

Overview of Concussive Injury & Coordination of Care

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 Medicine for Business and Industry
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1

My Concussion Journey

Created by: Lauren Ziaks

- Northeastern University, Boston, MA
 - ATC 2009, DPT 2012.
- TBI survivor!
 - 2014 was my 9th concussion – “bottom fell out of the bag”
 - Started treating concussions 2015.
- Initiated my program and treatment regimens in a private clinic
- Transitioned to a major hospital group in Utah to build a comprehensive concussion program in 2018
- As of 2022 – treated >1200 patients with concussion using the integrative protocols I’ve helped develop
 - Integrated treatment is the focus of my research and presentations.
- Launched Phoenix Concussion Recovery in 2016
- Participated in >15 episodes for www.ConcussionTalk.com
 - Patient friendly podcast series



2

Learning Objectives

- Identify concussive injuries in their clinical practice who arrive with or without a previous diagnosis of concussion.
- Classify patients by concussion domain – identify appropriate understanding of primary and secondary drivers of injury.
- Provide patient education on early management techniques and importance of “active recovery”.
- Implement cervicogenic exercises within treatment context of whiplash associated disorders and other cervical pathology related to concussive injury.
- Demonstrate understanding and implementation of VOMS
- Determine when advanced referrals are appropriate to manage domains outside of clinicians area of specialty
 - i.e., vision or vestibular rehabilitation, speech language pathology / neuropsychology, mental health providers



3

Typical population/referrals

- Seasonal! Park City.
 - My favorite population are those with chronic deficits - >1 year.
- Variety of ages 7+, large portion Medicare depending on time of year
- Sport (typical and atypical), falls, MVA, assault
- Typically overachieving population – tends to have more psych involvement. Work closely with local providers to address.
- Referral pool:
 - ED, instacare, PCPs, and Pediatricians.
 - Worker’s Compensation
 - MVA – lawyer referrals
 - Collaborate with local ATCs



4

There is life after concussion!



Neuroplasticity

- “The ability for neuronal circuits to make adaptive changes on both a structural and functional level, ranging from molecular, synaptic, and cellular changes to more global network changes.”



Benefits?⁷

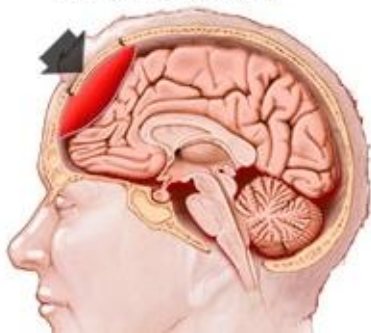
- Brain *continues* to be adaptable!
 - Provide new stimuli
 - Compensatory mechanisms with therapy
- “Window of opportunity” for recovery
 - When provided the appropriate targeted therapies.



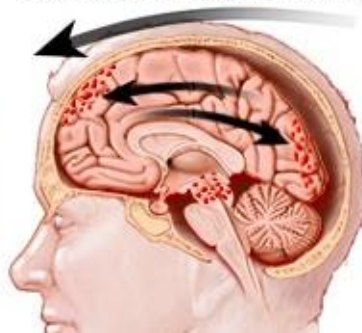
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Types of traumatic brain injury (concussions)

Direct impact injury



Acceleration-deceleration injury



Blast injury



What is a concussion

- LOC has NO predictive value - <10% of all cases
- We no longer have grades – not a Grade 1 or Grade 2
- Adolescents in the sports concussion group heal the SLOWEST
- Symptoms can be DELAYED




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Post Concussion Syndrome?



9

- Conflicting facts and figures:
 - 90% heal in <4 weeks
 - But approx. 30% will have protracted recovery...
- According to the CPG 20-58% will experience protracted recovery (>4 weeks)
- PCS has negative social implications
- New terminology being proposed
 - Prefer Protracted Concussion Recovery or Persistent Post-Concussion Symptoms (PPCS)

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More Common Than We Think



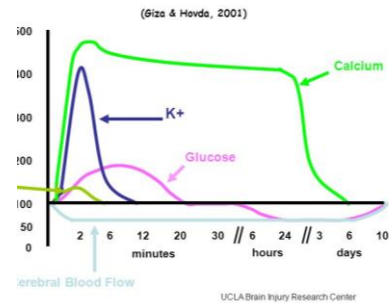
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- 1.6-3.8 million sports / recreational related concussions per year
- Could be as much as **12x more** outside of sports
 - Falls, MVA, assault
- Older adults likely most underdiagnosed population
 - CDC estimates adults >75 have greatest incidence rate
 - You may have a working population in this age group due to current climates!

What happens in a concussion?

- A concussion: blow to the body or the head that causes the brain to rock inside the skull.
- A chemical cascade occurs in our brain as the cells have damage to their walls and leak out tiny chemicals.
- The clean up system works harder to tidy up → reduction in our energy currency (ATP, glucose)
- Research: NO consistent timeline for how long this lasts – lots of ideas/theories.
 - Current though – 1-2 weeks to resolve

Neurometabolic Cascade Following Cerebral Concussion/MTBI



11

Why Early and Short Rest is Vital

Concussion causes *temporary interference of brain function* – no structural changes will be identified on current imaging.

- Acute neurometabolic cascade → neurovascular changes
- Axonal injury can occur

These changes lead to functional deficits which we can identify with screening tools and target in therapy.

Because of the demand on brain energy to correct the ion flux – patients experience symptoms.

- Physical and cognitive tasks place greater demands on the system while it is healing → increased symptoms and delayed recovery



12

Protracted Recovery

Are you treating the concussion?

Are you treating secondary syndromes of the concussion?

How do we know when the brain has actually “healed”

Each injury really always worse?



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13

What if I get a 2nd concussion

- Second Impact Syndrome
 - Catastrophic cerebral edema
 - Rare but DEADLY
- Immediate removal from play is crucial!
 - Primarily 2nd hit occurs within hours of 1st.
 - Rare cases demonstrate ~4weeks
- In athletes playing 1 add'l play → 50% increase in time to recovery



14

Second-Impact Syndrome

Swelling on **both** sides of the brain

Swelling on **one** side of the brain



USNews

Graphic by Ethan Rosenberg for USN&WR. Source: Sports Legacy Institute

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Concussion Red Flags – CDC 2022

- Repeated vomiting*
- Slurred speech
- Unequal pupil size
- Convulsions / seizures
- Prolonged LOC
- Increasing confusion or agitation
- Weakness, numbness, decreased coordination
- Drowsiness or difficulty staying awake
- Severe or worsening of headache



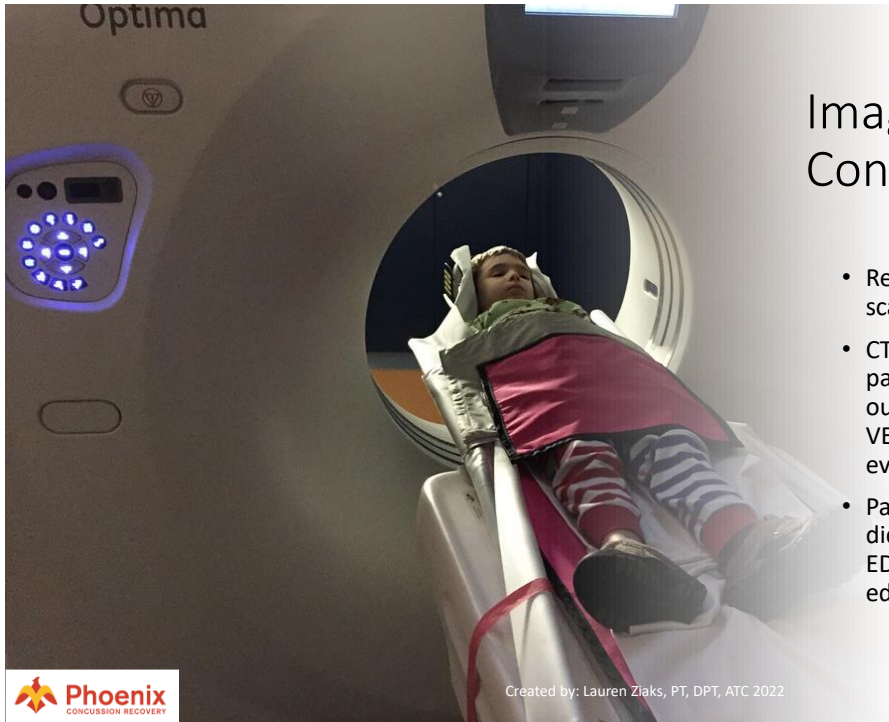
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Concussion Symptoms

| COGNITIVE | PHYSICAL | EMOTIONAL / MOOD | SLEEP |
|-------------------------------|---------------------------|---------------------------|--------------------------|
| Delayed processing speeds | Headache | Irritability | Sleeping more than usual |
| Difficulty thinking clearly | Vision changes | Sadness | Sleeping less than usual |
| Difficulty concentrating | Nausea / vomiting | More emotional than usual | |
| Confusion / memory impairment | Dizziness | Anxiety | |
| | Noise / light sensitivity | | |
| | Fatigue | | |



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Imaging for Concussion?

