

Whiplash Mechanism
Cervical Spine

• Whiplash
  • Defined as a mechanism of acceleration-deceleration transferred to the cervical spine

• Concussion
  • type of traumatic brain injury—or TBI—caused by a bump, blow, or jolt to the head or by a hit to the body that causes the head and brain to move rapidly back and forth. – CDC website
What do they tell you?

• I have a headache
• I have some neck pain – but not always...
• My neck just feels stiff
• I wake up with my headaches
• I have difficulty concentrating
• I feel foggy
• I feel off or floaty...
Cervical Impairments

- ROM
- Sensation
- Palpation
- Joint stability testing
- Strength testing
- Manual therapy as indicated
- Cervical Proprioception testing and training
Cervical Spine Management

• Rationale
• Examination
  • Red & Yellow Flags
• Intervention
• Big picture
Cervical Spine - Examination

• Know your red and yellow flags

• Upper cervical instability testing
  • Sharp-Purser
  • Alar ligament
  • Transverse ligament

• AROM in all planes
  • Overpressure in the pain free motions
  • Quadrant assessment

• Segmental examination

https://moodystoplightshirts.files.wordpress.com/2011/01/podstoplight1.png
Cervical Spine - Examination

• Cervicogenic headache
• Soft tissue structures
• 1st Rib Elevation
• Radiculopathy
• Thoracic spine assessment
  • Scapular mobility

Cervical Spine – Examination

• Differentiating between the cervical spine versus concussion with regards to origin of symptoms post injury is critical to direct treatment

• Specific tests can be helpful for differential diagnosis
  • Joint position error (JPE) test
  • Smooth pursuit neck torsion test
  • Head-neck differentiation test
  • Cervical flexion rotation test
  • Physical neck

Cervicogenic Headache

• C2–3 zygapophyseal joint and 3rd occipital nerve appear most vulnerable to trauma from acceleration-deceleration (“whiplash”) injuries of the neck

• Pain from the C2–3 zygapophyseal joint is referred:
  • occipital region
  • frontotemporal region
  • periorbital region

• Injury to this region is a common cause of cervicogenic headache.

• The majority of cervicogenic headaches occurring after whiplash resolve within a year of the trauma

Biondi, 2005
Cervicogenic Headache

• Ex of referral patterns for specific trigger points in the neck and face muscles associated with headaches.
  • The black x sign indicates a trigger point within a muscle and areas marked in red illustrate where that trigger point sends referred pain:

http://newbody-newmind.com/headache-migraine-treatment/causes/
Cervical Spine – Manual Intervention

• Cervicogenic headache
  • Suboccipital release with or without longitudinal distraction
  • Upper cervical spine hold-relax techniques
    • AA & OA
    http://www.massagetoday.com/content/images/lowe5_med_13639_1_1_6431.jpg

• Joint mobilizations
  • Supine
  • Prone
• Isometric resisted facet upslide
Cervical Spine – Manual Intervention

• Soft tissue release techniques
• METs
• Radiculopathy specific
  • Unloading → loaded exercise
• Scapular mobilizations
• Addressing rib dysfunction
• Don’t‘ forget the thoracic spine
Cervical Spine – Ther Ex

• Barrel hug stretch
• Foam roll/towel roll
  • Snow angels
  • Retractions
• Chin tuck with progression into dynamic positions
• Prone lower trapezius strengthening
• Cervical stabilization

Cervical Spine – Ther Ex
Thoracic Spine – Ther Ex

• Scapular Stabilization
  • Upright rows
  • Scapular adduction with shoulder ER
  • Eccentric scapular retraction
  • Prone – Y, I, T and Ws

• Don’t forget about the core strength!
  • Planks, planks, planks
Cervicogenic Dizziness

- Cervicogenic Dizziness results from a sensory mismatch between somatosensory information from the cervical spine and input from the visual and vestibular systems.
- Most research has been focused on whiplash injuries.

From Cervicogenic Dizziness Competency Course by Rob Landel
# Cervicogenic Dizziness

## Symptoms:

<table>
<thead>
<tr>
<th>Concussion</th>
<th>Whiplash</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Headache</td>
<td>• Neck pain/stiffness</td>
</tr>
<tr>
<td>• Dizziness</td>
<td>• Dizziness</td>
</tr>
<tr>
<td>• Sensitivity to noise, light</td>
<td>• Headaches</td>
</tr>
<tr>
<td>• Balance problems</td>
<td>• Unsteadiness</td>
</tr>
<tr>
<td>• Fatigue</td>
<td>• Fatigue</td>
</tr>
<tr>
<td>• Concentration and memory problems</td>
<td>• Concentration and memory problems</td>
</tr>
<tr>
<td>• Problems</td>
<td>• PTSD</td>
</tr>
<tr>
<td>• Irritable, sad, anxious</td>
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</tr>
</tbody>
</table>

*From Cervicogenic Dizziness Competency Course by Rob Landel*
Posture

• Why is posture so important?

How Heavy is Your Head?

12 lbs.  32 lbs.  42 lbs.

Normal Posture  2 Inches Forward  3 Inches Forward
Autonomic Dysfunction/Physiologic Impairments
Concussion
Exercise After Concussion

• Buffalo Treadmill Protocol
  • Subsymptom threshold exercise prescriptin
• Stationary bike for headache management
• Ther ex to address thoracic and cervical impairments
• Level of activity prior to the injury
Physiologic/ Autonomic Dysfunction: When can I exercise?

- Research has shown that the Balke Treadmill protocol has been an effective tool to help identify symptom reproduction in post concussion syndrome.

