An Integrative Approach to Concussion Identification and Treatment

Mo Mortazavi, MD & Tanya Polec, OD FCOVD
SPARCC Sports Medicine, Rehabilitation, and Concussion Center

Thank you for your RESEARCH and Teaching !!

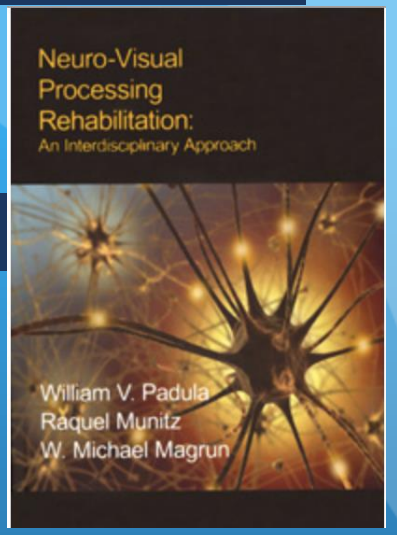
Occurrence of oculomotor dysfunctions in acquired brain injury: A retrospective analysis

Kenneth J. Ciuffreda, O.D., Ph.D., Neera Kapoor, O.D., M.S., Daniella Rutner, O.D., M.S., Irwin B. Suchoff, O.D., D.O.S., M and Shoshana Craig, O.D.

Kenneth Ciuffreda

Bill Padula

Penelope Suter



A Randomized Clinical Trial of Trea... for Convergence Insufficiency in Ch...

Derek Tong

DeAnn Fitzgerald

Robert Fox

Larry Wallace

Eric Ikeda

A Randomized Clinical Trial of Treatment ... Convergence Insufficiency in Children

Deborah Zelinsky

Janet Berthiaume

Michell Scheiman

Bob Sanet

Vincent Vicci

Review of Vestibula... Concussion Rehab...

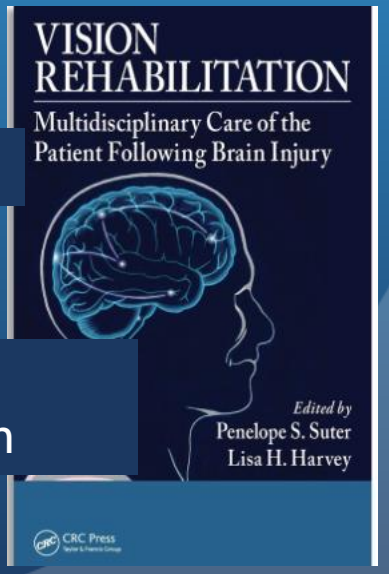
Susan Wenburg

Hannu Laukkanen

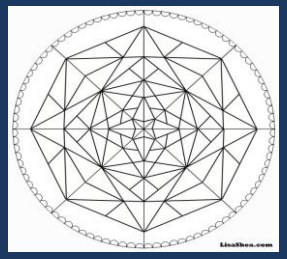
Curti Baxstrom

Anthony P. Kontos, PhD*; Jamie McAllister Deitric... Michael W. Collins, PhD*; Anne Mucha, DPT†

*UPMC Sports Medicine Concussion Program/Department of Orthopaedic Surgery and †UPMC Centers for Rehabilitation Services, University of Pittsburgh, PA

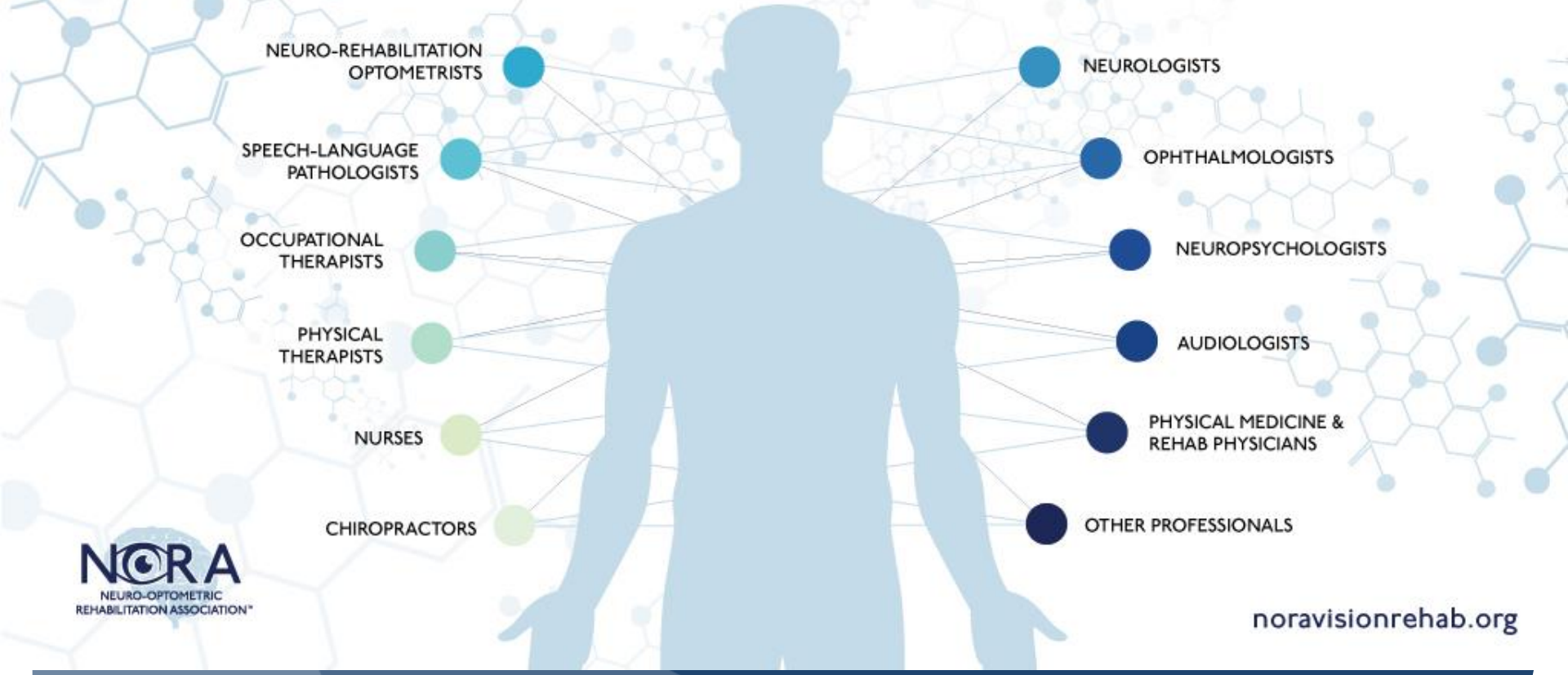


Integrative treatment of closed head injury.



Who, Why, How

An interdisciplinary, integrated team approach can play a vital role in visual rehabilitation.



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No Financial Disclosures

Mo Mortazavi, MD

Background:

- Medical School/Residency: UC Davis Pediatrics
- Sports Medicine Fellowship: Children's Colorado and CU Sports Medicine
- Sports Medicine Faculty at UC Davis and University of Arizona

Current:

- Medical Director, SPARCC (Sports Medicine, Rehabilitation, Concussion Center)
- Department of Pediatrics, Tucson Medical Center
- Medical Director TUSD, Sahuarita School Districts
- Academic Preceptor (UA, TMC, NAU, Midwestern, AT Still, Burrell, Wright Center)

Outline

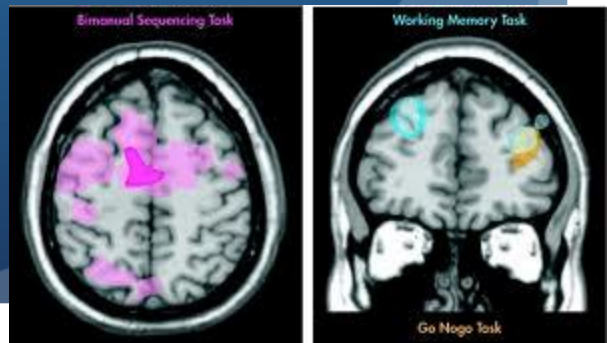
- Case Reviews
- Background and Current Literature
- Concussion and visual dysfunction
- Multidisciplinary Clinical Paradigm
- Management and Vision Rehab

Case 1

- 11 year old high level gymnast in minor MVA
- No LOC, C/O ‘in a fog’, dizziness, and HA
- Assessed by school nurse next day, returns to class saying “I’m fine”
- Continues with school and activities over next 1-2 weeks as usual
- Completed tests, computer projects, lots of note taking

Case 1 (2 weeks later)

- Hospitalized for severe HA, gait disturbance, and difficulty with speech.
- Normal Brain/Spine MRI, Normal EEG
- Discharged with diagnosis of concussion 2 days later
- Referred to our concussion clinic



Case 1 (Our clinic at 1 month)

- Cognitive testing showed severe memory and processing deficits
- Vestibular testing showed poor postural control and balance
- Vision testing showed abnormal:
  - smooth pursuits
  - saccadic movements (KD time >75sec)
  - Convergence (NPC 14cm)

What's next ?

Case

- 13 year old healthy boy with elbow to head in PE basketball
- No LOC, some HA and dizziness
- Assessed and had no “red flags”
- Continues with regular school activities
- Complains of ongoing worsening headache and new migraines

Case (4 weeks)

- See neurologist and starts on Topamax
- Normal MRI brain
- Symptoms continue to progress
- No longer tolerating sports or even exercise
- Struggling with academics and grades (was 4.0 student)
- Feeling depressed and hopeless

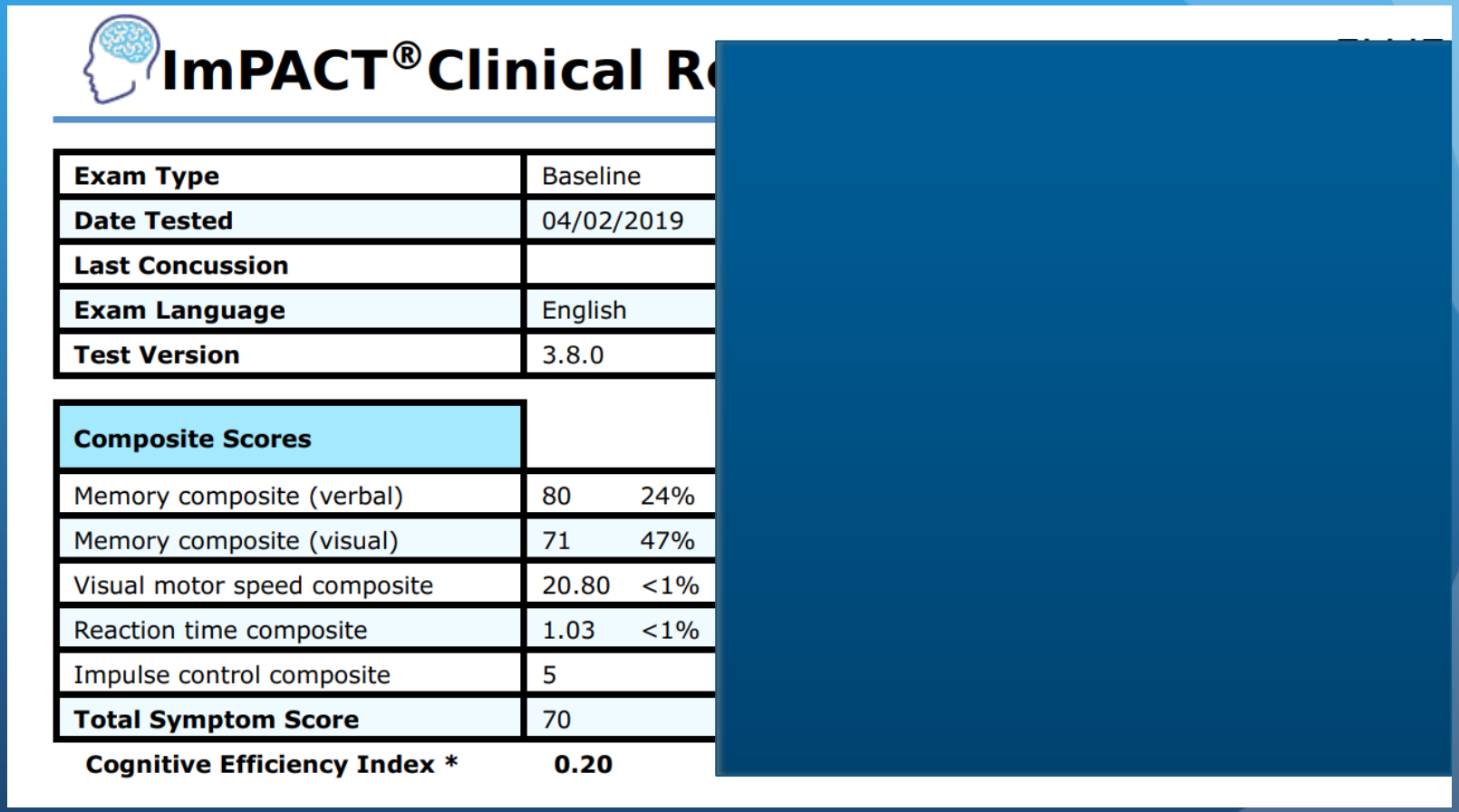
NO Academic Accommodations

Case (3 months)

- Seen in our clinic 3 months later
- Ongoing severe:
  - Cognitive deficits
  - Vestibulocular deficits
  - Exercise intolerance
  - Cervical dysfunction and migraines

Now What?