- Research does not support scanning every patient!
- CT scans and MRIs are for patients who need to rule out skull fracture or bleed – VERY IMPORTANT but not for everyone!
- Patients will be upset “They didn’t even image me in the ED” – good time for education



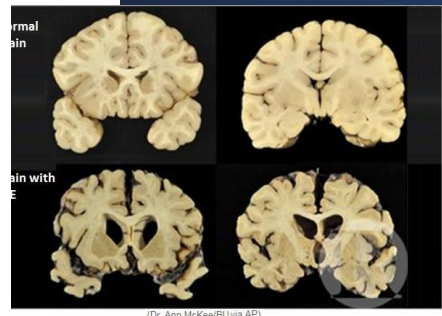
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17

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What is CTE?


- Short answer:
 - We don’t know yet
 - Will I automatically have CTE?
 - The studies have been amazing but skewed.
- The most important thing to do it not live in fear, make good choices, seek out treatment for deficits, donate healthy and female brains to science!




(Dr. Ann McKee/BU via AP)



18



Questions?




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19

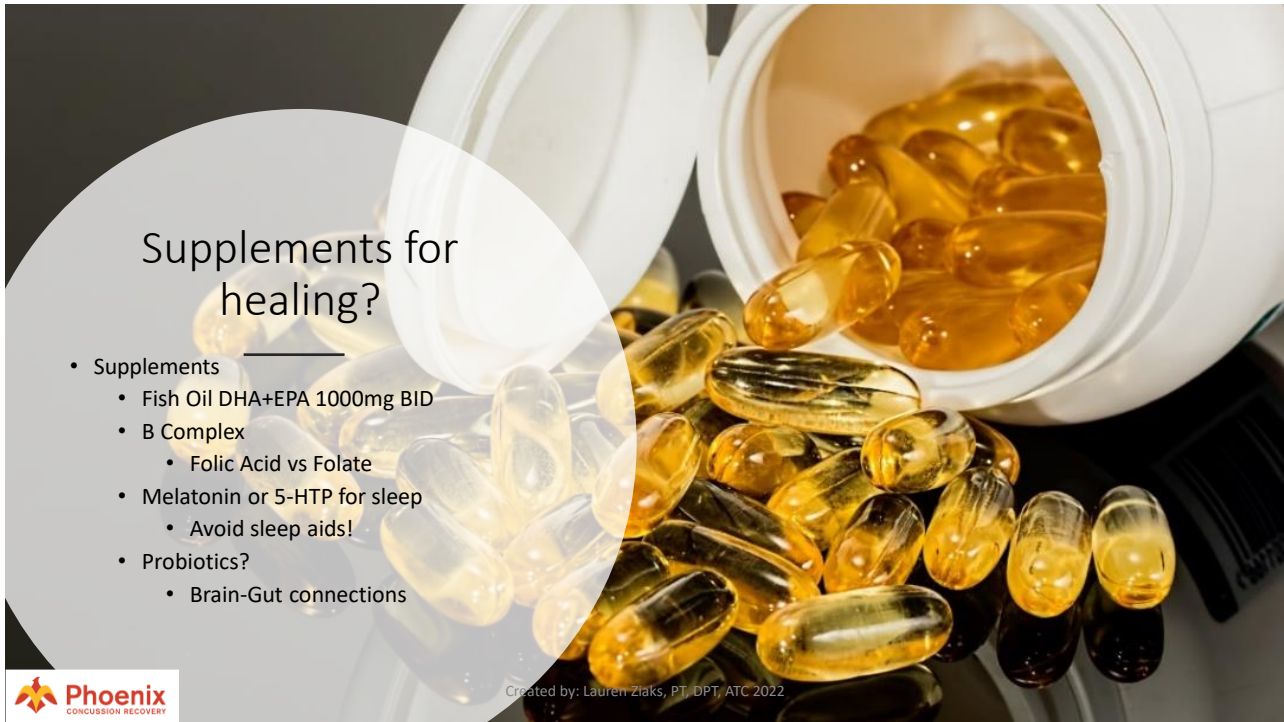
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Early Management and Patient Education



20



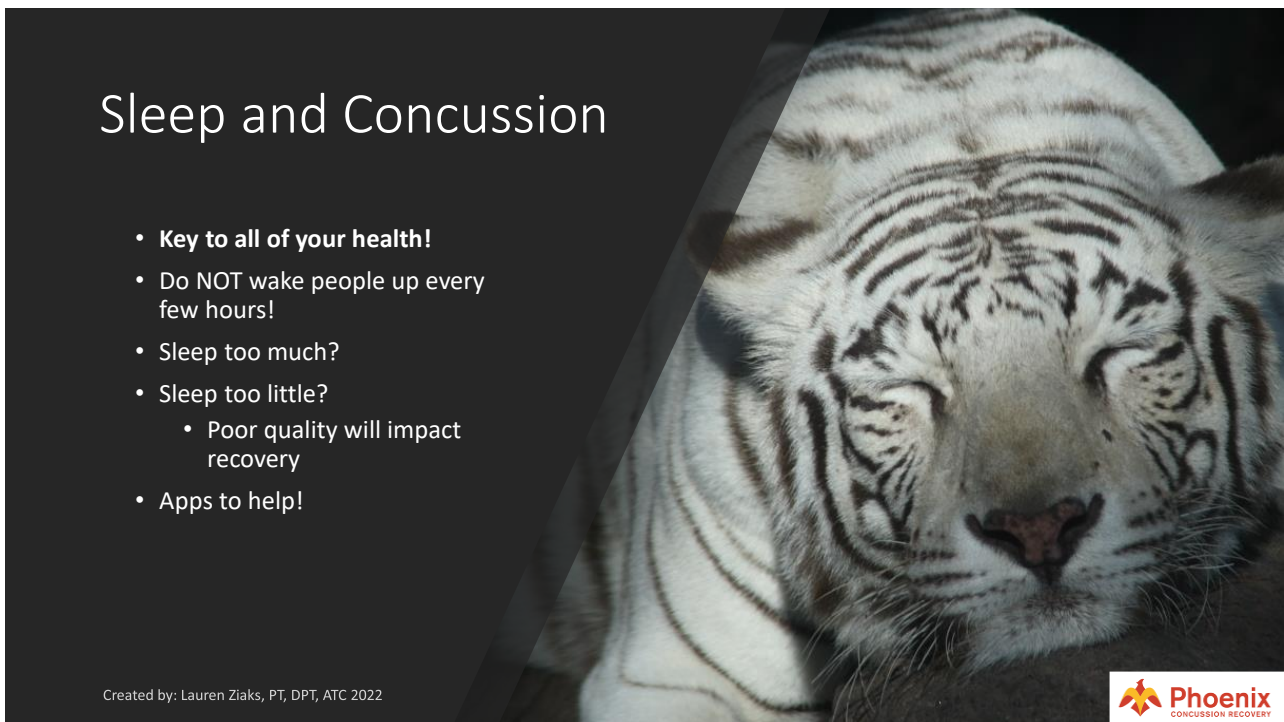


Supplements for healing?

- Supplements
 - Fish Oil DHA+EPA 1000mg BID
 - B Complex
 - Folic Acid vs Folate
 - Melatonin or 5-HTP for sleep
 - Avoid sleep aids!
 - Probiotics?
 - Brain-Gut connections

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21



Sleep and Concussion

- **Key to all of your health!**
- Do NOT wake people up every few hours!
- Sleep too much?
- Sleep too little?
 - Poor quality will impact recovery
- Apps to help!