- It has also been rated for reliability for accurately reproducing maximal heart rate and systolic blood pressure of symptom reproduction in those with PCS.

- Based on these findings it is useful to determine sub symptom threshold exercise prescription for those that are still experiencing symptoms as well as determining readiness to initiate the return to play/activity protocol.

Evidence-Based Practice: Physiological Markers

• Some patients with PCS have difficulty tolerating return to exercise
  • May have inability to pass exertional testing due to symptom onset
• Found to be a result of altered cerebral blood flow (CBF) regulation due to reduced CO₂ sensitivity
  • Hypothesized to then cause symptoms of headache and dizziness at threshold intensity
• Utilization of a progressive subthreshold exercise program
  • Increased CO₂ sensitivity to near normal levels
  • Improved exercise tolerance with ability to exercise to exhaustion without symptom onset
• Suggests that “return of normal control of exercise CBF and of exercise tolerance could be objective physiological markers of recovery for concussion, which has implications for establishing prognosis and preventing premature return to sport, activity, or military duty
Buffalo Concussion Treadmill Protocol

• Purpose:
  • To investigate exercise tolerance in patients with post-concussive symptoms.
  • To help establish appropriate levels of exercise to aid in Return to Play for concussed athletes and assist in treatment protocols.
  • To aid in differentiating between possible diagnoses for concussive symptoms (Cervicogenic injury, PCS, etc.) and etiology of the concussion.
  • To identify physiological variables associated with exacerbation of symptoms, and the patient’s level of recovery.
Buffalo Concussion Treadmill Protocol

• Set treadmill at a speed of 3.6mph for patients over 5’5”, and 3.2mph for those 5’5” and under. Starting incline is 0 degrees.
  • Speed can be adjusted depending on athletic status or overall comfort of the treadmill speed – patients should be moving at a brisk walking pace.

• After 1 minute, treadmill incline is increased to 1.0 deg.
  • Participant is asked to rate RPE and symptom severity. HR should be noted as well.

• Continue treadmill increasing in incline at a rate of 1 degree/minute if patient is not reporting a 3 point change in symptoms and is safe to continue

• Once treadmill reaches maximum incline (15 degrees or 12 degrees in modified test), speed is increased by 0.4mph each minute in lieu of increased incline.

• Once test is terminated, speed is reduced to 2.5mph and incline reduced safely back to 0 for a 2 minute cool-down.
Buffalo Concussion Treadmill Protocol - Recommendations

- On completion of the BCTT, concussion patients may be given an exercise prescription based on 80% of the maximum heart rate reached without symptom exacerbation.
- Patients are instructed to exercise at this level for 20 minutes daily without exceeding the time, or heart rate constraints.
- If any post-concussion symptoms return along the progression, the athlete must return to the previous asymptomatic stage/maximum heart rate.
- Other prescriptions and recommendations will be based on the patient’s particular complaints.
Return to Play Protocols

Concussion
Return to Play/Activity

- Symptom management continues even with RTP

- Returning an athlete to play prior to full resolution of the concussion can have negative effects
  - *Research has shown that student athletes who have engaged in high levels of activity in the weeks following a concussion had increased symptoms, worsened neurocognitive data, and significantly longer recovery times* (Majerske et al. J of Athletic Training 2008)
Return to Play Criteria

- Symptom free at rest
- Clear oculomotor/Vestibular and balance exam
- Symptom free with cognitive/physical exertion
- Full day/schedule/load at school
- Off medications* *
- Normal neurocognitive data – both baseline and post exertion for optimal clearance*
Updated Return to Play Progression

- Considering the level of participation the patient is involved with, break up RTP as follows:
  - Pre-return to play drills
  - Early stage, min-mod intensity: RPE 11-15
  - Late stage, max intensity: RPE 16-20
Updated Return to Play Progression

• Sport Specific Example – Racquet Sports
  • Pre-return to play
    • Quick feet on block to metronome pace
    • Alternating forehand and backhand swings
    • Walking with ball bounce on racquet
  • Early stage: min – mod intensity
    • Jump rope intervals
    • Agility ladder
    • Repeated serves against the wall
  • Late stage: max intensity
    • Up from prone to hit ball
    • Shuttle runs
    • Bunkies
Updated Return to Play Progression

• Sport Specific Example – Baseball/Softball
  • Pre-return to play
    • Bouncing on trampoline while throwing ball in a semi-circle pattern
    • Therapist throws tennis ball to rebounder at different speeds and player catches
    • Roll tennis ball to player, who tosses ball back to therapist
  • Early stage: min – mod intensity
    • Ball catch off rebounder, jump turn/pivot turn to pass to therapist (can do from ground or on trampoline)
    • Running jump turn off bosu to catch ball
    • Bunting, then run to base
    • Coming out of crouch (for catchers)
Updated Return to Play Progression Cont.

• Sport Specific Example – Baseball/Softball
  • Late stage: max intensity
    • Resisted running
    • Shuttle runs/suicides
    • Up from prone to throw ball
    • Kneeling: Diving catch onto mat
    • Fielding ball against brick wall at fast speeds
    • Sliding into base
    • Pitching/Catching
Return to Play

• Important to fully testing athlete with vestibular/oculomotor changes.

• Use a variety of positional changes with cognitive tasking that are sport specific.

• Full practice before competition

• Contact prior to competition
Case Studies

Concussion
Summary

- Concussion & PCS are disabling conditions in the general population and athletes alike
- Individualized approach to treatment
- Interdisciplinary management is necessary and results in successful outcomes.
- Research is ongoing across all areas of management and changing daily
THANK YOU!

QUESTIONS??