Case: Cognitive test



ImPACT® Clinical R

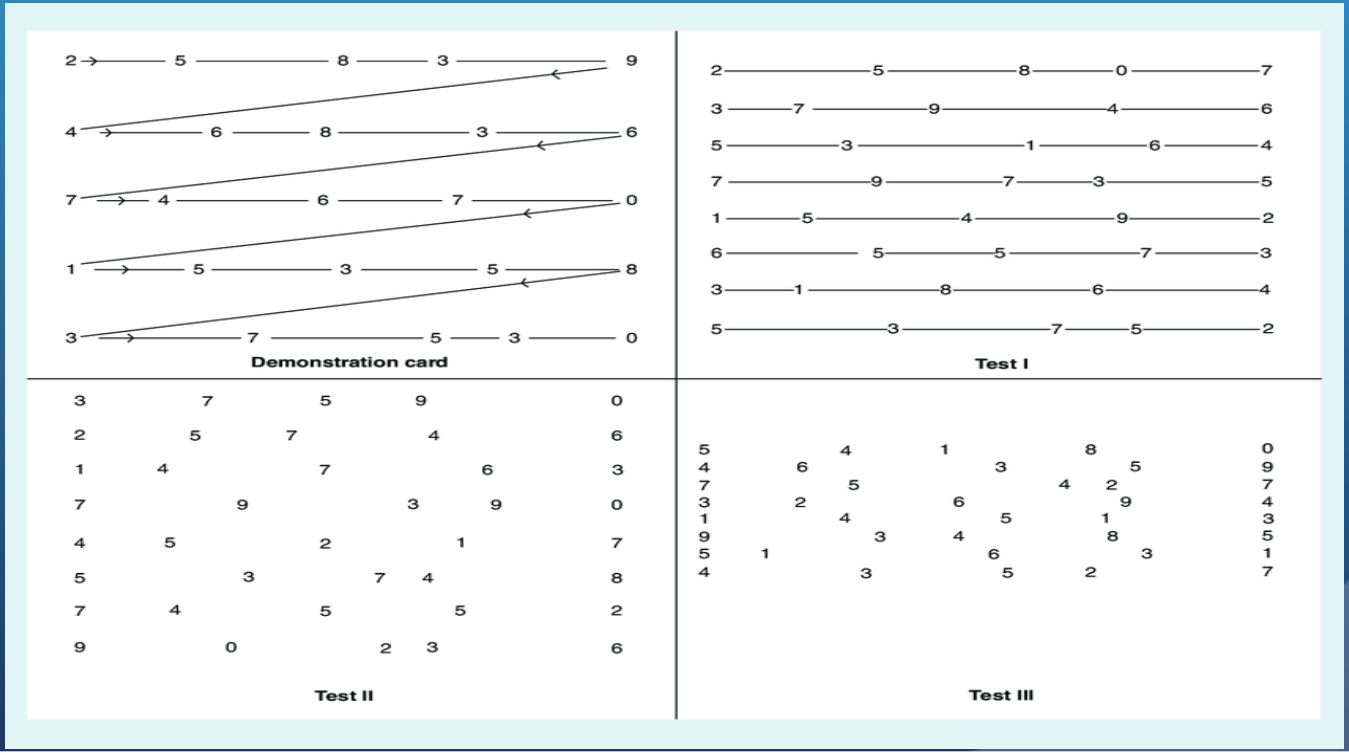
Exam Type	Baseline
Date Tested	04/02/2019
Last Concussion	
Exam Language	English
Test Version	3.8.0

Composite Scores		
Memory composite (verbal)	80	24%
Memory composite (visual)	71	47%
Visual motor speed composite	20.80	<1%
Reaction time composite	1.03	<1%
Impulse control composite	5	
Total Symptom Score	70	

Cognitive Efficiency Index * **0.20**

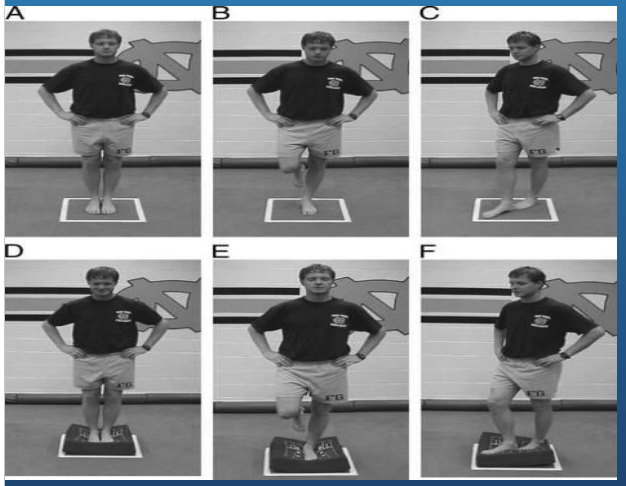
Case: Vision testing

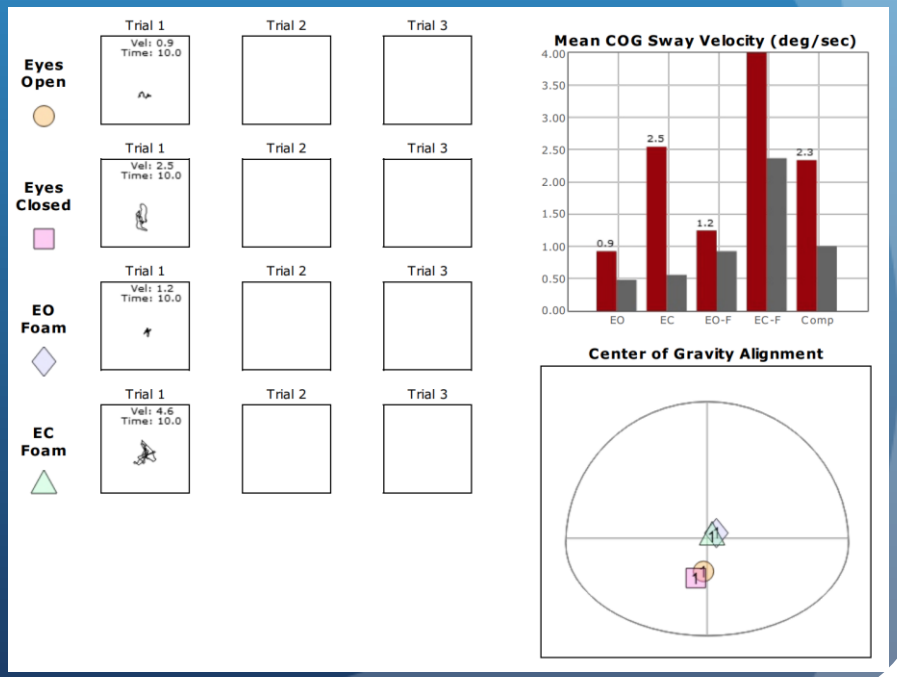
- KD scores: 25, 31, differed
- NPC: 17cm Accommodation: R: 18cm L:12cm



Case: Vestibular testing

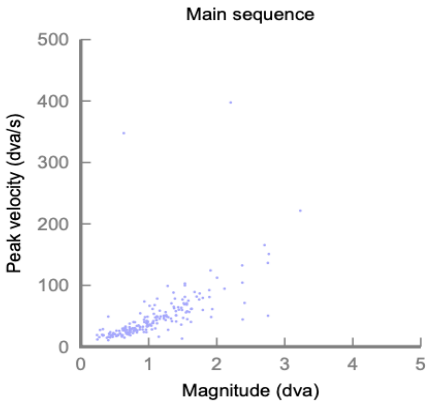
- BESS Testing: 1: macro sway, 2: >5 errors, 3: differed
- Force Plate: Severe deficits with post/left midline shift
- Laser Sway: 8 deviations

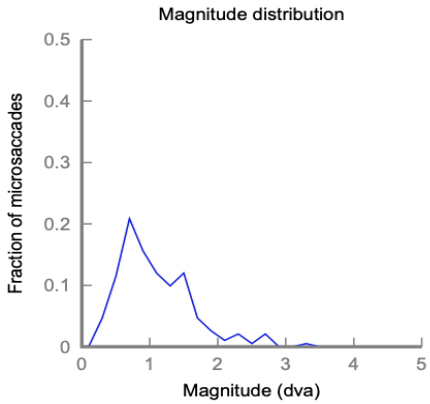


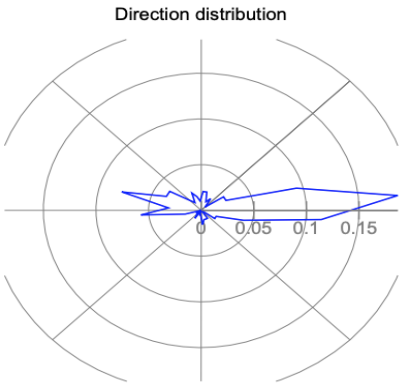


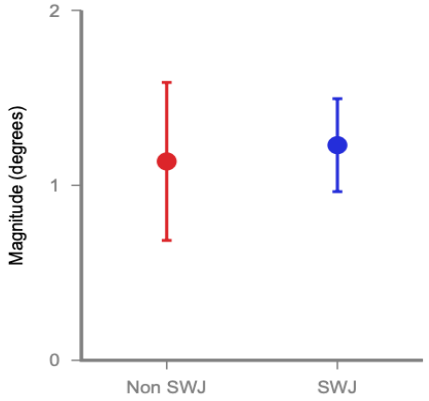
Oculomotor Tracking

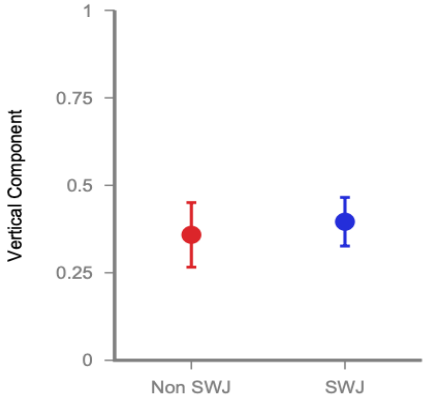
Fixation results





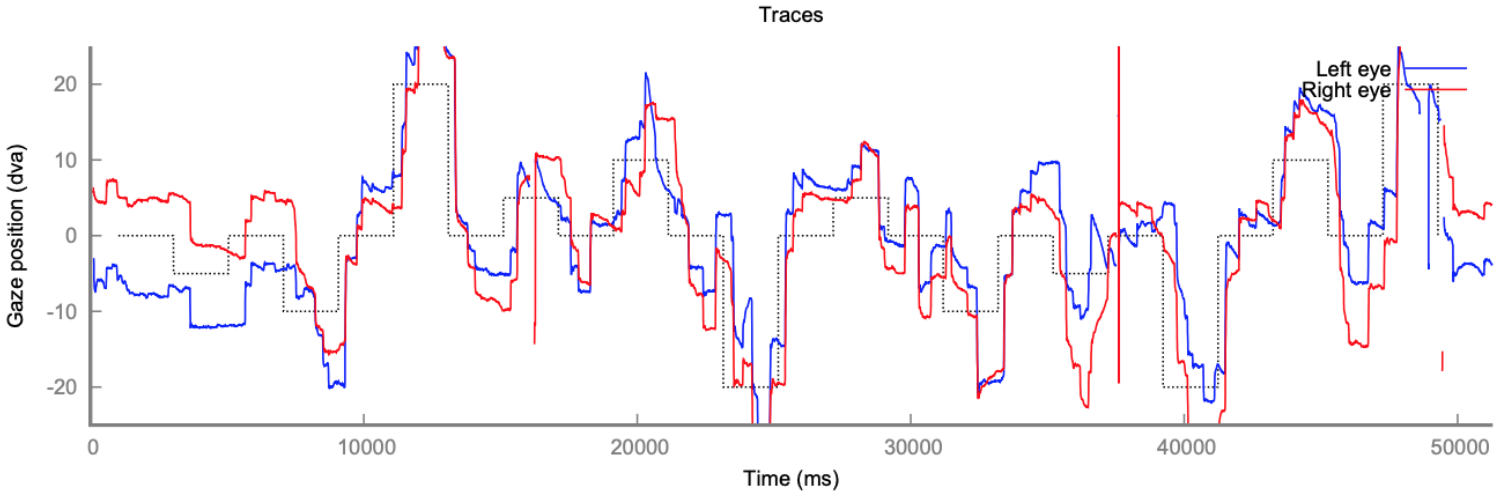


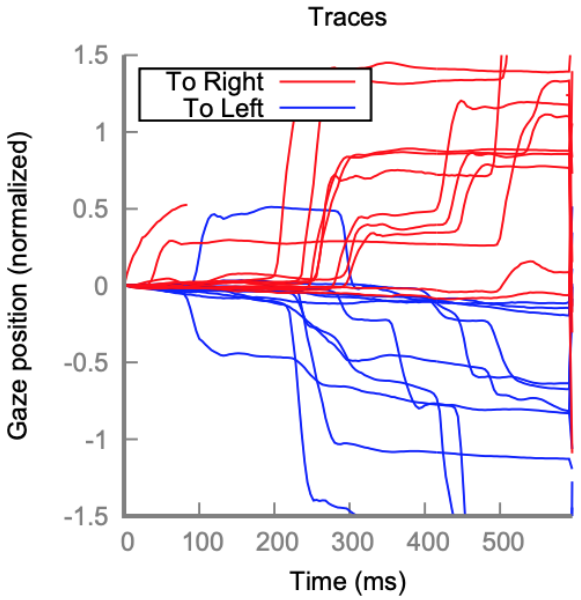


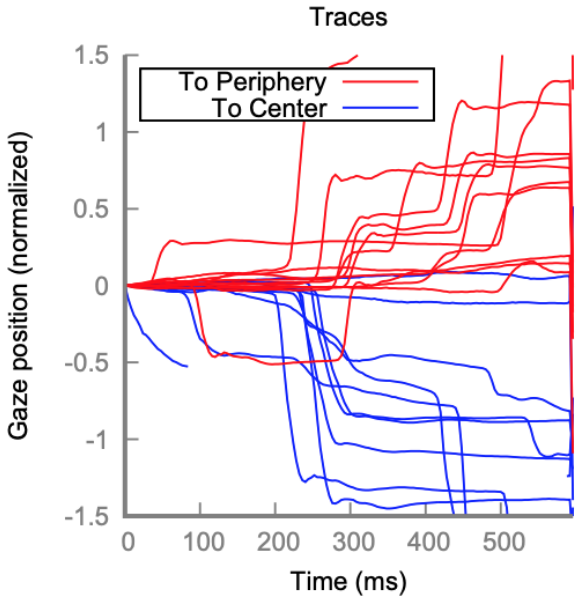


Average magnitude	1.09 deg	Average peak velocity	48.89 deg/s
Main sequence slope	45.64 1/s	Number of microsaccades	192
Average vertical component	0.24	Number of SWJs	8
Harmonic velocity	0.86 deg/s	Gaze entropy	7.37 bits