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22



Sleep and Concussion

- Sleep apnea post TBI
- Medications
 - MDs may choose to use trazadone, amitriptyline / nortriptyline
 - Avoid Lunesta, Tylenol PM
- CBT-I
 - Public health risk sleeping <5 hours per night
 - Altered arousal state



23

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Early Management^{1,5,41}

- Rest?
 - **Only the first 24-48 hours**
 - Cocoon therapy leads to INCREASED problems with concussion.
 - Physical exercise: initiate LIGHTLY at 48-72 hours post
- Light sensitivity:
 - The longer you spend in the dark the more light sensitive you will become



24

Return to Cognition

- Accommodations for school/work
 - Return to Learn protocol⁶
 - GET THEM IN THE BUILDING!
 - **Blue blockers for the computer/phones (eyekeeper)**
 - Glasses or a filter for the computer screen
 - “Night shift” on the iphone or an app for android



25

Pacing strategies

- 20/20/20 rule
 - 20min on, 20off, 20ft away
- Stoplight theory
- Paper calendars
- Reminders on their phones



26



Stop Light Theory

- Human nature to “speed through the yellow”
- Teach patients to ID “yellow” zone and recover to “green”
- “Red zone” or “wired tired” – use up all ATP stores and glucose, have to physically lay down and sleep to recover
 - Explain the WHY to patients to help them build success



| Stage | Activity | Objective |
|---|---|--|
| No activity | Complete cognitive rest — no school, no homework, no reading, no texting, no video games, no computer work. | Recovery |
| Gradual reintroduction of cognitive activity | Relax previous restrictions on activities and add back for short periods of time (5-15 minutes at a time). | Gradual controlled increase in subsymptom threshold cognitive activities. |
| Homework at home before school work at school | Homework in longer increments (20-30 minutes at a time). | Increase cognitive stamina by repetition of short periods of self-paced cognitive activity. |
| School re-entry | Part day of school after tolerating 1-2 cumulative hours of homework at home. | Re-entry into school with accommodations to permit controlled subsymptom threshold increase in cognitive load. |
| Gradual reintegration into school | Increase to full day of school. | Accommodations decrease as cognitive stamina improves. |
| Resumption of full cognitive workload | Introduce testing, catch up with essential work. | Full return to school; may commence Return-to-Play protocol (see Step 2 in Table 2). |

Source: Master CL, Gioia GA, Lasky JJ, Grady MF

SIDEBAR 2. School Accommodations Upon Re-Entry

- Breaks as needed in a quiet place
- Preprinted class notes
- Additional time for assignments
- Excuse nonessential work, no double workload of make-up work and new work
- Additional help and tutoring as needed
- No testing until tolerating a full day of school, then untimed testing

Source: Adapted from www.cdc.gov/concussion/headsup/pdf/ACE_care_plan_school_version_01.pdf

Return to Learn Protocol



- Research comes from Return to Learn
- Disability model
 - The longer patients are out, the longer they take to get back
- Providing accommodations and getting patients active as soon as possible is in their best interest
 - Allow for rest breaks, modified placement / workload
 - Modified days – 50% or every other day if altered shift length not possible
- A modified transition in a supportive environment will lead to better success
 - Dim screens, allow hats if unable to change lighting, blue light filters
 - If OD recommends glasses following concussion – support and assist with access ASAP

Return to Work Protocol



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29

The Return to Sport Process⁵

Downloaded from <http://bjsm.bmj.com/> on April 27, 2017 - Published by group.bmj.com

Consensus statement

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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30

The Return to Activity Process⁵

- Research comes from Return to Sport
- Early cardiovascular exercise (without symptom increase >2-3/10) promotes blood flow to the brain and reduces recovery times
 - The longer patients are out, the longer they take to get back
- Help patients understand how to modify activity, how to pace, and the importance of cardiovascular exercise to assist with prevention of disability and chronic pain (centralization)
 - Modify with stationary bike, slow walk around the block / on a TM for 10-20mins
 - Increase as tolerated until return to PLOF
- Exercise is an excellent management technique for mood / psych
 - These factors can play a significant role in delayed recovery



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31

Questions?



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32

Protracted Recovery

Not all patients will recover <4 weeks

Predictors of protracted recovery:

- Psych – anxiety/depression, PTSD
- Previous concussion
- Migraine hx – 7x more likely to have protracted recovery
- Learning differences – ADD/ADHD, dyslexia, sensory processing disorders
- Amnesia
- Dizziness at onset of injury – 6x more likely to last >3 weeks (Lau et al 2011)
- Age, gender, mechanism of injury
- Delayed removal



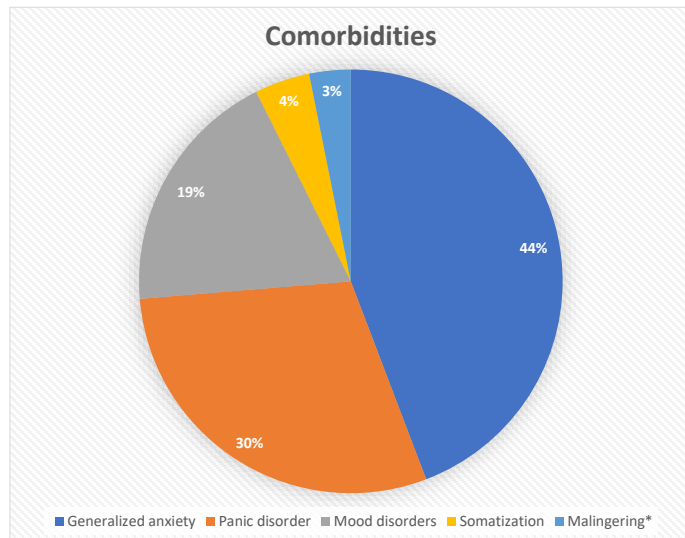
<https://www.henryford.com/services/behavioral-health/neuropsychology/conditions/head-injuries>

*J. Orthop Sports Phys Ther. 2020;50(4):CPG1-CPG73. Physical therapy evaluation and treatment after concussion/mTBI

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Concussion Doesn't Occur in a Vacuum



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Post-Concussion Syndrome?



35

- Moving away from PCS!
 - Post-concussion syndrome considered outdated and has poor psychosocial impacts both for patients and providers
- New options – will be further established in research:
 - Persistent Post Concussion Syndrome (PPCS) – symptoms >1 month – Dr. Leddy’s group in NY
 - Persisting Symptoms after Concussion (PSaC) – Broshek’s group published 2020.

Concussion Domains – What is Your Primary Driver?



36

- DOMAINS ARE NOT MUTUALLY EXCLUSIVE, APTA CPG⁴¹:
 - Cervical musculoskeletal impairments (C-level), Vestibulo-ocular impairments (B-level), Autonomic/Exertional tolerance impairments (B-level), Motor function impairment (B-level)
 - Motor function: balance, coordination/control, dual/multi-tasking
- This is missing a bigger piece:
 - Cognitive domains, psychological domains
 - Visuo-vestibular is my preference – vision is not a subset of vestibular!

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Primary vs Secondary Drivers

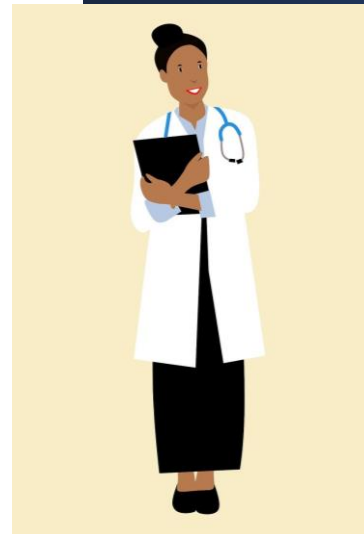
- Patients often have “mixed” presentations
 - Identify the primary driver first – greatest complaints with vision vs with exercise vs neck pain
- Complete treatment in a sequential manner to avoid overloading the nervous system
- Pay attention to the cumulative HEPs patients are prescribed
- As Primary Drivers begin to resolve – integrate treatment for Secondary Drivers



38

Detailed Patient History!

- Asking the right questions validates your patient AND gives you the right information to guide your evaluation and education.
- Risk factors present?
- Vision symptoms:
 - HA with reading, interm blurry vision, diplopia, decreased reading comprehension/retention, fatigue
- Vestibular:
 - Balance – stairs, low light, busy environments, Dizziness – different types!, Oscillopsia, Motion Sensitivity
- ANS symptoms:
 - Activity intolerance, heat/cold intol, changes in appetite/thirst, sensitivity to dehydration, feeling palpitations/SOB
- Cognitive/other:
 - Changes in concentration/focus, fidgeting behaviors, sensory overload, difficulty in social interactions, changes in handwriting, memory changes, difficulty with divided attn



39



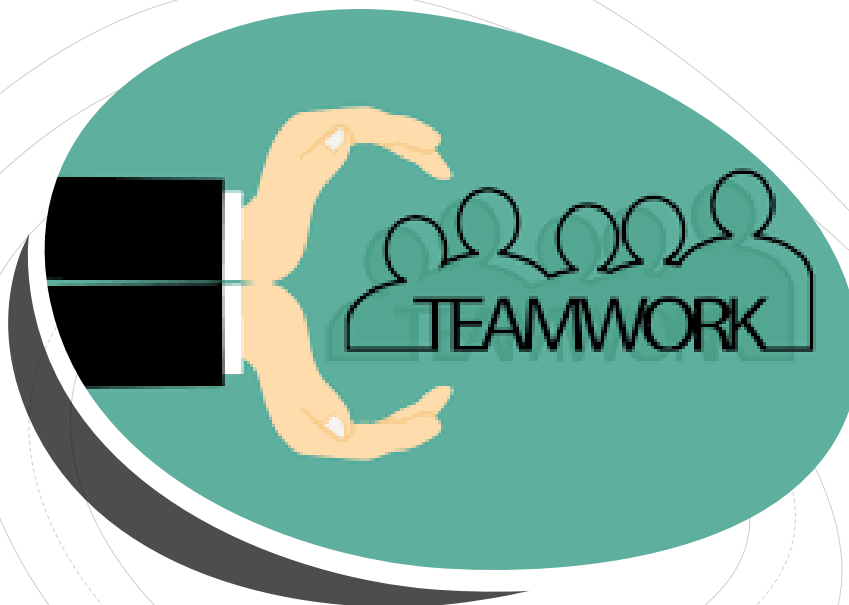
What a patient will sound like:

- Accommodative insufficiency:
 - I get dizzy/HA/blurry vision when I am in school and have to look up at the board.
 - I have difficulties in the car and have to rely on my speed control
 - I feel a "delay" when I look at my phone and then back up at the TV
- Vision vs Vestibular? Integrated!
 - At an intersection I will have to check multiple times to make sure someone isn't coming
 - I have to check and re-check my mirrors – I rely on my blind spot detectors
 - When I turn a corner I feel the world has to catch up
- ANS:
 - I can't tolerate being in a hot tub now
 - I get hot flashes and sweaty when I'm stressed or overwhelmed – will occur with reading as well
 - Even just walking up the stairs I feel SOB and like my heart is fluttering
 - I feel so out of shape but every time I try to exercise I get headaches or my legs feel dead



Phoenix
CONCUSSION RECOVERY

40



The Team
Approach



Phoenix
CONCUSSION RECOVERY

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41

How Do We All Work Together?



42

- Collaboration.
- It will look different everywhere you go
- Domain Based Treatment
- All concussion treatment is advanced treatment – not learned in school for any of us – SLP, PT, OT
 - Learn to collaborate – trust one another, respect boundaries



Examples

- Moderate-Severe TBI is a different animal than concussion!
 - Patients aren't working or going to school.
 - Rehab IS their full-time job
- Mild TBI (concussion) is a transient experience
 - Most patients transition back to work or school in some capacity *fairly quickly**
 - Often required to continue to fill family roles
 - “Walking Wounded” – “But you look fine”



43

mTBI – Pick your battles

- You need a systematic approach for these people
- What are their TOP needs? What are their driving factors?
- If this patient has neck pain, can't read, has psych issues, and has memory impairment how do I streamline their care?
 - Perhaps address pacing strategies during manual therapy portion of ortho treatment and refer for mental health services



44

Treating Concussion – a Collaborative Approach

- Depending on the interests of your team and training levels your team may look different at each location.
 - There is a lot of overlap between licenses and limited knowledge is learned in school regarding concussion/mTBI management.
- I.e.,
 - OT may be trained in vision and vestibular while screening for appropriate referrals for musculoskeletal, cognitive, or exercise intolerance complaints
 - PT may be trained in vision and vestibular while screening for the same
 - PT may serve for vestib, msk, and exercise but screen for vision and cognitive deficits



45

Requirements for a comprehensive program:

ALL practitioners should be able to screen for referrals to all domains

ALL practitioners should be able to take a thorough history and provide adequate patient education across domains.

All teams should have adequate referral sources:

- FCOVD or NORA trained neuro-optometrist to supervise / provide vision therapy and Rx lenses
- Medical oversight: doesn't have to be a neurologist!
 - Needs to be a caregiver who is educated and interested in population – MD, OD, PA, PM&R, Neurology, Pediatrics
- PSYCH – EMDR and CBT specifically



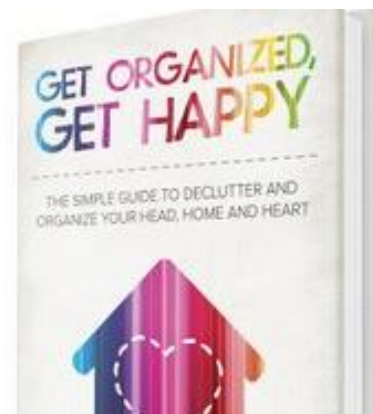
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46

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Referral to SLP

- For my practice:
 - I have education for Return to Learn/Work/Sport guidelines
 - I can educate on pacing strategies and organizational skills
- When I would refer:
 - Patient education for pacing strategies becomes repetitive, requires >20mins of my treatment session
 - Patient's cognitive deficits not improving with vision therapy – after 1 month as I taper down – I would add speech to replace me
 - Patient requires a 504 plan for school



47

Protracted Recovery – Cognitive Changes

- ADD occurs in 5-15% of injuries.
- Therapist completes a **Cognitive Communication Evaluation**
- Therapy will address:
 - Memory issues
 - Impaired communication skills – word accessing/finding, fluency of speech, effortful speech
 - Decreased executive functioning:
 - Attention strategies for work or school
 - Planning and organizational skills, time management skills



48

Assessment Tools

- The ceiling effect is the hardest part
 - MOCA
- imPACT
 - Most widely known – passive – computer based
 - Need someone qualified to read it
 - Has been watered down to improve access
 - Issues with appropriate administration
- C3Logix – more comprehensive
 - Newer examination – ipad based
 - Includes section of neuro-cog examination performed by SLP and neuropsych
 - Trails A & B, reaction time, choice reaction time, perception tests
 - Includes SCAT5
 - Includes DVA
- None replace the benefits of comprehensive testing
 - Most patients will not need full 6-8 hour battery of tests, most deficits will resolve with appropriate treatment as they are due to functional deficits



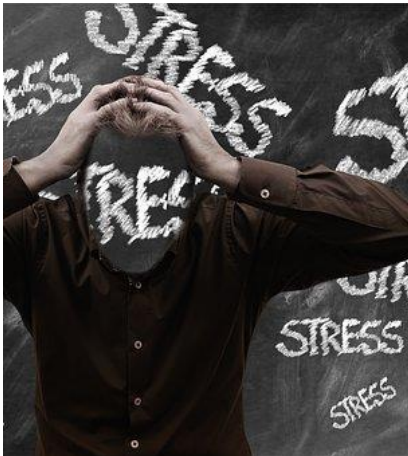
49

Assessment of Cognitive Difficulties⁴²

| | |
|---------|---|
| Level B | <p>“A patient sustaining a concussion should be evaluated for the presence of cog difficulties, and consideration taken to the impact of such difficulties on functional areas such as performance at work or school and completing tasks within the home and community etc.”</p> <p>“This can be done through focused clinical interview regarding symptoms and administration of validated post-concussion questionnaire for the purpose of assessing and tracking symptoms.”</p> |
| Level B | Co-morbidities (ADHD, learning differences, anxiety/mood disorders, pain, fatigue etc) can intensify or prolong cognitive dysfunction. Education to the patient on overlay and relationship is key! |
| Level A | “Patients who have cognitive symptoms...not resolving and interfere with daily functioning >4 weeks should be considered for specialized cognitive assessment.” |



50



Psych – Mind-Body

- Chicken or the egg?
- Depression, anxiety, PTSD all overlay with concussion/TBI
- You must treat the WHOLE person
 - EMDR
 - Level A evidence: CBT is well established in the literature.⁴²
- Apps, journaling



51

Questions?

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52

Impairments and Treatments Across Domains

Manual therapy and physical exercise

Vision and Vestibular Rehabilitation Therapy

- Should be Integrative!

Testing and progressions for suspected Dysautonomia v
Exercise Intol.



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53

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What Does the CPG Say?⁴¹

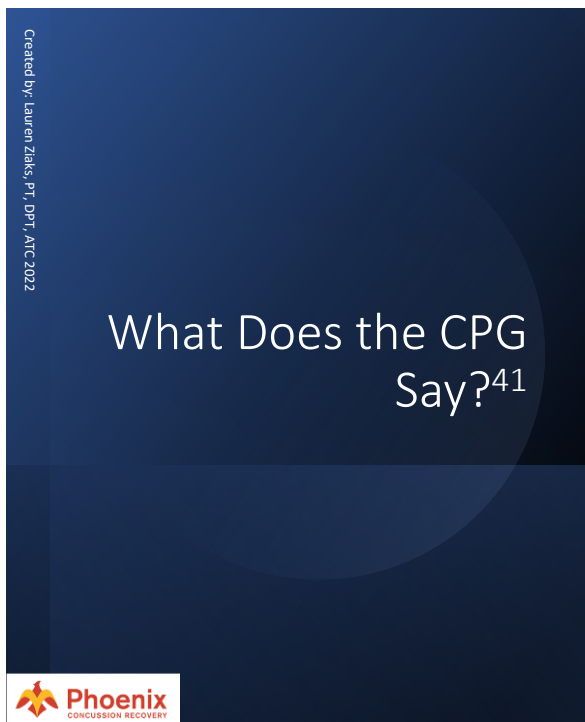


54

You SHOULD evaluate – Level C (weak evidence)

You SHOULD treat impairments – Level II evidence (RCTs)

Gap in Knowledge Exam: requires specific neck pain CPG for direction. Should also assess in patients **without neck pain** due to hypothetical and theoretical links to reinjury and prevention.