Horizontal saccades

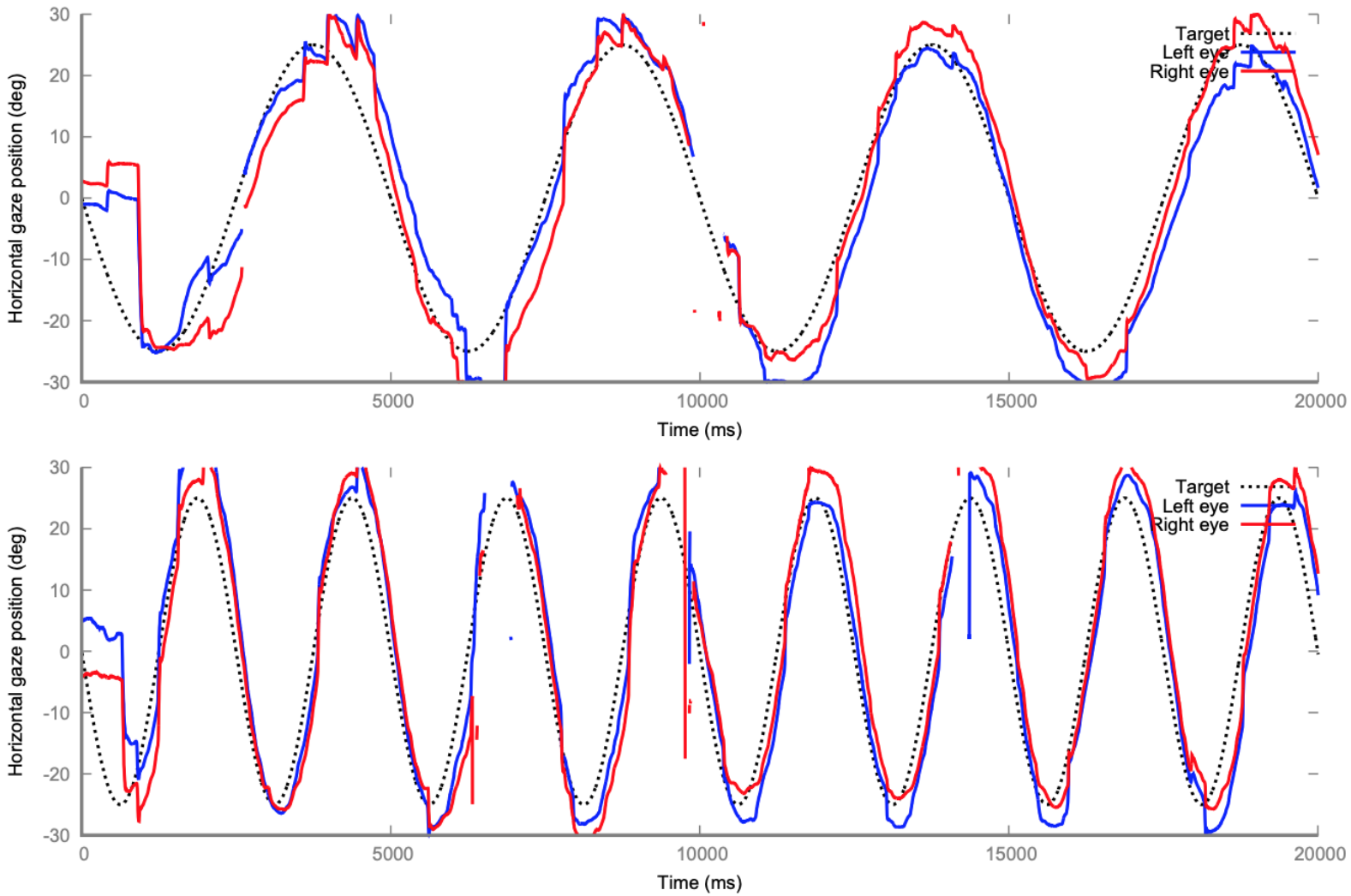






Magnitude gain	0.66	Average latency	326.35 ms
Main sequence slope	45.07 1/s	Number of misses	2
Fraction of multisteps	0.50	Multistep fractional amplitude	0.68

Smooth pursuit



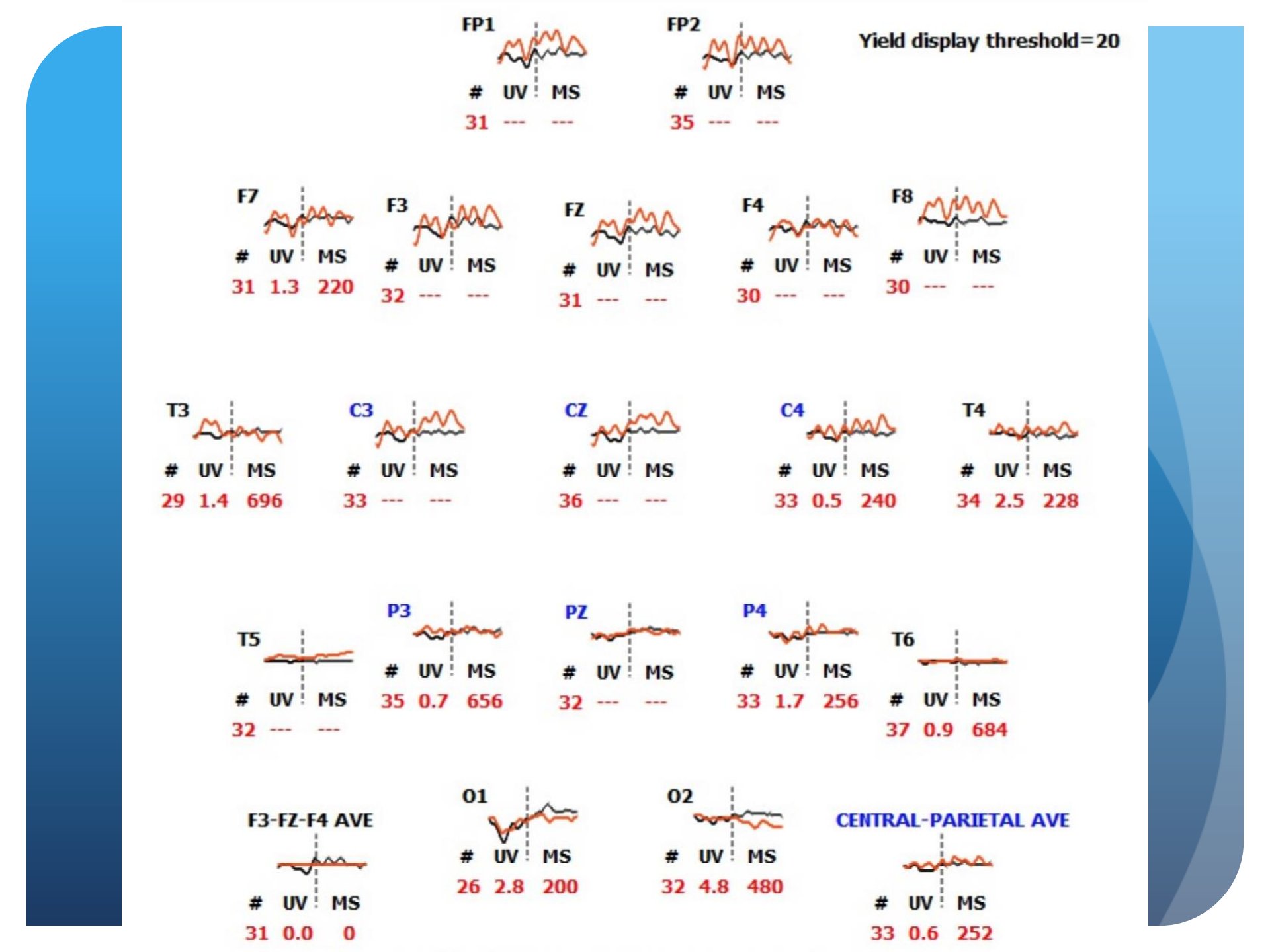
	0.2 Hz	0.4 Hz
Velocity gain	1.13	1.15
Saccade rate	1.35 sacc/s	0.90 sacc/s
Saccade amplitude	6.41 deg	9.16 deg

Evoked Potentials (P300)

Session 1 (6/25/2019)	Baseline	N/A	N/A	N/A	7-9 | 4-6

Symbol Key: ⬓ = Low Data Yield, ✻ = Sync Blinks which may affect accuracy of reported P300 depth

Performance Assessments	**Session 1 (6/25/2019)**	**Ref. Range (45 yrs)**
Physical Reaction Time	675 (±135) ms	318–388 ms
Trail Making Test A	66 sec	34–50 sec
Trail Making Test B	110 sec	56–100 sec
Evoked Potentials (Best Central Parietal)		
Audio P300 Delay	N/A	283–331 ms
Test/Retest Change	-	±6%
Audio P300 Voltage	1.7 µV	10–20 µV
Test/Retest Change	-	±12%
State (Power)		
CZ Eyes Closed Theta/Beta	1.1	0.8–2.8
F3/F4 Eyes Closed Alpha	1.2	0.8–1.2
Muscle Tension (β Power)		
T3/CZ (Left Jaw)	1.1	0.6–1.0
T4/CZ (Right Jaw)	1.2	0.6–1.0
O1/PZ (Left Neck)	1.4	1.0–1.8


Yield display threshold=20
FP1
UV MS
31 --- ---
FP2
UV MS
35 --- ---
F7
UV MS
31 1.3 220
F3
UV MS
32 --- ---
FZ
UV MS
31 --- ---
F4
UV MS
30 --- ---
F8
UV MS
30 --- ---
T3
UV MS
29 1.4 696
C3
UV MS
33 --- ---
CZ
UV MS
36 --- ---
C4
UV MS
33 0.5 240
T4
UV MS
34 2.5 228
T5
UV MS
32 --- ---
P3
UV MS
35 0.7 656
PZ
UV MS
32 --- ---
P4
UV MS
33 1.7 256
T6
UV MS
37 0.9 684
F3-FZ-F4 AVE
UV MS
31 0.0 0
O1
UV MS
26 2.8 200
O2
UV MS
32 4.8 480
CENTRAL-PARIETAL AVE
UV MS
33 0.6 252

Management: 5th Consensus

BJSM Online First, published on April 26, 2017 as 10.1136/bjsports-2017-097699

Consensus statement on concussion in sport—the 5th international conference on concussion in sport held in Berlin, October 2016

Paul McCrory,[1] Willem Meeuwisse,[2] Jiří Dvorak,[3,4] Mark Aubry,[5] Julian Bailes,[6] Steven Broglio,[7] Robert C Cantu,[8] David Cassidy,[9] Ruben J Echemendia,[10,11] Rudy J Castellani,[12] Gavin A Davis,[13,14] Richard Ellenbogen,[15] Carolyn Emery,[16] Lars Engebretsen,[17] Nina Feddermann-Demont,[18,19] Christopher C Giza,[20,21] Kevin M Guskiewicz,[22] Stanley Herring,[23] Grant L Iverson,[24] Karen M Johnston,[25] James Kissick,[26] Jeffrey Kutcher,[27] John J Leddy,[28] David Maddocks,[29] Michael Makdissi,[30,31] Geoff Manley,[32] Michael McCrea,[33] William P Meehan,[34,35] Sinji Nagahiro,[36] Jon Patricios,[37,38] Margot Putukian,[39] Kathryn J Schneider,[40] Allen Sills,[41,42] Charles H Tator,[43,44] Michael Turner,[45] Pieter E Vos[46]

► Additional material is published online only. To view please visit the journal online (http://dx.doi.org/10.1136/bjsports-2017-097699)

For numbered affiliations see end of article.

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Accepted 6 March 2017

PREAMBLE

The 2017 Concussion in Sport Group (CISG) consensus statement is designed to build on the principles outlined in the previous statements[1–4] and to develop further conceptual understanding of sport-related concussion (SRC) using an expert consensus-based approach. This document is developed for physicians and healthcare providers who are involved in athlete care, whether at a recreational, elite or professional level. While agreement exists on the principal messages conveyed by this document, the authors acknowledge that the science of SRC is evolving and therefore individual management and return-to-play decisions remain in the realm of clinical judgement.

articles were screened by the expert panels for the Berlin meeting. The details of the search strategies and findings are included in each of the systematic reviews.

The details of the conference organisation, methodology of the consensus process, question development and selection on expert panellists and observers is covered in detail in an accompanying paper in this issue.[5] A full list of scientific committee members, expert panellists, authors, observers and those who were invited but could not attend are detailed is at the end of the summary document. The International Committee of Medical Journal Editors conflict of interest declaration for all authors is provided in Appendix 1.

Readers are encouraged to copy and freely

Management: 5th Consensus

- **Research supports multi-disciplinary therapeutic approach:**
  - Return to Learn and cognitive support
  - Vestibulocular rehabilitation
  - Cervical rehabilitation
  - Return to play protocol
  - Graded Exertional Rehabilitation (ARP)

5th Consensus (Updates)

- **Acute Phase Considered first 24-48hrs**
  (as opposed to 2-3 weeks -4th Consensus)
- **Early Intervention > Absolute Rest**
  - **Sub symptom threshold exertional rehab protocol (Revised RTP)**
  - **Vestibulocular/cervical exercises**
  - **Implement Return to Learn**

Reduced recovery time…

Decreased PPCS mobidity

Better Outcomes!

Consensus statement

Consensus statement on concussion in sport—the 5th international conference on concussion in sport held in Berlin, October 2016

Paul McCrory,[1] Willem Meeuwisse,[2] Jiří Dvorak,[3,4] Mark Aubry,[5] Julian Bailes,[6] Steven Broglio,[7] Robert C Cantu,[8] David Cassidy,[9] Ruben J Echemendia,[10,11]

November 5, 2018

Centers for Disease Control and Prevention Guideline on the Diagnosis and Management of Mild Traumatic Brain Injury Among Children

Angela Lumba-Brown, MD[1]; Keith Owen Yeates, PhD[2]; Kelly Sarmiento, MPH[3]; et al

≫ Author Affiliations

JAMA Pediatr. 2018;172(11):e182853. doi:10.1001/jamapediatrics.2018.2853

Consensus statement

American Medical Society for Sports Medicine position statement on concussion in sport

Kimberly G Harmon,[1] James R Clugston,[2] Katherine Dec,[3] Brian Hainline,[4] Stanley Herring,[5] Shawn F Kane,[6] Anthony P Kontos,[7] John J Leddy,[8] Michael McCrea,[9] Sourav K Poddar,[10] Margot Putukian,[11,12] Julie C Wilson,[13] William O Roberts[14]

Consensus Summaries

- Avoid routine CTs
  - Multidisciplinary Functional testing
- Validated tools
  - SCAT5/ImPACT/VOMS
- PCS up to 20-30%
  - Refer after 4-6wks
  - ID PCS risk factors
- Avoid absolute cognitive rest >2-3d
  - Customized RTL
- Rehabilitation>Meds
  - ARP after 48hrs
  - Vestibulocular rehab
  - Cervical rehab

Vision ?

CONCUSSION EVALUATION: Combination of Measures

- Detailed history
  - Symptom checklist
  - Prior concussions
  - Red flags/Imaging?
- Neurologic exam
- Cognitive exam / MMSE
- Vestibulocular testing

BJSM Online First, published on April 26, 2017 as 10.1136/bjsports-2017-097506SCAT5

To download a clean version of the SCAT tools please visit the journal online (http://dx.doi .org/10.1136/bjsports-2017-097506SCAT5)

SCAT5©

SPORT CONCUSSION ASSESSMENT TOOL —5TH EDITION

DEVELOPED BY THE CONCUSSION IN SPORT GROUP

FOR USE BY MEDICAL PROFESSIONALS ONLY

supported by

Concussion Symptoms (SCAT5)

- **Physical symptoms**
- **Cognitive symptoms**
- **Psychiatric symptoms**
- **Sleep disturbance**

BJSM Online First, published on April 26, 2017 as 10.1136/bjsports-2017-097506SCAT5

To download a clean version of the SCAT tools please visit the journal online (http://dx.doi.org/10.1136/bjsports-2017-097506SCAT5)

SCAT5©

SPORT CONCUSSION ASSESSMENT TOOL —5TH EDITION

DEVELOPED BY THE CONCUSSION IN SPORT GROUP

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supported by

Patient details

Name: _____

DOB: _____

Address: _____

ID number: _____

Examiner: _____

Date of Injury: _____ Time: _____

WHAT IS THE SCAT5?

The SCAT5 is a standardized tool for evaluating concussions designed for use by physicians and licensed healthcare professionals[1]. The SCAT5 cannot be performed correctly in less than 10 minutes.

If you are not a physician or licensed healthcare professional, please use the Concussion Recognition Tool 5 (CRT5). The SCAT5 is to be used for evaluating athletes aged 13 years and older. For children aged 12 years or younger, please use the Child SCAT5.

Preseason SCAT5 baseline testing can be useful for interpreting post-injury test scores, but is not required for that purpose.Detailed instructions for use of the SCAT5 are provided on page 7. Please read through these instructions carefully before testing the athlete. Brief verbal instructions for each test are given in italics. The only equipment required for the tester is a watch or timer.

Recognise and Remove

A head impact by either a direct blow or indirect transmission of force can be associated with a serious and potentially fatal brain injury. If there are significant concerns, including any of the red flags listed in Box 1, then activation of emergency procedures and urgent transport to the nearest hospital should be arranged.

Key points

- Any athlete with suspected concussion should be REMOVED FROM PLAY, medically assessed and monitored for deterioration. No athlete diagnosed with concussion should be returned to play on the day of injury.
- If an athlete is suspected of having a concussion and medical personnel are not immediately available, the athlete should be referred to a medical facility for urgent assessment.
- Athletes with suspected concussion should not drink alcohol, use recreational drugs and should not drive a motor vehicle until cleared to do so by a medical professional.
- Concussion signs and symptoms evolve over time and it is important to consider repeat evaluation in the assessment of concussion.
- The diagnosis of a concussion is a clinical judgment, made by a medical professional. The SCAT5 should NOT be used by itself to make, or exclude, the diagnosis of concussion. An athlete may have a concussion even if their SCAT5 is "normal".

Remember:

- The basic principles of first aid (danger, response, airway, breathing, circulation) should be followed.
- Do not attempt to move the athlete (other than that required for airway management) unless trained to do so.
- Assessment for a spinal cord injury is a critical part of the initial on-field assessment.
- Do not remove a helmet or any other equipment unless trained to do so safely.

OFFICE OR OFF-FIELD ASSESSMENT

Please note that the neurocognitive assessment should be done in a distraction-free environment with the athlete in a resting state.

STEP 1: ATHLETE BACKGROUND

Sport / team / school: _____

Date / time of injury: _____

Years of education completed: _____

Age: _____

Gender: M / F / Other

Dominant hand: left / neither / right

How many diagnosed concussions has the athlete had in the past?: _____

When was the most recent concussion?: _____

How long was the recovery (time to being cleared to play) from the most recent concussion?: _____ (days)

Has the athlete ever been:

Hospitalized for a head injury?	Yes	No
Diagnosed / treated for headache disorder or migraines?	Yes	No
Diagnosed with a learning disability / dyslexia?	Yes	No
Diagnosed with ADD / ADHD?	Yes	No
Diagnosed with depression, anxiety or other psychiatric disorder?	Yes	No

Current medications? If yes, please list:

_____

_____

_____

_____

_____

_____

Name: _____

DOB: _____

Address: _____

ID number: _____

Examiner: _____

Date: _____

2

STEP 2: SYMPTOM EVALUATION

The athlete should be given the symptom form and asked to read this instruction paragraph out loud then complete the symptom scale. For the baseline assessment, the athlete should rate his/her symptoms based on how he/she typically feels and for the post injury assessment the athlete should rate their symptoms at this point in time.

Please Check: ☐ **Baseline** ☐ **Post-Injury**

Please hand the form to the athlete

	none	mild		moderate		severe	
Headache	0	1	2	3	4	5	6
"Pressure in head"	0	1	2	3	4	5	6
Neck Pain	0	1	2	3	4	5	6
Nausea or vomiting	0	1	2	3	4	5	6
Dizziness	0	1	2	3	4	5	6
Blurred vision	0	1	2	3	4	5	6
Balance problems	0	1	2	3	4	5	6
Sensitivity to light	0	1	2	3	4	5	6
Sensitivity to noise	0	1	2	3	4	5	6
Feeling slowed down	0	1	2	3	4	5	6
Feeling like "in a fog"	0	1	2	3	4	5	6
"Don't feel right"	0	1	2	3	4	5	6
Difficulty concentrating	0	1	2	3	4	5	6
Difficulty remembering	0	1	2	3	4	5	6
Fatigue or low energy	0	1	2	3	4	5	6
Confusion	0	1	2	3	4	5	6
Drowsiness	0	1	2	3	4	5	6
More emotional	0	1	2	3	4	5	6
Irritability	0	1	2	3	4	5	6
Sadness	0	1	2	3	4	5	6
Nervous or Anxious	0	1	2	3	4	5	6
Trouble falling asleep (if applicable)	0	1	2	3	4	5	6
Total number of symptoms:							of 22
Symptom severity score:							of 132
Do your symptoms get worse with physical activity?						Y	N
Do your symptoms get worse with mental activity?						Y	N
If 100% is feeling perfectly normal, what percent of normal do you feel?							

If not 100%, why?

_____

_____

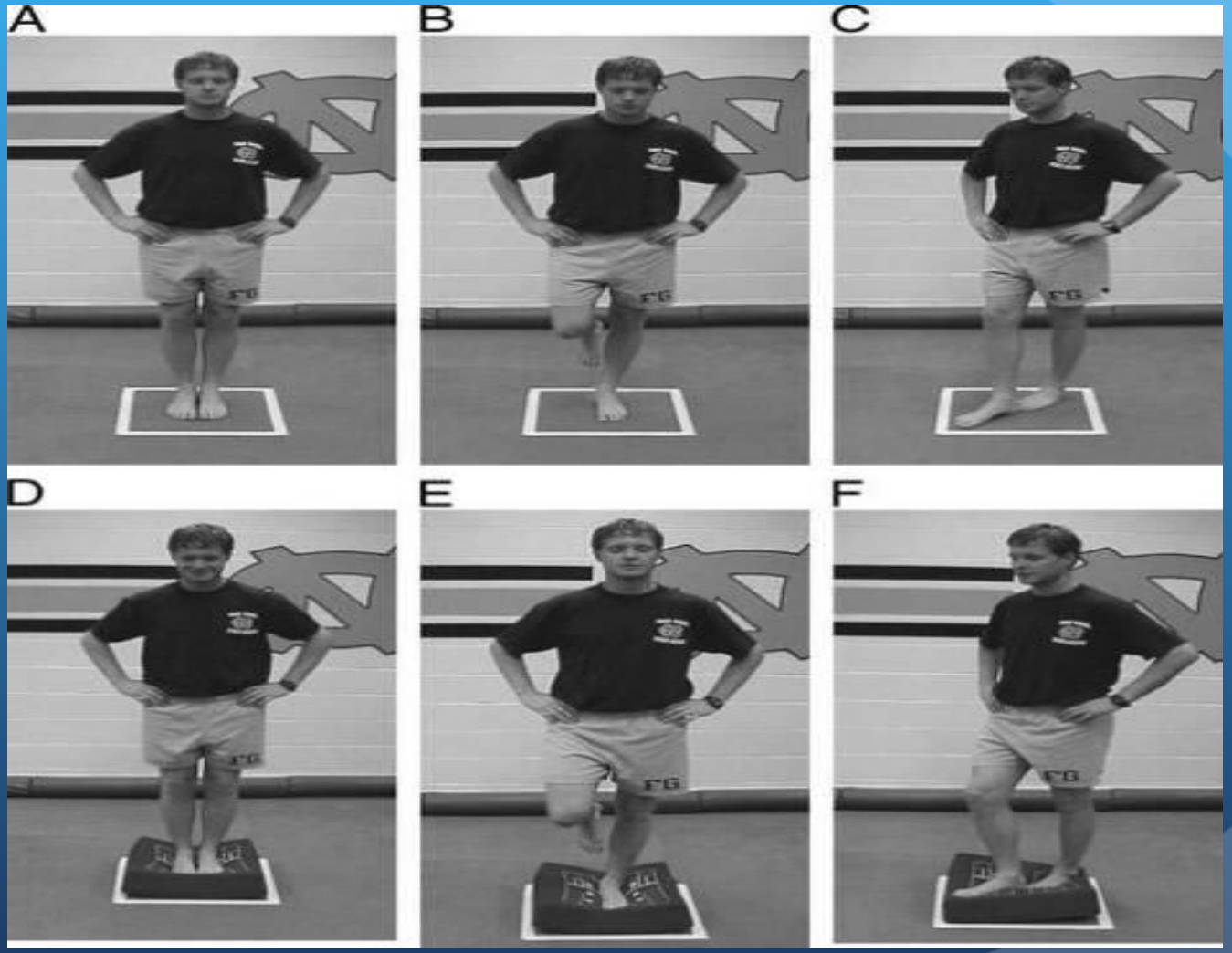
_____

Please hand form back to examiner

Mini Mental

- Immediate and delayed recall (3 words)
- Serial 7's or 3's
- Spell "WORLD" backwards
- Months or weekdays in reverse
- Numbers in reverse

mBESS TESTING



mBESS ERRORS

Document:

- Hands lifted off iliac crest
- Opening eyes
- Step, stumble, or fall
- Hip abduction >30 deg
- Lifting forefoot or heel
- Moving out of test position >5 sec

The Vestibular/Ocular Motor Screening-VOMS

Smooth Pursuits

Horizontal and Vertical Saccades

Horizontal Vestibular-Ocular Reflex (VOR)

Near Point Convergence

Visual Motion Sensitivity

Mucha et al., 2014; AJSM

“VOMS”

- Smooth Pursuits
- Near Point Convergence (<6-8cm)
- Saccades (V/H)
- VOR/dolls eye (V/H)
- Visual Motor sensitivity

Mucha, AM etal. A Brief Vestibular/Ocular Motor Screening (VOMS) Assessmentto Evaluate Concussions: Preliminary Findings. Investigation performed at the University of Pittsburgh, Pittsburgh, Pennsylvania, USA. 2014.

Journal of Athletic Training 2017;52(3):256–261
doi: 10.4085/1062-6050-51.11.05

www.natajournals.org

literature review

Review of Vestibular and Oculomotor Screening and Concussion Rehabilitation

Anthony P. Kontos, PhD*; Jamie McAllister Deitrick, PhD*; Michael W. Collins, PhD*; Anne Mucha, DPT†

*UPMC Sports Medicine Concussion Program/Department of Orthopaedic Surgery and †UPMC Centers for Rehabilitation Services, University of Pittsburgh, PA

Vision Exam/Testing

- Exam:
  - VOMS (NPC!)
  - Accommodation
  - Cover/uncover (mal alignment)
  - Pursuit/Saccadic dysfunction

- Visual Testing tools:
  - Oculomotor tracker
  - Pupillometer
  - Visual evoked potentials (VEP)

Additional Testing

- Cognitive (ImPact, Cambridge Brain Sciences)
- Exertional tolerance: “Active Rehab Protocol”
- Balance/Vestibular
- Reaction time, fine motor
- Dual tasking
- Electrophysiology (P300 Auditory Evoked Potentials)

Imaging and Labs (PPCS)

- MRI Brain (rule out structural abnormalities)
- Labs for PPCS: Pituitary gland, nutritional
- Functional Neuroimaging
  - Diffusion tensor imaging
  - fMRI, SPECT, MR spectroscopy, PET
- Serum biomarkers
  - SNE, SB100, Banyan, etc
- Genetic Markers
  - Apo E gene profiles

Investigational

Active Rehab Protocol (ARP)/Testing

- Begin at 24-48hrs ONLY if tolerated
- Sub symptom threshold exertion
- Monitored exertional tolerance test
- Establish SAFE exertional step:
  - Intensity
  - Modality
  - Duration

BJSM Online First, published on April 26, 2017 as 10.1136/bjsports-2017-097699

Consensus statement on concussion in sport—the 5th international conference on concussion in sport held in Berlin, October 2016

Paul McCrory,[1] Willem Meeuwisse,[2] Jiří Dvorak,[3,4] Mark Aubry,[5] Julian Bailes,[6] Steven Broglio,[7] Robert C Cantu,[8] David Cassidy,[9] Ruben J Echemendia,[10,11] Rudy J Castellani,[12] Gavin A Davis,[13,14] Richard Ellenbogen,[15] Carolyn Emery,[16] Lars Engebretsen,[17] Nina Feddermann-Demont,[18,19] Christopher C Giza,[20,21] Kevin M Guskiewicz,[22] Stanley Herring,[23] Grant L Iverson,[24] Karen M Johnston,[25] James Kissick,[26] Jeffrey Kutcher,[27] John J Leddy,[28] David Maddocks,[29] Michael Makdissi,[30,31] Geoff Manley,[32] Michael McCrea,[33] William P Meehan,[34,35] Sinji Nagahiro,[36] Jon Patricios,[37,38] Margot Putukian,[39] Kathryn J Schneider,[40] Allen Sills,[41,42] Charles H Tator,[43,44] Michael Turner,[45] Pieter E Vos[46]

► Additional material is published online only. To view please visit the journal online (http://dx.doi.org/10.1136/bjsports-2017-097699)

For numbered affiliations see end of article.

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Accepted 6 March 2017

PREAMBLE

The 2017 Concussion in Sport Group (CISG) consensus statement is designed to build on the principles outlined in the previous statements[1–4] and to develop further conceptual understanding of sport-related concussion (SRC) using an expert consensus-based approach. This document is developed for physicians and healthcare providers who are involved in athlete care, whether at a recreational, elite or professional level. While agreement exists on the principal messages conveyed by this document, the authors acknowledge that the science of SRC is evolving and therefore individual management and return-to-play decisions remain in the realm of clinical judgement.

articles were screened by the expert panels for the Berlin meeting. The details of the search strategies and findings are included in each of the systematic reviews.

The details of the conference organisation, methodology of the consensus process, question development and selection on expert panellists and observers is covered in detail in an accompanying paper in this issue.[5] A full list of scientific committee members, expert panellists, authors, observers and those who were invited but could not attend are detailed is at the end of the summary document. The International Committee of Medical Journal Editors conflict of interest declaration for all authors is provided in Appendix 1.

Readers are encouraged to copy and freely

Management: 5th Consensus

- **Research supports multi-disciplinary therapeutic approach:**
  - Return to Learn and cognitive support
  - Return to play protocol
  - Vestibulocular rehabilitation
  - Cervical rehabilitation
  - Graded Exertional Rehabilitation (ARP)

New Advice to Move More After a Concussion

Phys Ed

By GRETCHEN REYNOLDS MAY 17, 2017

NY TIMES

May, 2017

John McDonnell/The Washington Post, via Getty Images

When young athletes sustain concussions, they are typically told to rest until all symptoms disappear. That means no physical activity, reading, screen time or friends, and little light exposure, for multiple days and, in severe cases, weeks.

Restricting all forms of activity after a concussion is known as "cocooning." But now new guidelines, written by an international panel of concussion experts and published this month in The British Journal of Sports Medicine, question that practice. Instead of cocooning, the new guidelines suggest that most young athletes should be encouraged to start being physically active within a day or two after the injury.

Research

JAMA Pediatrics | Original Investigation

Early Subthreshold Aerobic Exercise for Sport-Related Concussion A Randomized Clinical Trial

JAMA 2019

John J. Leddy, MD; Mohammad N. Haider, MD; Michael J. Ellis, MD; Rebekah Mannix, MD; Scott R. Darling, MD; Michael S. Freitas, MD; Heidi N. Suffoletto, MD; Jeff Leiter, PhD; Dean M. Cordingley, MSc; Barry Willer, PhD

November 5, 2018

Centers for Disease Control and Prevention Guideline on the Diagnosis and Management of Mild Traumatic Brain Injury Among Children

Angela Lumba-Brown, MD[1]; Keith Owen Yeates, PhD[2]; Kelly Sarmiento, MPH[3]; et al

≫ Author Affiliations

JAMA Pediatr. 2018;172(11):e182853. doi:10.1001/jamapediatrics.2018.2853

"limiting the duration of rest in the first days after an injury is one of the most important messages of the guideline."