55

- **Gap in Knowledge Intervention:** requires research to determine optimal interventions for patients post concussion + msk impairments.
- Level B (moderate evidence) – SHOULD implement interventions.

Manual Therapy & Ther Ex for Concussion⁴¹

- Often whiplash component
 - Research demonstrates a combination of manual therapy AND strengthening is the best
- Cervicogenic headaches:
 - Often triggered by suboccipitals, SCMs, and CTJ
 - Watch for dizziness / hearing changes / jaw pain associated with SCMS
- Postural Stability Exercises
 - Improvements in energy efficiency
 - Assessing and treating the entire kinematic chain
 - Head and neck need a stable base of support to operate properly



56

Give extra attention
to the Deep Neck
Flexors!

Patients will lose contact with the DNF

Just like VMO and RTC – autogenic inhibition occurs in whiplash

Patients will lose the ability to “feel” their DNF fire

Tactile cues, verbal cues


- Feel for the muscles firing OR the absence of the SCMS and suboccipitals!
- Clinically, takes 1-2 weeks of practice to start to feel the muscle connection again!



57

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Cervicogenic Dizziness



58

Dizziness generated in the cervical spine – associated with WAD.

Due to inter-relationship between following reflexes:

- VOR
- VCR – vestibulo-collic reflex
 - Compensatory neck muscle activation with response to movement in inner ear
 - Stabilize head and gaze in space
- CCR – cervico-collic reflex
 - Compensatory neck muscle movements due to motion of the body
 - Stabilize head on body
- COR – cervico-ocular reflex
 - Eye response elicited by rotation of the neck – low velocity
 - Typically minimal input in humans
 - Assists in postural stability in combination with VOR

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Cervicogenic Dizziness

- Gap in knowledge for BEST test, BEST explanation
 - Body on head testing
 - Seated, stabilize patients head and have them rotate SLOWLY side to side
 - Joint Position Error Test – JPE
 - Looking for accuracy AND symptom presentation
 - Used as assessment and tool
 - Kinesthetic awareness – Laser exercises
 - Used as assessment and tool
 - Can progress into more dynamic positions
 - Standing
 - Sitting + rotation
 - Quadruped



59

JPE and Kinesthetic Awareness

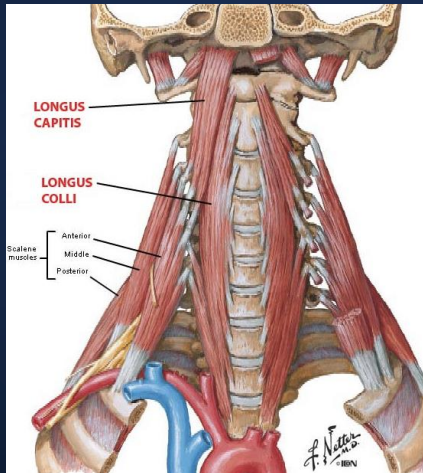
Equipment needed: hats, clothespins, lasers, printouts