-Co-author Matthew J. Breiding, CDC, Atlanta, Georgia

American Medical Society for Sports Medicine position statement on concussion in sport

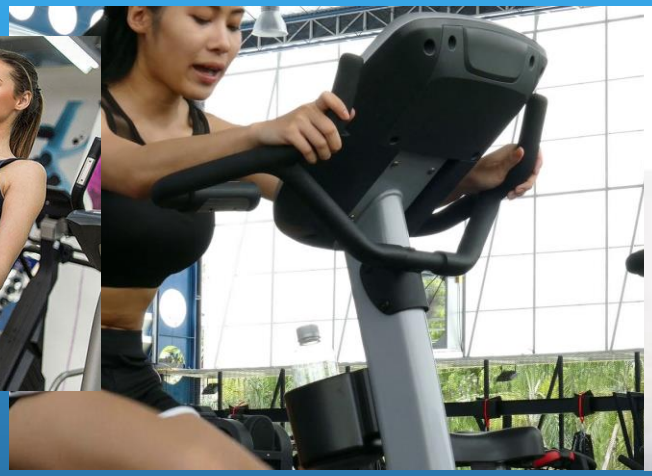
Kimberly G Harmon,[1] James R Clugston,[2] Katherine Dec,[3] Brian Hainline,[4] Stanley Herring,[5] Shawn F Kane,[6] Anthony P Kontos,[7] John J Leddy,[8] Michael McCrea,[9] Sourav K Poddar,[10] Margot Putukian,[11,12] Julie C Wilson,[13] William O Roberts[14]

Emerging data suggest that symptom-limited activity, including activities of daily living and non-contact aerobic exercise, may begin as soon as tolerated after an initial brief period (24–48hours) of cognitive and physical relative rest.

Active Rehab Protocol (ARP)

- Multiple Protocols (Buffalo Protocol)
  - BCTT (treadmill), BCBT (bike)
- Determine exertional “dose”:
- *5 Step Protocol:*
  - *Step 1-Light (50-60% MHR)*
  - *Step 2- Moderate (60-70% MHR)*
  - *Step 3- Vigorous (70-80% MHR)*
  - *Step 4- Maximal (80-90% MHR)*
  - *Step 5- Maximal with MDM (bridge sport)*

5 Step Protocol



ARP: Risks/Side Effects

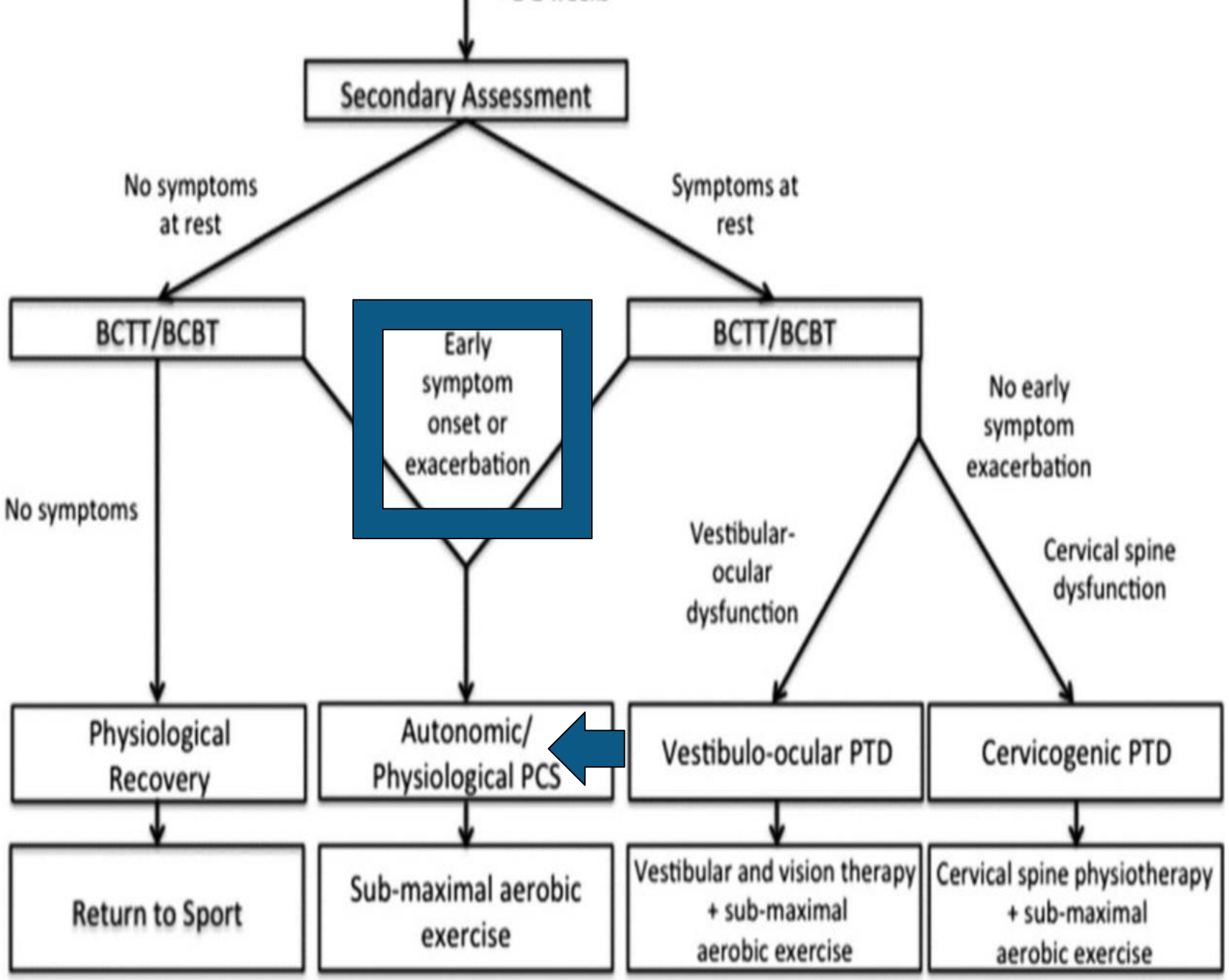
- **Studies to date have shown little to no adverse risks**
- Main risk is exacerbation of symptoms:
  - Pushing through the threshold
  - Eager athletes may not endorse Sx
  - Not following strict protocol/parameters
  - Highly symptomatic or VOMS + patient may not be ready (Syncope/Fall risk)
  - Exertional Dysautonomia

Exercise Intolerance?

- Symptoms during exercise:
  - HA, dizziness, pre-syncope, nausea
  - Fatigue, SOB, “out of shape”
- Causes:
  - Vestibular dysfunction
  - Visual dysfunction
  - Autonomic Dysfunction
  - Deconditioning
  - Psychogenic/Burnout

Exertional Dysautonomia

- **Autonomic dysfunction can lead to exercise intolerance (CBF instability)**
- HR/BP response to exercise
  - Rate of rise, HRV, decline with cool down
  - BP control during exercise
  - Orthostatic (tilt test) BP/HR instability
  - Others:
    - Pupillary reflex speeds
    - Sweat dysfunction
    - Heat homeostasis


Secondary Assessment
No symptoms at rest
Symptoms at rest
BCTT/BCBT
Early symptom onset or exacerbation
BCTT/BCBT
No symptoms
No early symptom exacerbation
Vestibular-ocular dysfunction
Cervical spine dysfunction
Physiological Recovery
Autonomic/ Physiological PCS
Vestibulo-ocular PTD
Cervicogenic PTD
Return to Sport
Sub-maximal aerobic exercise
Vestibular and vision therapy + sub-maximal aerobic exercise
Cervical spine physiotherapy + sub-maximal aerobic exercise

Management of Dysautonomia

- Sub-threshold exertion (Levine protocol)
- Autonomic rehab (Mayo Clinic):
  - Biofeedback
  - Cardio respiratory exercises
- Positional dysautonomia (POTS):
  - Postural and LE resistance exercises
  - Hydration and Salt
  - Medications (propranolol, florinef)

Cognitive Testing

- Computerized Cognitive Testing (ImPACT, CBS)
  - Memory, Processing, Attention, RT
- Formal Neuropsychiatric testing (comprehensive)
- qEEG/Evoked Potentials (P300)
  - RT, Attention, Cognitive capacity, brain mapping

Neurocognitive Testing

- Degree/type of cognitive impairment
- Targeted accommodations
- Baseline vs normative data
- Sport clearance tool
- Persistent or severe cognitive deficits >> Formal “NP” testing with neuropsychiatrist

Evoked Potentials (P300)

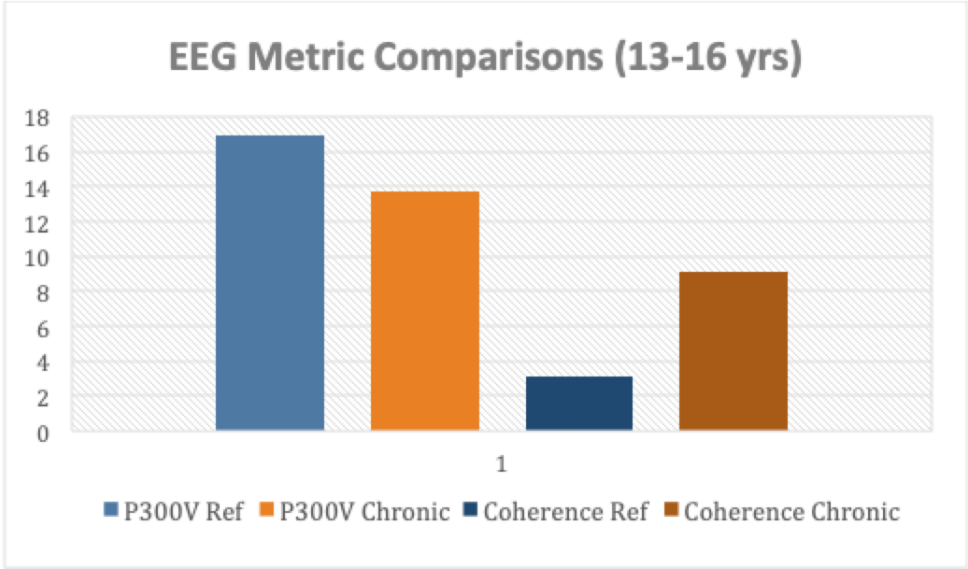
- Very objective measure of cognitive capacity
- Oddball test AERPs most common
- Many papers looking at P300 and cognition
- Recent promising papers illustrating clinical utility in complex concussion cases

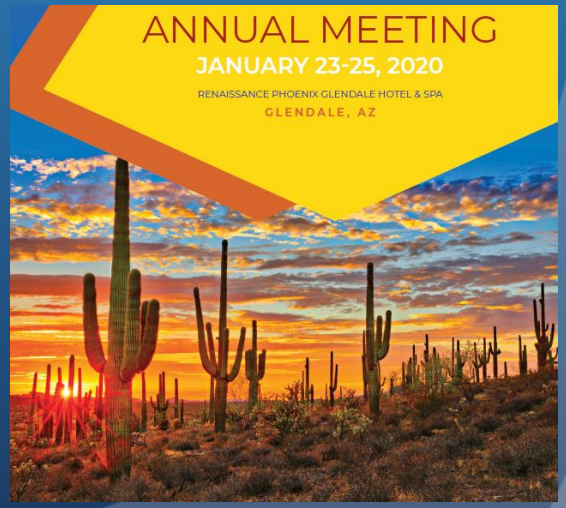
PRiSM
Pediatric Research in Sports Medicine Society

FUNCTIONAL NEUROCOGNITIVE DEFICITS AND CORTICAL EVOKED POTENTIALS IN PEDIATRIC PATIENTS WITH PROLONGED POST CONCUSSIVE SYMPTOMS

Mo Mortazavi, MD[01], David Oakley PhD[04], Jon Minor MD[01], Prem Kumar Thirunagari[02], Nassar Koucheki[03], Nitin Prabhaker, MD[05]

[01]SPARCC Sports Medicine, AZ, USA, [02] University of Arizona, AZ, USA, [03]Midwestern University, AZ, USA [04] Wavi CO, USA [05] Stanford Medical Center, CA, USA



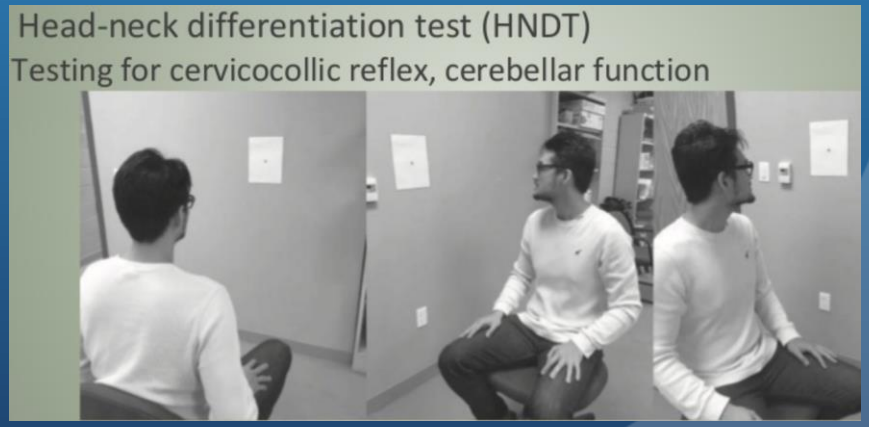


Vestibular Testing

- Force Plate (multiple protocols)
- BESS (SCAT 5)
- Peripheral vestibular testing
- Laser Sway
- Dual tasking (Tandem walk with cognitive task)

Cervicogenic Testing

- Rule out C spine injury (rare)
- Cervical ROM
- Cervical provocation tests/maneuvers



Vision is Central

- Identify, Characterize, Treat
- Variety of simple and complex vision tests
- Predictors for PPCS risk
- Predictors of academic tolerance
- Exercise Tolerance and vision biomarkers

Near Point Convergence and King Devick Test: Predictors of Post Concussion Syndrome?