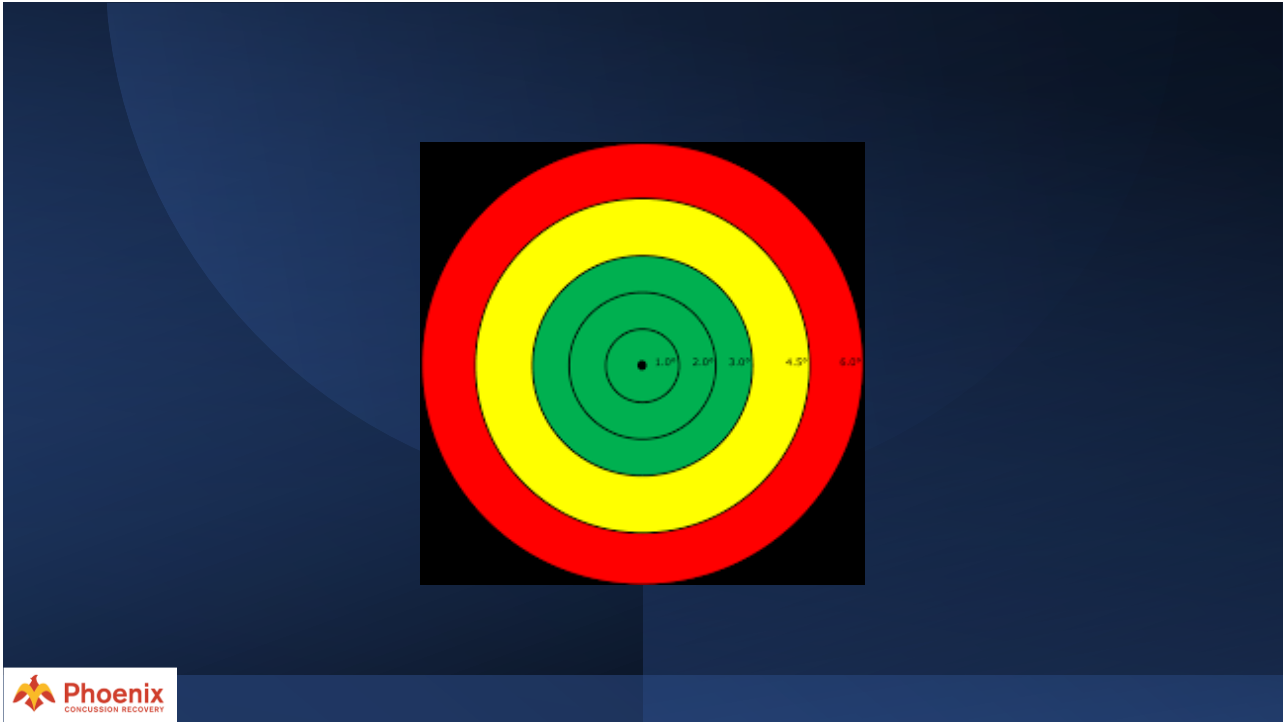
60

Deep Neck Flexors

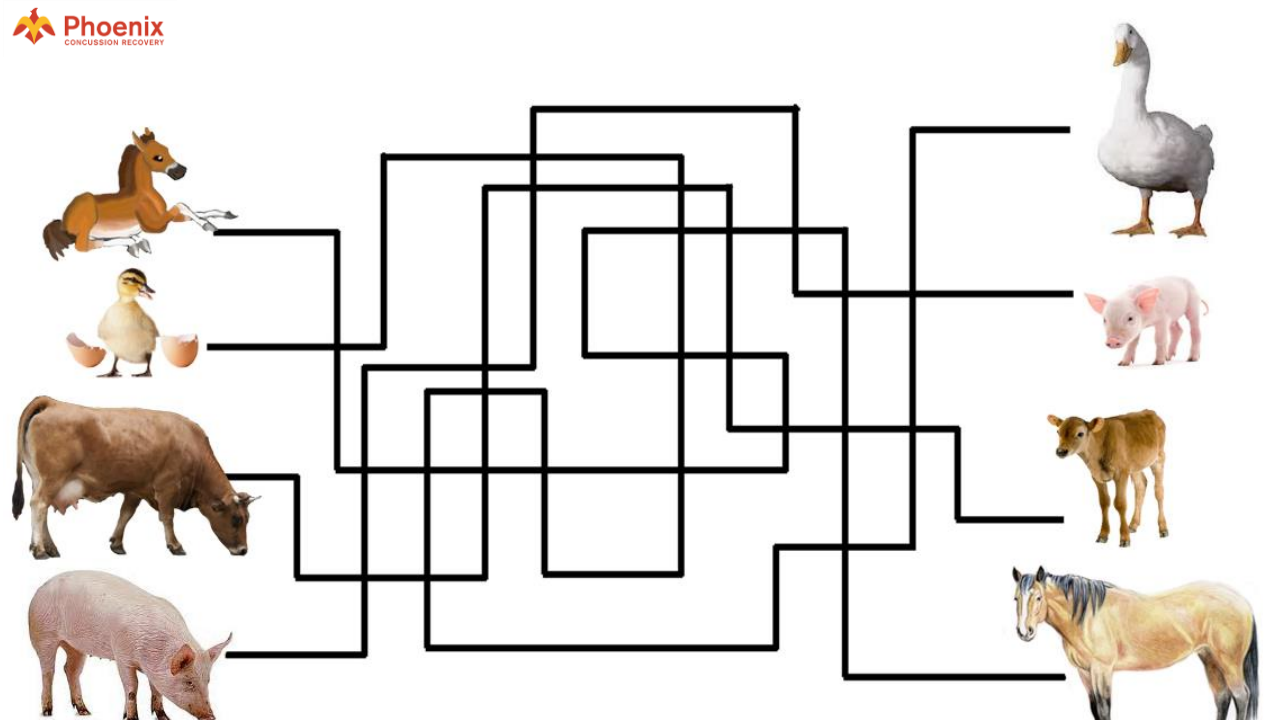
Equipment needed: beachball



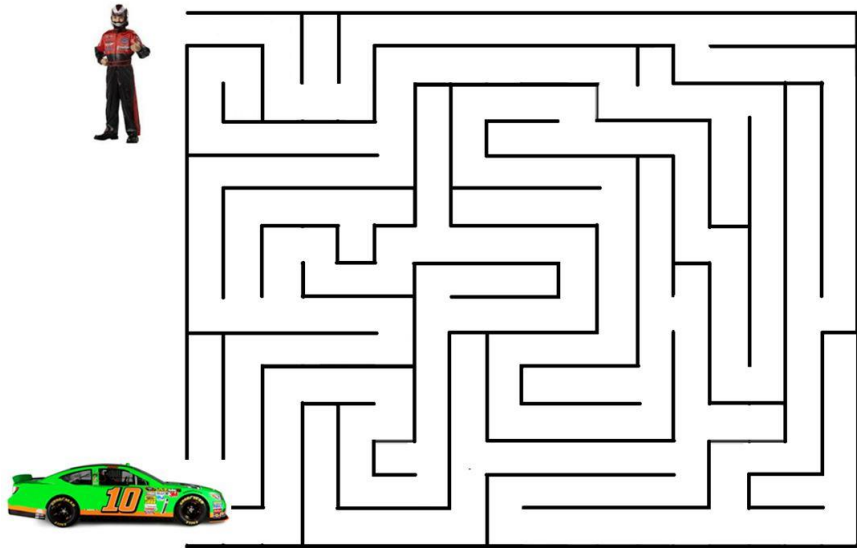
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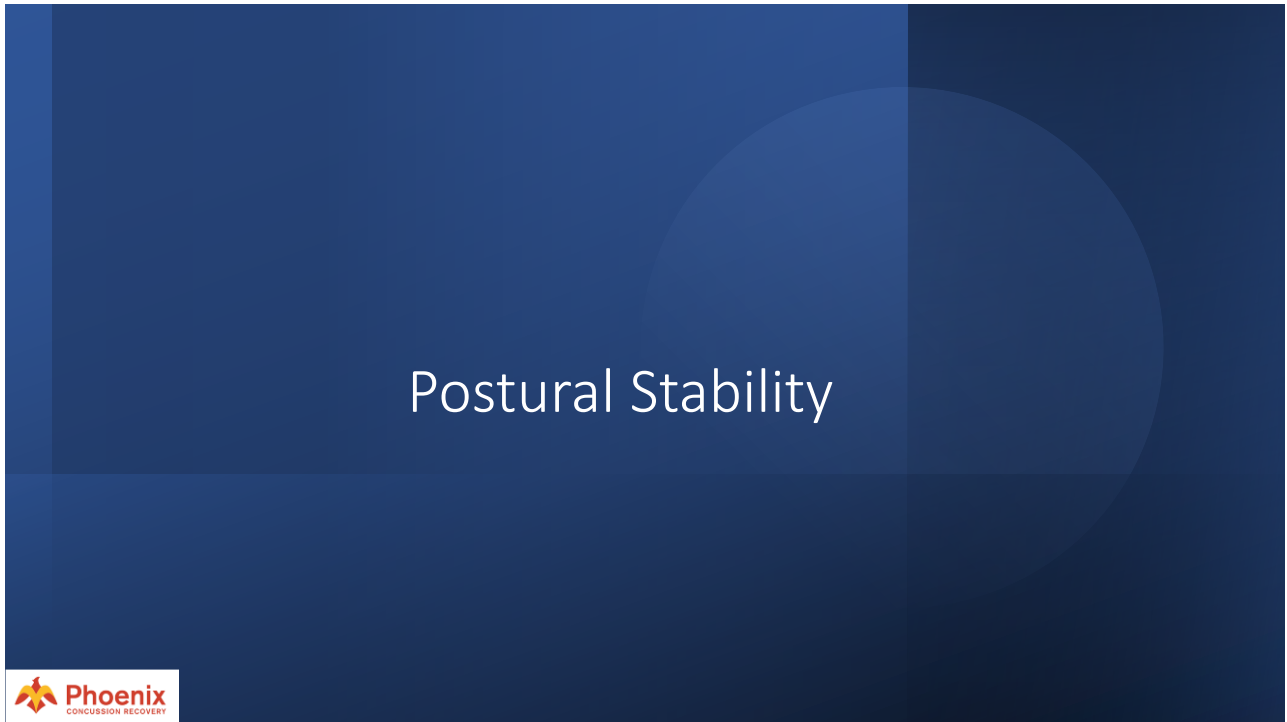
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63



64



65

Craniosacral Therapy

This can start right away!

Neural Calming and Physiological Quieting

- Decreasing the sympathetic drive (fight or flight)
 - Teaching patients to decrease symptoms on their own.
 - Often the Vision and Vestibular therapy will increase these symptoms temporarily – skills to use to help your own recovery.

Research:

- Decreased pain
- Improved range of motion (movement)
- Improved sleep, memory, and cognition



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66

Questions?



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67

Vestibulo-Oculomotor Examination – CPG⁴¹

Examination:

- Level 1 – BPPV may be present and use DHP to assess.
- Level 2 – support for exam to detect vestibular and oculomotor dysfunction that may contribute to symptoms. Saccadic eye movement, smooth pursuits, vergence, and accommodation.
- Level 2 – Support for VOMs screening post concussion

Gap in Knowledge:

- “Various strategies to examine vestibular and oculomotor function have been proposed...there is limited evidence to support one strategy over others” for examining patients post concussion.

Recommendations:

- Level B (moderate):
 - SHOULD examine vestibular and oculomotor function.
 - SHOULD examine ocular alignment, smooth pursuits, saccades, vergence, and accommodation, gaze stability, dynamic visual acuity, visual motion sensitivity, lightheadedness 2/2 orthostatic hypotension, and BPPV.
- Level A (strong):
 - If BPPV suspected – you SHOULD asses via DHP and other appropriate tests



68

Vestibulo-Oculomotor Intervention – CPG⁴¹

Intervention:

- Level 1 – if BPPV is identified – CRMs should be used
- Level 2 – weak-to-moderate evidence that vestibulo-oculomotor rehabilitation improves outcomes.

Gap in Knowledge:

- “More research is needed to evaluate the implementation of these guidelines in patients who have experienced a concussive event.”

Recommendations:

- Level A (strong): If BPPV identified – use CRMs
- Level B (moderate): Those with expertise in vestibular and oculomotor rehabilitation SHOULD implement an individualized rehabilitation plan.
- Level B (moderate): If visual vertigo/visual motion sensitivity is ID – individualized visual-motion habituation program may be beneficial.



69

Ignoring Vision Could Be Detrimental!

Associated Injuries:

- Brooks et al. 2016 demonstrated 2.48x > risk for lower extremity injury during 90-day period after RTP compared to controls!
- Loss of spatial awareness and dynamic postural control
- I use this when I'm explaining to patients about RTP!

Master et al. in 2016 reported increased neurocog impairment and > symptom reports in patients with convergence insufficiency.

- Needless loss of function and symptomatology in patients when CI is missed.



70

Protracted Recovery >3 weeks

- Vision Symptom Checklist:
- Headaches/difficulty with reading:
 - Words moving on the page, skipping lines, re-reading, decreased comprehension
 - Inconsistent blurring or doubling of images
 - Increased difficulty maintaining same grades
- Light sensitivity with screens/overhead lighting
- Difficulty returning to school/work tasks
 - Significant fatigue with visual activities
 - Dizziness
 - Clumsiness – poor hand-eye coordination
 - Changes in handwriting



71

Vision Impairment

90% of people immediately after concussion, upwards of 50% long term

80% of our vision comes from the neural pathways including visual processing, eye tracking, accommodation and focusing

Common Deficits:

- Accommodative and convergence insufficiency (40-50% each)
- Oculomotor deficits – differ in literature – 20-30%
- Visual field deficits – 32% - can be a processing issue “visual inattn”



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72

Equipment needed: metronomes, popsicle sticks + 14pt font

VOMS



73



VOMS

- Not a comprehensive vision examination!
- Developed as a screening tool
- Supplement with the Brain Injury Vision Symptom Survey – BIVSS
 - >31 + CI
- If patients show signs of strabismus/amblyopia or have NPC >4 inches – refer to OD



74

How to Complete VOMS

Use the screening tool

- Track symptom changes
- Look for abnormal quality of movement in each assessment
 - Quality of movement is not a typical outcome measure, as skilled clinicians you can do more than the lay person!

Assess:

- Pursuits
- Saccades
- NPC
- VORx1
- VOR CXL



75

Vestibular/Ocular-Motor Screening (VOMS)

Smooth Pursuits (Horizontal & Vertical)
Tests ability to follow a slowly moving target
Both patient and clinician are seated
Patient follows finger with eyes
Do NCT move head, just eyes
2 reps at rate of 2 sec / 1 rep
Rate symptoms (0-10)
Complete for both horizontal & vertical

Saccades (Horizontal & Vertical)
Tests ability of eyes to move quickly between targets
Both patient and clinician are seated
Clinician holds fingers 3" apart
Patient quickly looks L/R
Do NCT move head, just eyes
10 reps as quickly as possible
Rate symptoms (0-10)
Repeat with patient looking Up-Down

Convergence
Measures ability to view a near target without double vision
Patient holds target with 14-point font 7" of arm length
Patient brings target forward
Eyes focusing on the "X"
Stop when they see double
Clinician measures distance from tip of nose to target (cm)
Repeat 3x, record all 3
Rate symptoms (0-10)

Visual Motion Sensitivity
Tests visual motion sensitivity & ability to inhibit vestibular induced eye movements using vision
Patient holds arm outstretched in front with thumb up
Turn body on a tilt to L/R 80 deg from midline focusing on thumb
Use metronome 50 bpm
Repeat 5 revolutions
Rate symptoms (0-10)

Vestibular-Ocular Reflex (Horizontal & Vertical)
Assess ability to stabilize vision as head moves
Clinician holds target 3" from patient's eye level
Patient quickly turns head L/R
Keep eyes focused on target
Use metronome 180 bpm
Wait 10 seconds
Rate symptoms (0-10)
Repeat with patient looking Up-Down

Visit natafoundation.org/for-the-profession for more info including the NATA Foundation e-article on VOMS

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76

Pursuits – Following Target




77

- Pt and examiner seated – 3 feet apart
- Target with 14pt font (letter on popsicle stick)
- Horizontal:
 - Move target 1.5ft to the right and 1.5ft to the left of midline
- Vertical:
 - Move target 1.5ft up, 1.5ft down
- 1 rep = there and back, 2count each way
- Perform 2 repetitions each (I would like to see you complete 5-10ea. for ocular fatigue)
- **Record symptoms**

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Saccades – moving eyes between targets




78

- Pt and examiner seated – 3 feet apart
- 2 targets with 14pt font (letters on popsicle sticks)
- Horizontal:
 - Targets: 1.5ft right and 1.5ft left of midline, 30deg motion each.
- Vertical:
 - Targets: 1.5ft up, 1.5ft down, 30deg motion each.
- 1 rep = there and back, 10x each way
- **Record symptoms**

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NPC – ability to track an object inward



79

- Patient seated + corrective lenses
- Patient holds 14pt object at arms length – observe as pt brings target in towards nose.
- Stop the target when patient sees double (diplopia) OR if therapist observes ABD
- *Ignore blurring*
- Measure in cm from nose (I use inches)
 - Abnormal >6cm, 2inches
- Complete 3x
- **Record symptoms**

VOR – stabilize vision as head turns

- Pt and examiner seated – 3 feet apart
- Examiner holds 14pt target
- Horizontal (yaw):
 - Pt rotates their head 20deg each side + metronome @ 180bpm
 - (1beat per side)
- Vertical:
 - Pt rotates their head 20deg up/down + metronome @ 180bpm
- 1 rep = there and back, 10x each way
- **Record symptoms**



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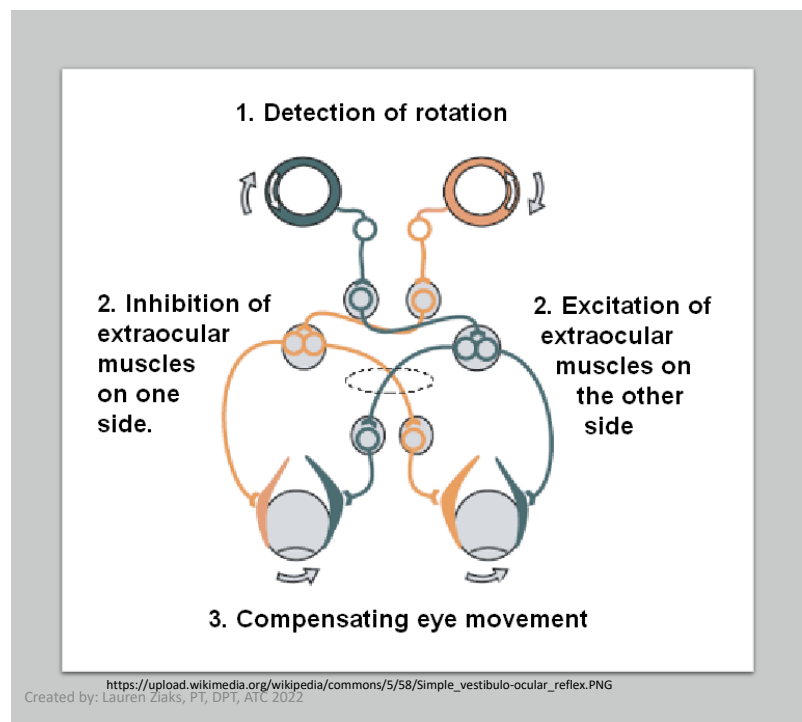
80

VOR – modifications

- In the baseline assessment tool start at 1.5cps (180bpm)
 - For injured persons it is best to start at 120bpm and increase to WNL
 - Highest sensitivity for + findings – no reason to exacerbate symptoms more than necessary
- Yaw plane – side to side
- Pitch plane – up and down



81



VOR CXL – Visual Motion Sensitivity Test

- Pt standing facing busy area
- Arm outstretched looking at their thumb
- Pt rotates as a unit 80deg left / 80deg right
 - 50bpm
- 1 rep = there and back, 5x each way
- **Record symptoms**



<https://www.physiotherapyalberta.ca/files/vomstool.pdf>

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82

VOR CXL – Visual Motion Sensitivity Test

Created by: Lauren Ziaks

Ability to inhibit vestibular-induced eye movements using vision

In clinic, smaller range of motion = goal
150bpm

Start slower! Likely to be provocative – you can increase as necessary

Typically pitch plane is more challenging visually

Shoulder to shoulder

Tip the ears forward and back

VOMS typically tests only yaw plane



83

VOMS Score Sheet:

| Vestibular/Ocular Motor Test | Not Tested | Headache 0-10 | Dizziness 0-10 | Nausea 0-10 | Fogginess 0-10 | Comments |
|------------------------------|------------|---------------|----------------|-------------|----------------|---|
| BASELINE SYMPTOMS: | | | | | | |
| Smooth Pursuits | | | | | | |
| Saccades – Horizontal | | | | | | |
| Saccades – Vertical | | | | | | |
| Convergence (near point) | | | | | | Trial 1 _____ Trial 2 _____ Trial 3 _____ |
| VOR Horizontal | | | | | | |
| VOR Vertical | | | | | | |
| Visual Motion Sensitivity | | | | | | |