Julia Howard MHS[1], Nitin Prabhakar MD, Dan Hekmatian, Jon Minor MD, Mohammed Mortazavi MD

1. Student Doctor, Arizona College of Osteopathic Medicine Class of 2019, Midwestern University, Glendale, Arizona

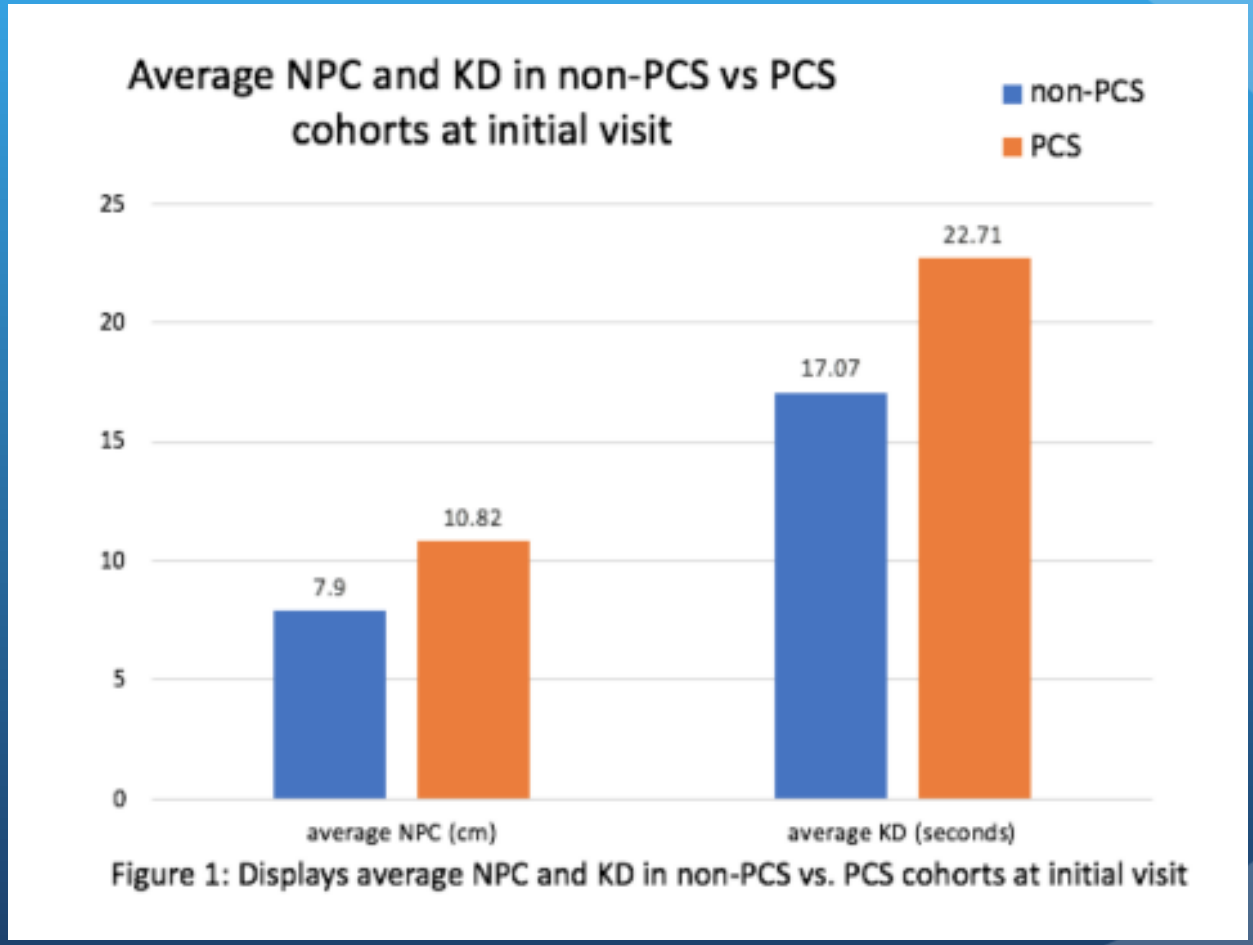


Figure 1: Displays average NPC and KD in non-PCS vs. PCS cohorts at initial visit

NPC and Exercise Tolerance

- Inverse relationship
  - NPC>17cm = Poor/Low tolerance (step 1 or 2)

Near Point of Convergence as a Clinical Predictor for Exercise Tolerance

Tyler Marx[1, 2], Mohammed Mortazavi MD[2], Jon Minor MD[2], Hirsch Handmaker MD[3]

1. Department of Physiology, University of Arizona, Tucson, Arizona
2. SPARCC Sports Medicine, Tucson, Arizona
3. CACTIS Foundation, Scottsdale, Arizona

ARP Step	NPC Average (cm)	P Value
1	16.97 ± 7.97	2.87×10^{-19}
2	16.70 ± 7.7	6.38×10^{-16}
3	14.1 ± 5.1	1.85×10^{-10}
4	10.95 ± 1.95	3.45×10^{-6}
5	8.61 ± 0.39	0.0752

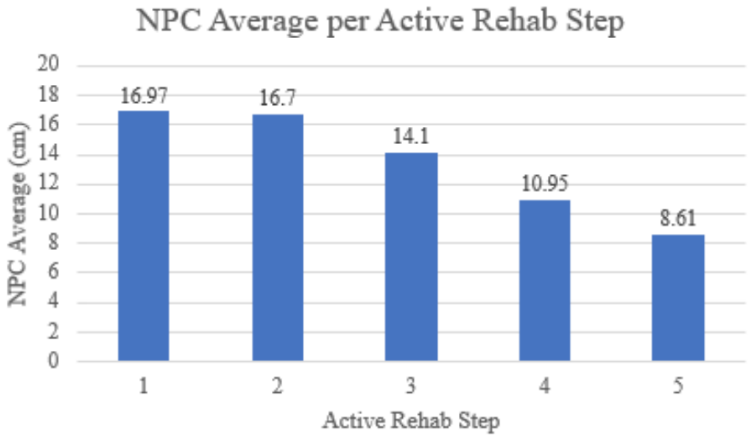


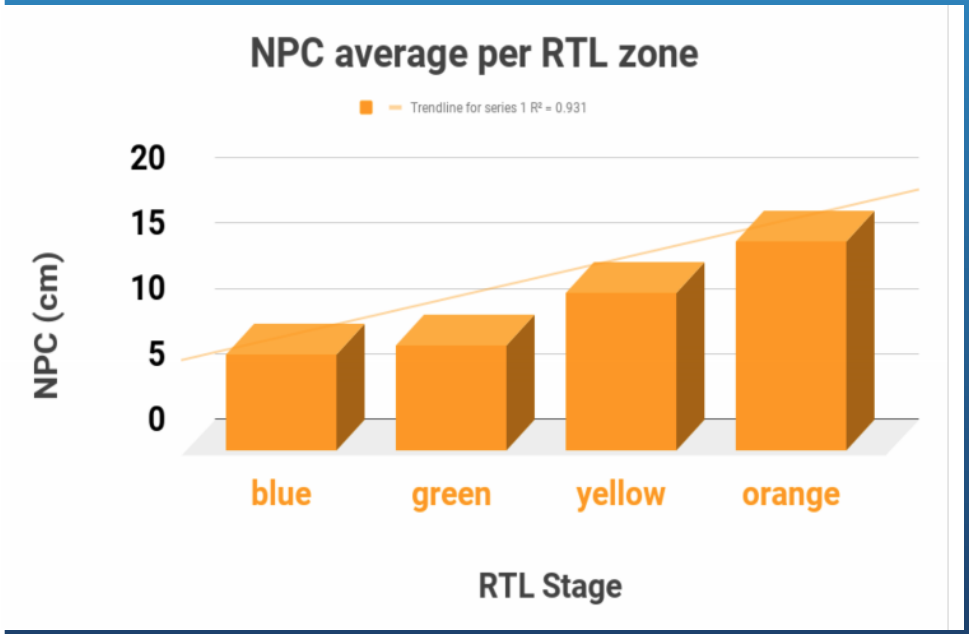
Figure 2: Displays the average NPC at a given ARP Step as seen in Table 1

CJSM 2019

NPC and Academic Tolerance

Near Point Convergence Predicting Return to Learn

Katelyn Paulsen[1,2]; Mohammed Mortazavi, MD[2]; Hirsch Handmaker, MD[3]
1.Department of Dance, University of Arizona, Tucson, Arizona
2. SPARCC Sports Medicine, Tucson, Arizona
3.CACTIS Foundation, Scottsdale, Arizona



ZONE	Ave. NPC (cm)	Percent of patients with NPC≤9cm	Percent of patients with NPC> 18cm
Orange	15.97	21.05%	35.14%
Yellow	12.00	31.09%	13.45%
Green	7.98	81.18%	4.55%
Blue	7.31	86.67%	0.00%

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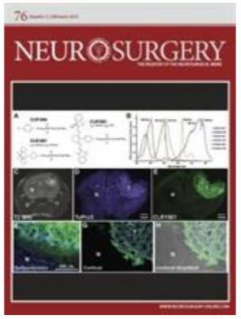
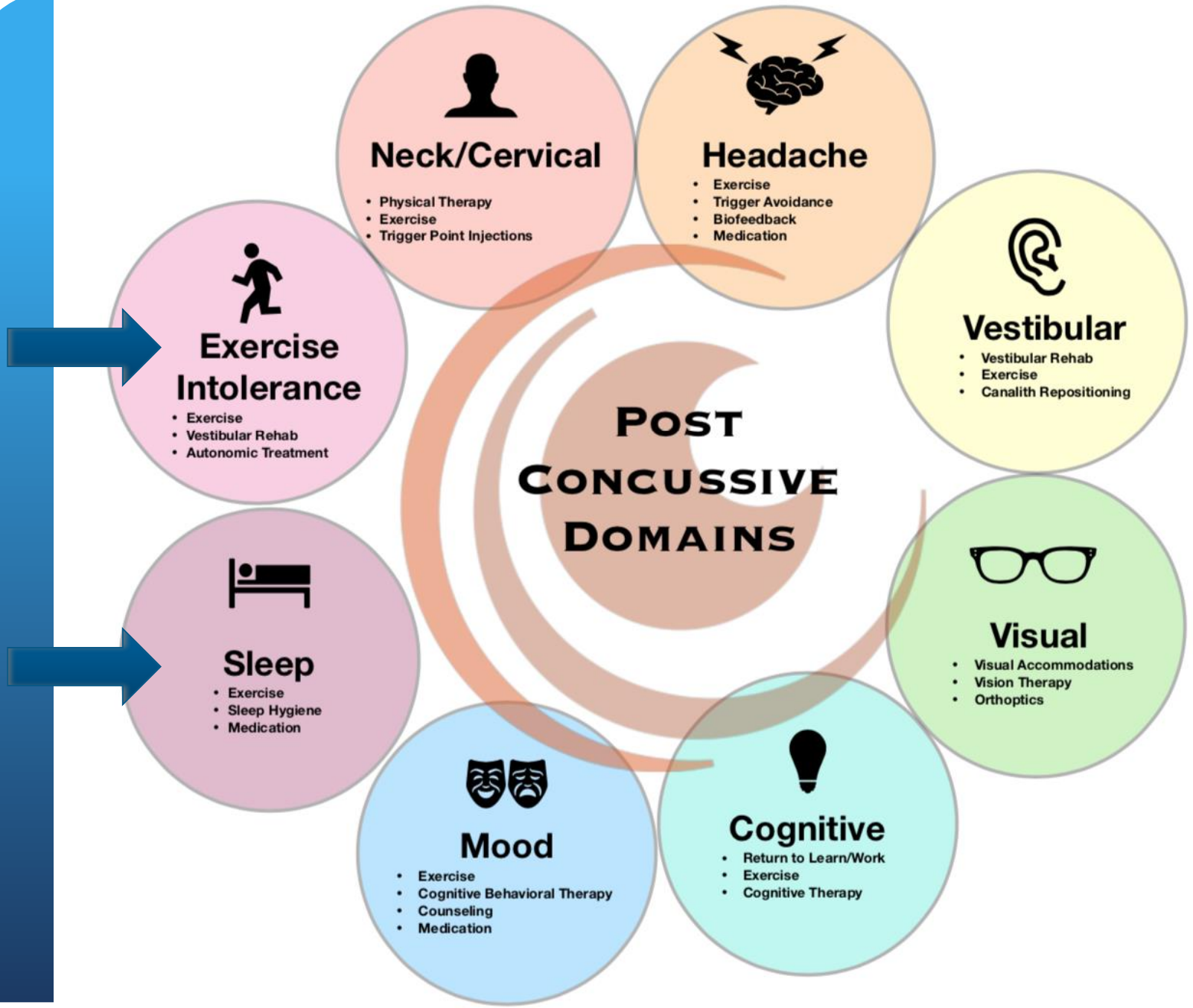
Comprehensive Management

"*Matching targeted and active treatments to clinical profiles* may improve recovery trajectories following concussion."



UPMC LIFE CHANGING MEDICINE

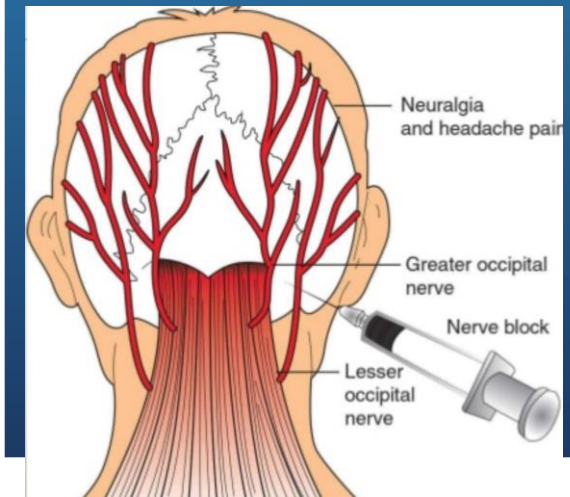

Neck/Cervical
Physical Therapy
Exercise
Trigger Point Injections
Headache
Exercise
Trigger Avoidance
Biofeedback
Medication
Exercise Intolerance
Exercise
Vestibular Rehab
Autonomic Treatment
Vestibular
Vestibular Rehab
Exercise
Canalith Repositioning
Post Concussive Domains
Sleep
Exercise
Sleep Hygiene
Medication
Visual
Visual Accommodations
Vision Therapy
Orthoptics
Mood
Exercise
Cognitive Behavioral Therapy
Counseling
Medication
Cognitive
Return to Learn/Work
Exercise
Cognitive Therapy

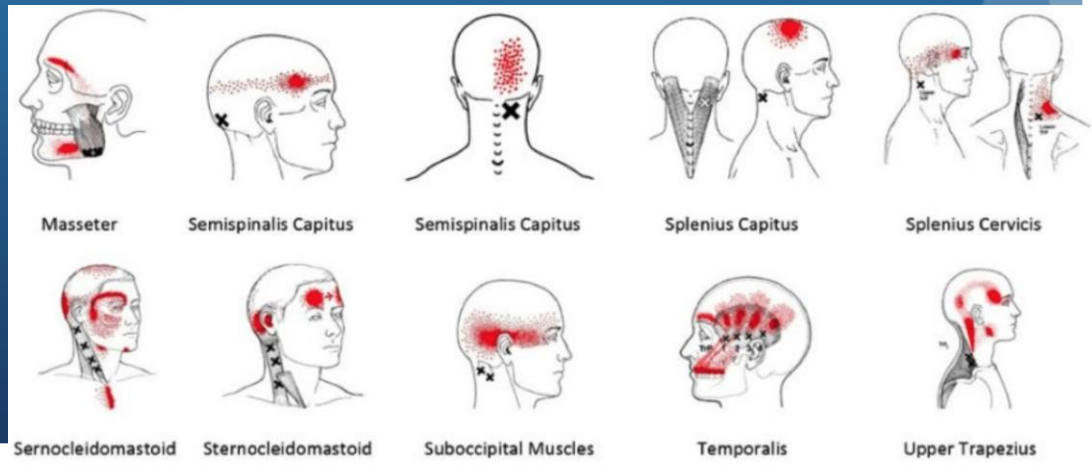
Post traumatic migraine

- Trigger avoidance
- Exercise (ARP)
- Sleep
- Biofeedback
- Cognitive Behavioral Therapy
- Medications (Elavil, Triptans, Tizanidine, SSRIs, Topamax)
- Supplements (Mg, B2, feverfew, butterbur, others)