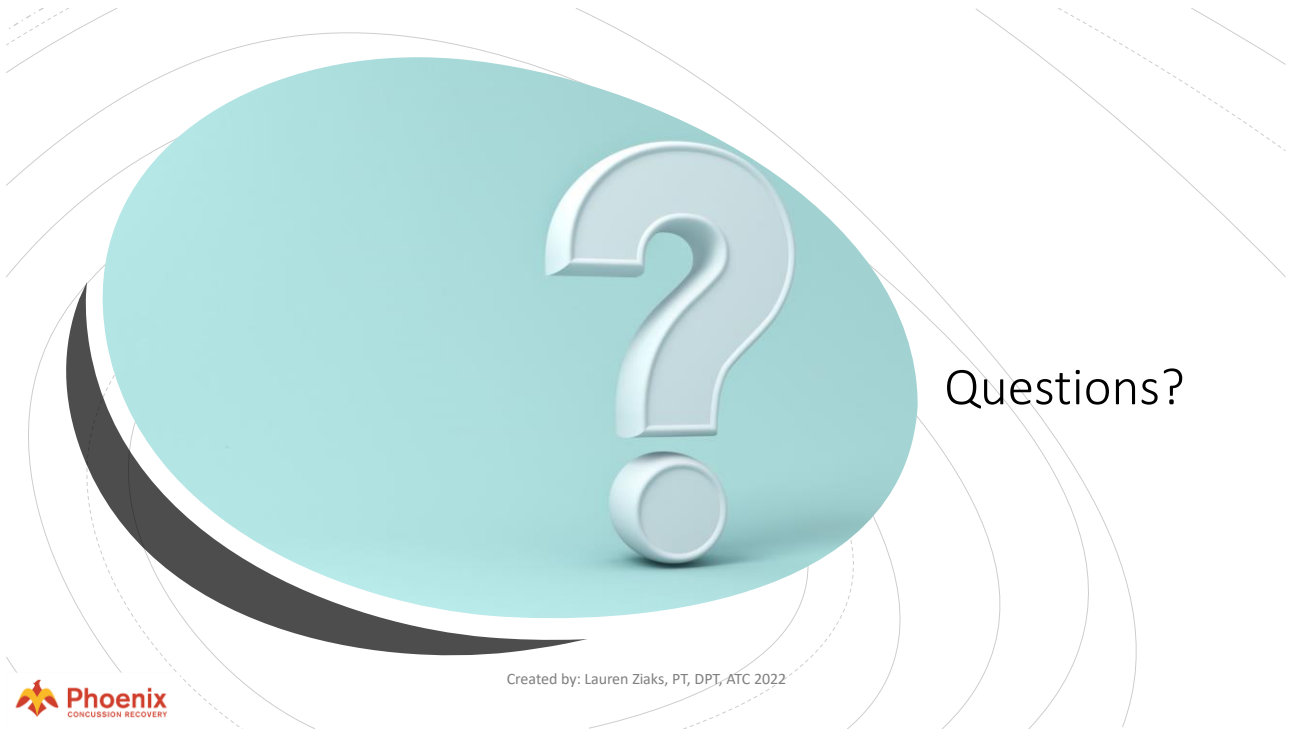


How do we treat vision disorders?

Created by: Lauren Ziaks

- Appropriately trained professionals – under neuro-optometrist supervision**
 - FCOVD vs NORA – approx. 15% of all OD in the US can do the type of exams we need
 - OT, PT, SLP
- Lot of studies saying deficits **exist** but not a lot saying what to do, how to do appropriately
 - Gap in Knowledge – APTA CPG
- Therapy is MORE than just pencil exercises and hart chart/brock string**
 - Knowing when to add treatments for vergences and accommodation





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Sequencing and integration of cervical manual therapy and visuo-vestibular therapy for concussion symptoms: retrospective analysis

- 59 records reviewed. N = 38 included with initial and final examinations.
- 25 male (65.8%) and 13 female (34.2%)
- Aged 26.9±19.7 years

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Visits

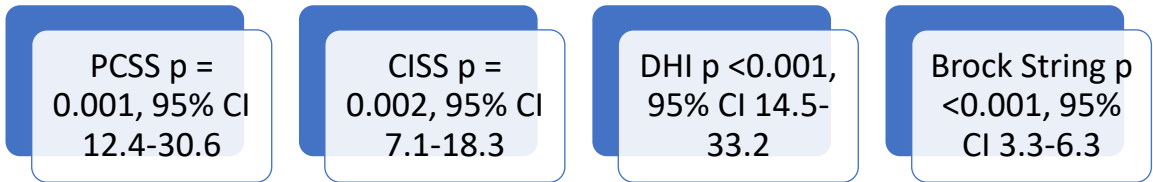


- Received an average of 10.4±4.8 treatment sessions over 57.6±34.0 days.
- Average number of sessions:
 - Cervical dysfunction was 4.0±3.8
 - Vision and vestibular dysfunction 4.8±3.0
 - Combined symptoms 1.7±0.8.

88

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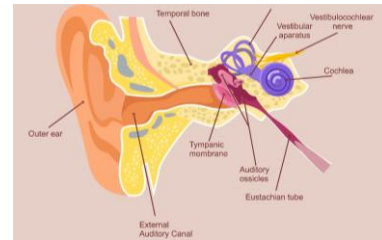
Outcomes



89

Protracted Recovery – Vestibular Changes

- Dizziness! (4 types!)
- Feeling “off balance” or “disoriented” frequent complaints
- Among TOP symptoms in PCSS
 - Dizziness 51%
 - Balance Problems 39% - Kantos 2012
 - Dizziness and balance impairments predict protracted recovery



90

BPPV

- If present, must be treated first!
- Cannot treat vision or complete appropriate vision examination with BPPV present.
- Use repositioning maneuvers – should resolve in 2-5 treatments (95-99%)
 - If you feel confident in the patients’ cognitive function or caregiver – teach patient to treat at home.
 - In 1 week between visits should fully resolve and allow you to move forward with assessments at next session.
 - Can be atypical in mTBI
 - More likely to be bilateral, multi-canal
- There is an excellent course on BPPV by Sue Whitney on Medbridge



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91

Vestibular Rehabilitation Therapy (VRT)

- Deficits of Vestibulo-ocular Reflex (VOR)
 - Loss of VOR gain
 - Blurry vision with head movements
 - Dizziness
 - Motion sensitivity
- Significant research supporting VRT
 - When done in the appropriate phase of recovery
 - Caution with starting too soon!

FEELING DIZZY? More than **1/3** of adults in the U.S. 40 and older have experienced some sort of vestibular dysfunction.*

BALANCE
Balance is controlled by:
• the inner ear (vestibular system)
• the eyes (vision)
• sense of touch (proprioception)

DIAGNOSIS
Vestibular disorders are not easy to diagnose. On average, patients consult 4 or 5 doctors before receiving a diagnosis.**
Your doctor will take a medical history and may order several types of testing, including:
HEARING BALANCE VISION
Getting a diagnosis may mean ruling out other conditions. Your condition may be short-term (acute) or long-term (chronic).

SYMPTOMS
You may experience one or several symptoms.
BALANCE PROBLEMS
• VERTIGO (sensation of movement)
• DIZZINESS
• IMBALANCE
PROBLEMS CONCENTRATING (or cognitive challenges)
VISION DISTURBANCE
HEARING CHANGES

TREATMENT
Your treatment will depend on your diagnosis.
• PHYSICAL THERAPY
• POSITIONING MANEUVERS
• DIET & LIFESTYLE CHANGES
• MEDICATION
• SURGERY
• COUNSELING

WHAT SHOULD I DO?
To learn more and find a specialist:
vestibular.org

VESTIBULAR DISORDERS ASSOCIATION



92

VOR Adaptations for Concussion

You may not be able to start with full 60sec intervals

You may not be able to start at “therapeutic load” – more for habituation and motion sensitivity before adaptation principles apply

You should meet the patient *where they are at* – vs provoking fear avoidance or increasing symptoms based on a therapeutic principle

Some patients WILL need progressions – most do not

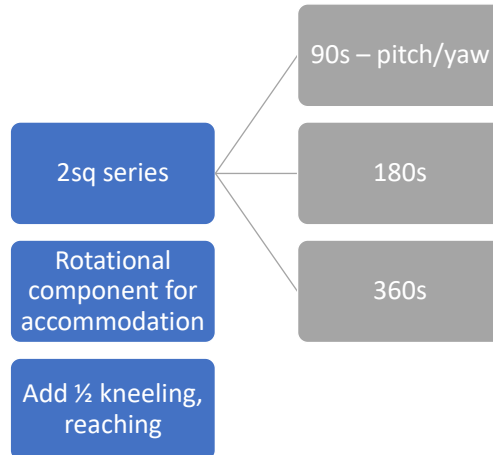
- Changing backgrounds
- Balance
- Reading + VOR etc



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93

Can add more habituation exercises as needed



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94

Patients with trends towards 3PD or motion intolerance

- May require extra visits during every other week portion of therapy to address fear-avoidance and habituation
- Add low level ex first to normalize balance and decr fear avoidance or high-risk strategies
 - Weight shifting AP, lateral
 - Static balance rhomb, SLS, tandem
- Habituation videos
- Pencil pursuits



95

Vestibular Testing / Adaptations

Can be instrumented or clinical – perfect world all testing would be instrumented but this isn't reality.

- DVA, gaze stabilization, gaze-evoked nystagmus, spontaneous nystagmus, HIT, HINTs

Posturography

- Careful with BESS – loses efficacy after 5 days post injury

VOR adaptations for concussion:

- Start as slow as required for symptom management (no >3/10)
- Provide one beat per side

Visual Motion Sensitivity:

- Often improves with vision therapy but can add specific exercises in VRT
- Patients will have difficulty in busy/crowded environments, watching moving objects/TV



96

Balance / Mobility Assessments

Often patients with concussion are subjected to the “ceiling effects” of standardized tests:

- 6MWT
- FGA
- DGI
- HiMAT – likely the best option

Testing for conditional balance provides good clinical information

- mCTSIB
- SOT
- Assist with creating POC



97

Take Away

- Concussions aren't going away – you can make good decisions but you can't PREVENT them
- Good early management will improve overall outcomes and speed of recovery. REST IS NOT BEST.
- Therapies exist and are highly effective for protracted recovery and should only be performed by trained professionals.
- We need more great, motivated, people in this field!
- CTE – we know less than the media says.
 - Encourage people to make good choices but not live in fear!



98

**TRIES TO IMPRESS
BAE WITH A GUITAR**



**GIVES HIMSELF A
CONCUSSION**

Thank you

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99



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100

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101

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