Cervical dysfunction

- Primary or secondary?
- Cervical Rehabilitation
- Trigger point injections, Acupuncture
- Manual therapy, Craniosacral, OMM, Myofascial





Active rehab protocol

- Progressive sub symptom threshold exertional rehabilitation
- Determining exertional “dose” after exercise tolerance testing:
  - Step 1
  - Step 2
  - Step 3
  - Step 4
  - Step 5

Vestibular dysfunction

- Vestibular rehab
- Exercise (ARP)
- Canalith repositioning (peripheral dysfunction)
- ENT/audiology evaluation
- Meds (meclizine, etc)

Individualized Cognitive Action Plan (ICAP)

- Return to learn/work plan considering:
  - Cognitive Tolerance/Fatigue
  - Specific Cognitive deficits
  - Cognitive accommodations/modifications
  - Include critical visual, vestibular, and exertional accommodations

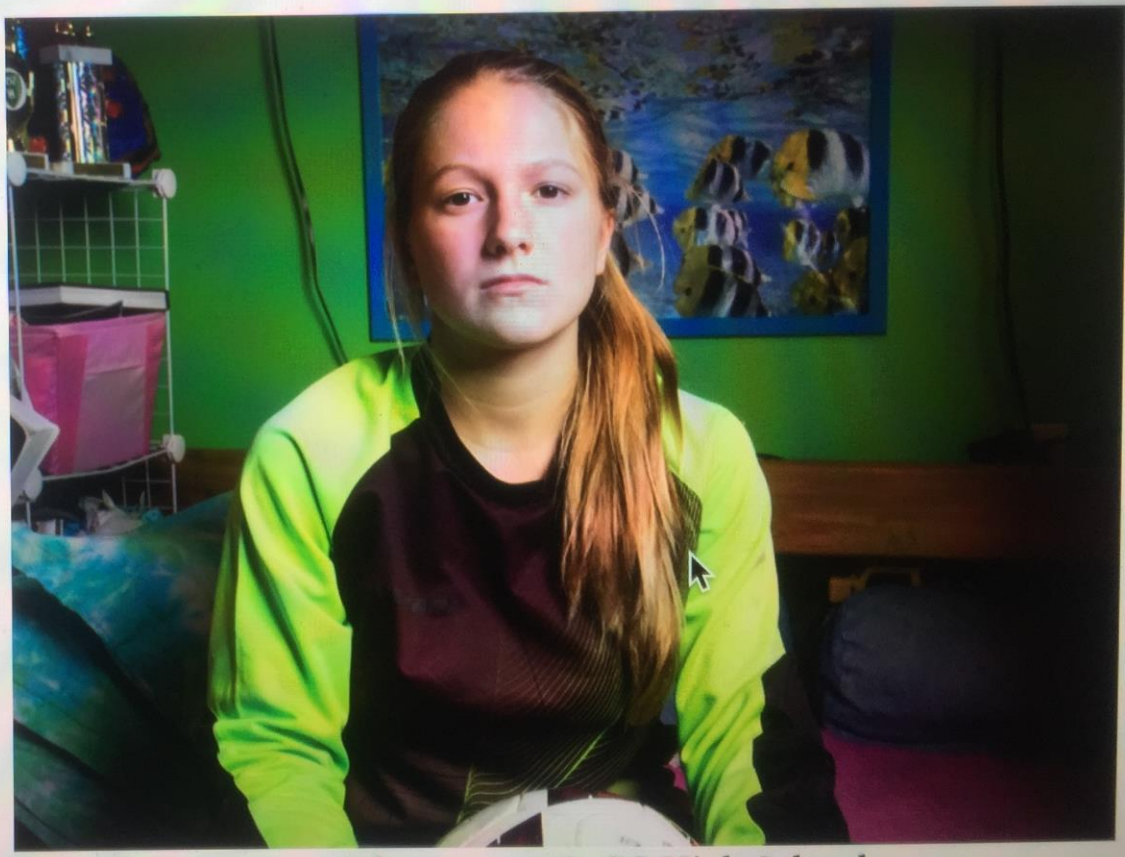
How Concussions Affect Students Academically

When student-athletes sustain a concussion, strict rules govern their return to play, but not their return to school.

BY JULIE RASICOT

Goalie Sally Egan watched as an opposing player approached her during a Saturday soccer scrimmage in February 2014. Focused on stopping the player from scoring, the 14-year-old dove for the ball just as the other girl swung her foot.

"The forward kicked me in the head," says Sally, now a 16-year-old sophomore at Bethesda-



Sally Egan, now a sophomore at B-CC High School, was diagnosed with a concussion two years ago after being kicked in the head during a soccer game.

RETURN to LEARN

- Depending on severity of symptoms may need up to 1-2 days off (RED ZONE)
- Part time with maximal individualized accommodations (ORANGE ZONE)
- Full time with partial supports (YELLOW ZONE)
- Gradual return to normal school work as tolerated by symptom threshold (GREEN)
- Back to full academics and sports (BLUE)

School Accommodations

Do not go over the symptom threshold!

- Allows the brain to continue healing without prolonging symptoms
- Keeps the student stimulated (avoid potential for increase in depressive symptoms)

Accommodation Methods

- No testing
  - Postpone or alternate methods
- Limited or no screen time/projectors
  - Audio books, printed notes
- No PE or recess
  - Light walking and rehab
- Extra time/help for projects
  - Tutors, study groups, make up work plan
- Avoid Busy Hallways
  - Hall pass

RTL Consistency

- Return to Learn Plan needs leverage points!!
- Depending on type of accommodations needed:
  - No sports, PE, regular recess
  - No recreational screens or smart phones
  - No video games
  - No driving or long travel
  - No High Stimuli Events (noise, lights)

Anxiety/Mood

- Exercise (ARP)
- Coping strategies
- Sleep
- Psychotherapy
- Biofeedback
- Cognitive Behavioral Therapy
- Medications (Lexapro, Celexa, Zoloft)

Sleep Disturbance

- Exercise (ARP)
- Sleep Hygiene
  - Sleep/Wake Routine (8-10hrs)
  - Avoid stimulation after dinner
  - Tryptophan rich dinner
  - Meditation/Journaling/Action Plans before bed
- Supplement/Medications: Melatonin, Trazodone, others


VISION?

POLEC's Model for Visual Rehabilitation

- **Post Trauma Vision Syndrome (PTVS)**

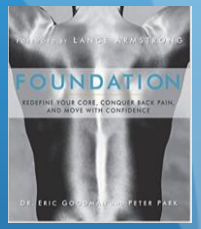
  Concussion and TBI through HX/Evaluation

- **Visual Midline Shift Syndrome (VMSS)**
  - ***Dynamic* VML Assessment**

    Risk of Fall (RoF), Neurological Event (Padula),

    Home treatment 1) improved no longer needed

    2) once stabilized give as rx



- **Core Body Awareness/Base of Support**

  Visual Body Mapping, Primitive Reflexes, Core Strength (body/neck) (Fitzgerald)

- **Neuro Visual Processing Rehabilitation**

  The effective use of lenses, prisms and sectoral occlusion

  including *Neuro Visual Postural Therapy* (Padula) - Peripheral vision with body and vestibular

- **Vision Therapy**

  Ocular motor, vergences, saccades, movement with body/head

  with binocular activities

Post Trauma Vision Syndrome & Visual Midline Shift Syndrome

- VMSS was treatable with Yoked Prisms lenses.[2 3 4]
- Treatment of VMSS with Yoked Prisms lenses reduces Risk of Fall.[4]

[4] *Padula W, Subramanian P, Spurling A, Jenness J. Risk of fall (RoF) intervention by affecting visual egocenter through gait analysis and yoked prisms. NeuroRehabilitation 2015;37:305-14*

Padula et. al. (2009) found VMSS in over 70% of patients with stroke.[2]

[2] *Padula W, Nelson C, Padula W, Benabib R, Yilmaz T, Krevisky S. Modifying postural adaptation following a CVA through prismatic shift of visuo-spatial egocenter. Brain Injury 2009;23:566-76.*

Bansal et. al. (2014) found VMSS In 40% of ABI patients.[3]

- Retrospective Study at SUNY
- 60 ABI patients
- includes TBI, CVA, other brain injuries

Fig. 1 – Visual midline shift test normal response.

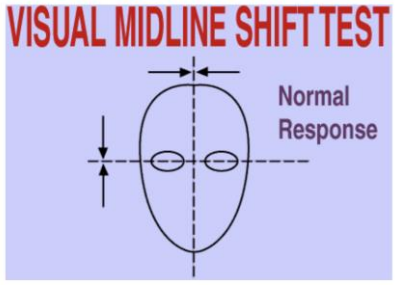


Fig. 2 – Visual midline shift to the right

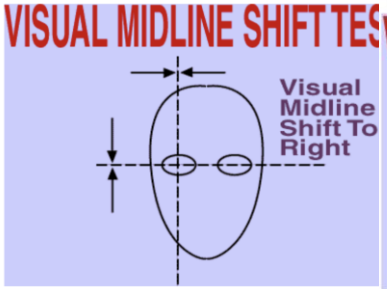


Fig. 4 – Posterior visual midline shift

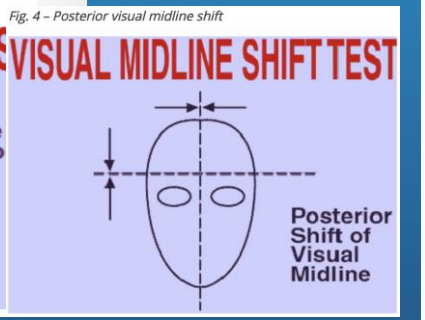


Fig. 3 – Visual midline shift to the right affecting posture.

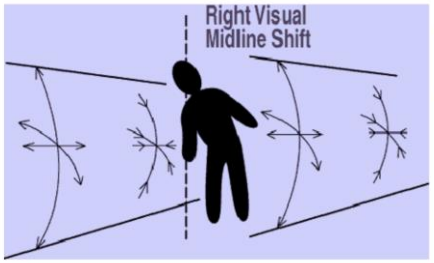
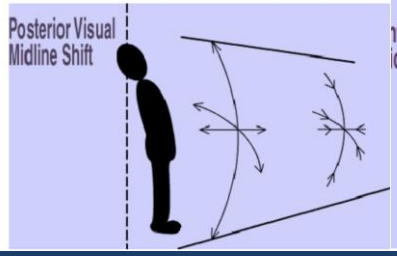
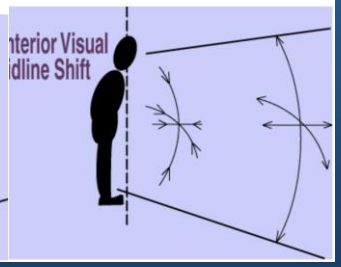


Fig. 5 – Posterior visual midline shift affecting posture



. 7 – Anterior visual midline shift affecting posture



Risk of Fall (RoF) Intervention by affecting Visual Egocenter through Gait Analysis and Yoked Prisms

- W. Padula OD
- Prem Subramanian PhD, MD
- April Spurling OD
- Jonathan Jenness OD
- WV. Padula PhD

Brain Injury (2015) 23:6, 566-576

Sensory reweighting dynamics in human postural control
J Neurophysiol. 2014 May 1; 111(9): 1852–1864.

Journal of Neurophysiology
American Physiological Society

Sensory reweighting dynamics in human postural control

Lorenz Assländer and Robert J. Peterka

Additional article information

Abstract

Healthy humans control balance during stance by using an active feedback mechanism that generates corrective torque based on a combination of movement and orientation cues from visual, vestibular, and proprioceptive systems. Previous

Dynamic changes of a sway responses can result not only from a change in the sensory reweighting dynamics but also from the change of the stimulus amplitude itself.

esent study a variety of PF and VS amplitude

dynamic changes of the sway responses can result not only from a change in the sensory weights (reweighting dynamics) but also amplitude itself. M without any reweig response following which the body sway response follows a transient time

course until it reaches a new steady-state condition.

reweighting and transient effects.

component was a broadband pseudorandom waveform

Investigate –
Visual interaction within threshold-based models

Therefore, the current threshold-based models need to be extended to include visual interactions and possible changes in strategies associated with the control of multisegmental body motion. Then simulations need to be performed to determine whether they can explain the experimentally observed time courses of body sway associated with intra- and intermodality sensory reweighting.

Gait & Posture
Volume 52, February 2017, Pages 244-250

Full length article

Balancing sensory inputs: Sensory reweighting of ankle proprioception and vision during a bipedal posture task

Rakshatha Kabbaligere [a, b], Beom-Chan Lee [a, b], Charles S. Layne [a, b, c]

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https://doi.org/10.1016/j.gaitpost.2016.12.009

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Abstract

During multisensory integration, it has been proposed that the central nervous system (CNS) assigns a weight to each sensory input through a process called sensory reweighting. The outcome of this integration process is a single percept that is used to control posture. The main objective of this study was to determine the interaction between ankle proprioception and vision during sensory integration when the two inputs provide conflicting sensory information pertaining to direction of body sway. Sensory conflict was created by using bilateral Achilles tendon vibration and contracting visual flow and produced body sway in opposing directions when applied independently. Vibration was applied at 80 Hz, 1 mm amplitude and the visual flow consisted of a virtual reality scene with concentric rings retreating at 3m/s. Body sway elicited by stimuli individually and in combination was evaluated in 10 healthy young adults by analyzing center of pressure (COP) displacement and lower limb kinematics.

Visual flow moderates the instability produced by disrupted ankle proprioception

Results - controlled visual flow in balance training

maintain balance.

- Visual flow moderates the instability produced by disrupted ankle

vision and proprioception.

- The results point to the potential use of controlled visual flow in balance training.

Journal of Sport and Health Science
Volume 5, Issue 1, March 2016, Pages 80-90

Review

Assessing proprioception: A critical review of methods

Jia Han [a, b], Gordon Waddington [b], Roger Adams [b], Judith Anson [b], Yu Liu [c]

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https://doi.org/10.1016/j.jshs.2014.10.004

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A recent brain imaging study also found that in addition to peripheral reflex mechanisms, central processing of proprioceptive information from the foot was essential for balance control.[57]

It has been suggested that in passive movement cutaneous receptors appears to play a greater role in sensory feedback.

In contrast, in active movement control, fusimotor drive and muscle spindle feedback are both involved, although input from muscle spindles is considered to play a more dominant role.[112, 113]

The brain may rely on different information from different receptors in the two phases, and the results may reflect hemispheric specialization in proprioceptive

Other vestibular knowledge-

Once the body is moving (automatic motion) the visual process becomes the dominant input for support.

Dynamic Midline shift

gravity, kinetics, proprioception,
movement in space, body posture

SENSORY INPUT

INPUT FROM THE EYES
INPUT FROM THE MUSCLES AND JOINTS
INPUT FROM THE VESTIBULAR SYSTEM
INTEGRATION OF SENSORY INPUT

PROCESSING OF CONFLICTING SENSORY INPUT

MOTOR OUTPUT
MOTOR OUTPUT TO THE MUSCLES AND JOINTS
MOTOR OUTPUT TO THE EYES

COORDINATED BALANCE SYSTEM

MIDLINE SHIFT
DYNAMICS

Shoes

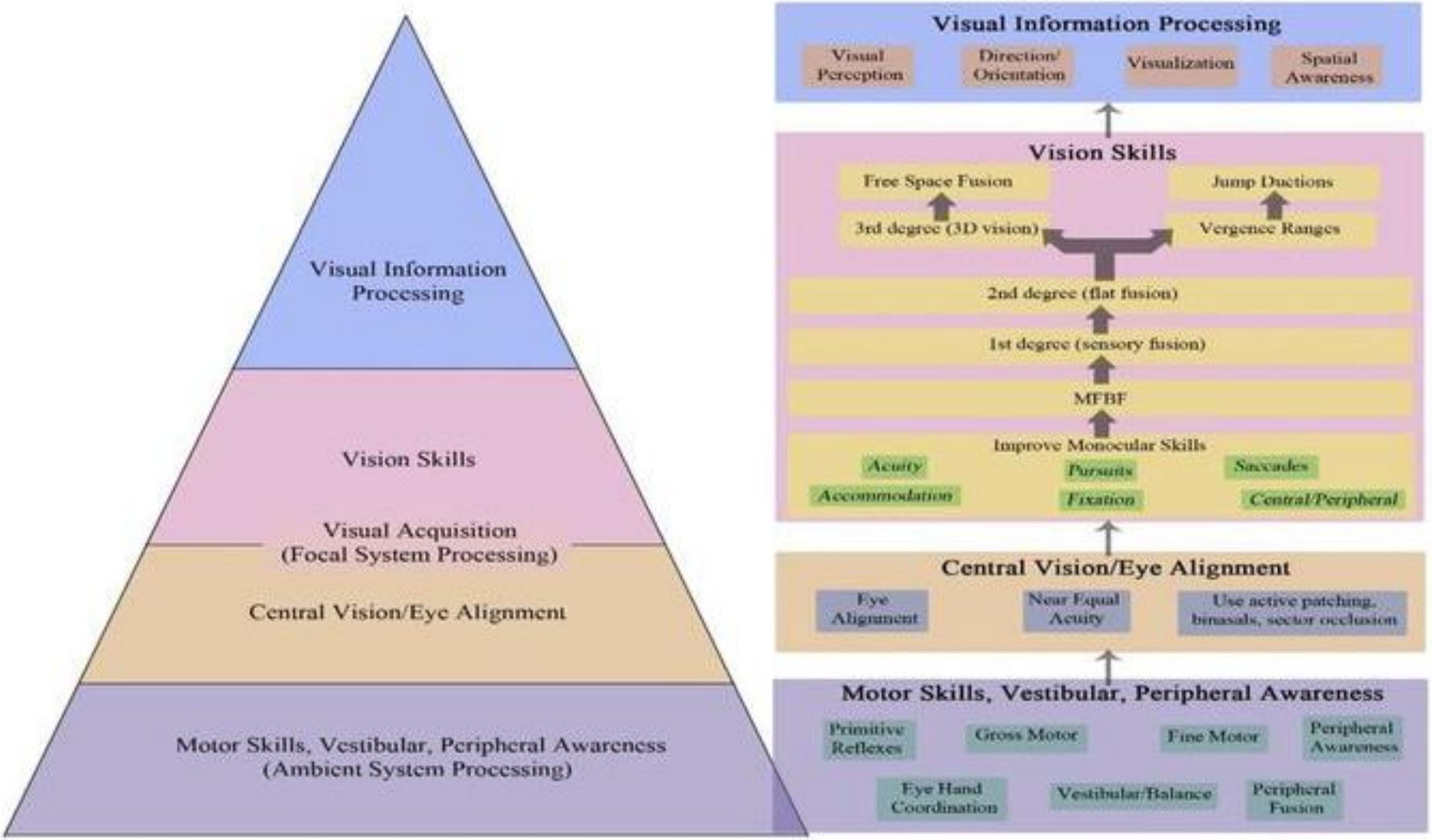
Help or Challenge communication between the body/vision?

25,000 PROPROCEPTORS IN OUR FEET!!

Our feet posture can change eye posture

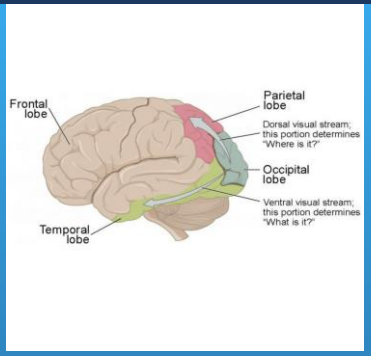
Merrell Vapor Glove shoes !

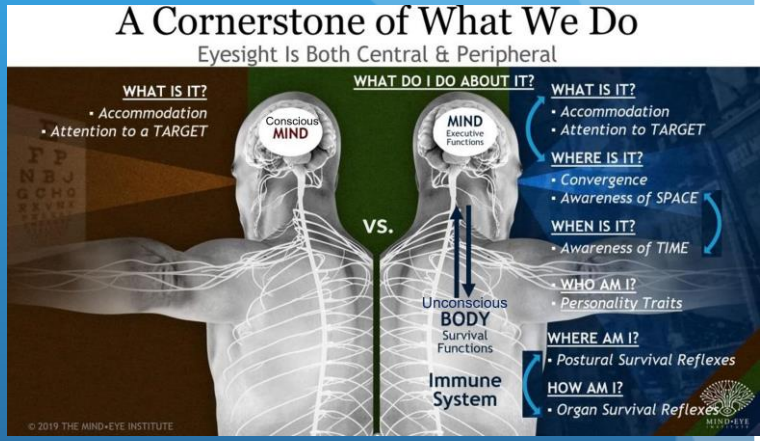
Need support? What is the least support needed?



Fitzgerald & Monroe

It's Spatial It's Core Body





- Skeffington's Circles
  - 1- Where is it? Where am I?
  - 2. What is it?
  - 3. How do I explain it? (speech and auditory)

Where – Spatial (Peripheral Visual) with body core (proprioceptive… some start with a plank (wall/floor)

Vision/Body Assessment
Dynamic Visual Midline Shift

Multisegmental Body Motion

Assessment of patients interpretation of space through the physical movement of the visual/body/vestibular system moving through space.

How do they interpret space by:

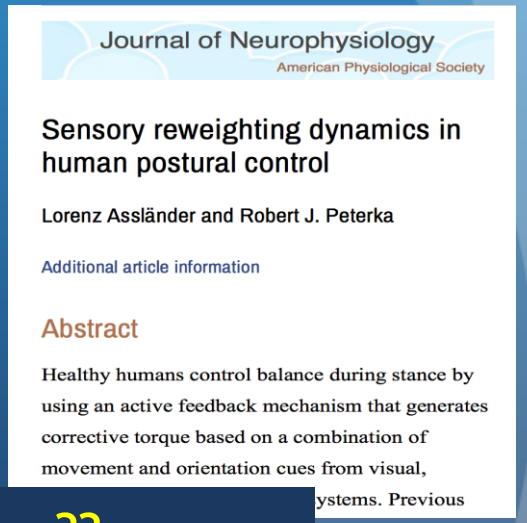
1. Standing straight
2. Initiating movement forward
3. Initiating stop
4. Over flow of body after stopping.

* Stand straight - Walk – Stop- Walk – Turn- Stand straight*

Sensory reweighting Dynamics

- Once stopped – this movement is what I interpret as the overflow between the visual, proprioceptive system and vestibular system.

i.e.
- Rocking – forward-backward
- Arms out for balance – (is it symmetrical?)
- Body twisted
- Head tilted



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ystems. Previous

How much is intermodality vs. Intramodality ??

Con't Assessment/TX VMLL with Body Motion

- Visual testing – sitting, standing, walking (difference?)
  - When does the symptoms occur?
  - How does the posture in activity change (reading, standing, walking)?

- Physical testing – restricted muscular tone/extension refer to PT on all assessment and treatment or manual manipulation tx.

- Visual/physical Tx – exercise controlled - ie static bike
  - Pursuit/saccadic movement (vertical/horizontal)
  - no head movement
  - With head movement

1040-5488/16/9300-0000/0 VOL. 93, NO. 00, PP. 00–00
OPTOMETRY AND VISION SCIENCE

ORIGINAL ARTICLE

Brain Injury Vision Symptom Survey (BIVSS) Questionnaire

Hannu Laukkanen*, Mitchell Scheiman†, and John R. Hayes‡

Results. At least 27 of 28 questions were completed by 93.5% of TBI subjects, and all 28 items were completed by all of the 157 reference subjects. BIVSS sensitivity was 82.2% for correctly predicting TBI and 90.4% for correctly predicting the optometry students. Factor analysis identified eight latent variables; six factors were positive in their risk for TBI. Other than dry eye and double vision, the TBI patients were significantly more symptomatic than either cohort of optometry students by at least one standard deviation ($p < 0.001$). Twenty-five of 28 questions were within limits for creating a single-dimension Rasch scale.

82% Predicting TBI

Conclusions. Nearly all of the adult TBI subjects were able to self-complete the BIVSS, and there was significant mean score separation between TBI and non-TBI groups. The Rasch analysis revealed a single dimension associated with TBI. Using the Likert method with the BIVSS, it may be possible to identify different vision symptom profiles with TBI patients. The BIVSS seems to be a promising tool for better understanding the complex and diverse nature of vision symptoms that are associated with brain injury.

(Optom Vis Sci 2016;93:00–00)

BIVSS CHECKLIST (Brain Injury Vision Symptom Survey)

Patient Name: _____ Today's date: _____

My brain injury was: ____ years ago My age is: ____ years today's date: _____

☐ I have had a medical diagnosis of brain injury (check box if true) Cause of injury: _____

☐ I sustained a brain injury without medical diagnosis (check box if true) _____

☐ I have NOT ever sustained a brain injury (check box if true)

Please check the most appropriate box, or circle the item number that best matches your observations. All information will be held in confidence. Thank you for your help!

SYMPTOM CHECKLIST ***Circle a number below:***

Please rate each behavior. **How often does each behavior occur?** (circle a number)	Never	Seldom	Occasionally	Frequently	Always
EYESIGHT CLARITY					
Distance vision blurred and not clear -- even with lenses	0	1	2	3	4
Near vision blurred and not clear -- even with lenses	0	1	2	3	4
Clarity of vision changes or fluctuates during the day	0	1	2	3	4
Poor night vision / can't see well to drive at night	0	1	2	3	4
VISUAL COMFORT					
Eye discomfort / sore eyes / eyestrain	0	1	2	3	4
Headaches or dizziness after using eyes	0	1	2	3	4
Eye fatigue / very tired after using eyes all day	0	1	2	3	4
Feel "pulling" around the eyes	0	1	2	3	4
DOUBLING					
Double vision -- especially when tired	0	1	2	3	4
Have to close or cover one eye to see clearly	0	1	2	3	4
Print moves in and out of focus when reading	0	1	2	3	4
LIGHT SENSITIVITY					
Normal indoor lighting is uncomfortable – too much glare	0	1	2	3	4
Outdoor light too bright – have to use sunglasses	0	1	2	3	4
Indoors fluorescent lighting is bothersome or annoying	0	1	2	3	4
DRY EYES					
Eyes feel "dry" and sting	0	1	2	3	4
"Stare" into space without blinking	0	1	2	3	4
Have to rub the eyes a lot	0	1	2	3	4
DEPTH PERCEPTION					
Clumsiness / misjudge where objects really are	0	1	2	3	4
Lack of confidence walking / missing steps / stumbling	0	1	2	3	4
Poor handwriting (spacing, size, legibility)	0	1	2	3	4
PERIPHERAL VISION					
Side vision distorted / objects move or change position	0	1	2	3	4
What looks straight ahead--isn't always straight ahead	0	1	2	3	4
Avoid crowds / can't tolerate "visually-busy" places	0	1	2	3	4
READING					
Short attention span / easily distracted when reading	0	1	2	3	4
Difficulty / slowness with reading and writing	0	1	2	3	4
Poor reading comprehension / can't remember what was read	0	1	2	3	4
Confusion of words / skip words during reading	0	1	2	3	4
Lose place / have to use finger not to lose place when reading	0	1	2	3	4

Sensorimotor External **Screening-** outside my primary practice

- VA, CoverTest, Pursuit, NPC –test area of interest (rd,copying, sport)
- Dynamic Visual Midline Shift – watch how the body/vision/space around body interplay.
- VEP (habitual & treatment lens) – when to use prisms/length, try various prism angles and multiple times in treatment.
- Force Plate (habitual & treatment lens)
- RightEye (habitual & treatment lens) – repeat as needed
- Photobiomodulation (Syntonics) – can also repeat VEP with this lens

Treatment Lens – Binasals (any occlusion option), Low Plus, Low Prism, Yoked Prism, Color Lenses, or any combination!!

No prisms are given at this time **only** photochromatic lenses and binasal occlusion.

Vision Assessment- at Primary Practice

- Full Neuro Optometric Evaluation –
  - Best *Functional* Rx (plus/prism vergence alignment/VMLS prism) – not always 20/20 (comfortable, tolerance)
  - Phoria, vergences, accommodation, NPC
  - Ocular Health
- Dynamic VMLS Evaluation –
  - Prisms (Walk-Stop-Walk)
  - Use Binasal Occlusion (Unilateral, Bilateral, Black, Opaque, Color Tints?) – Twist of body (residual from prism)
- Review testing from SPARCC/private clinic for overall treatment

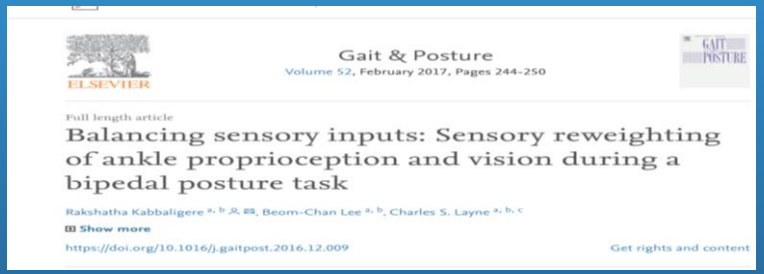
Treatment

- VMLS Rx – prism googles until stabilized – important to give – eliminate “focal binding”
- Peripheral Stimulation / Syntonics
- Core Body Building Neck/Body (Fitzgerald)
- Neuro-Visual Postural Therapy (Padula)
- Vision Therapy - further enhanced treatment binocularity/accommodative.
- Con’t co-manage - PT/OT/ST/AT/Nurse as needed.

* continued review of VMLS Rx throughout process.

VMLS Rx- TX with *Movement*!!

- Bike/Treadmill with HRV (heart rate variabi
- Exercise – faster recovery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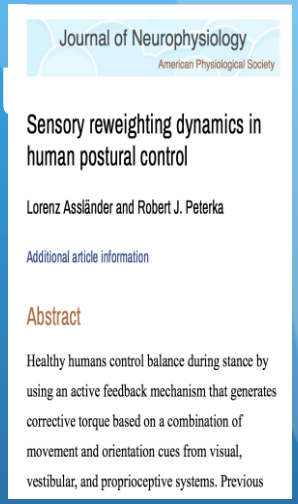
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- Driving?! – test on Sanet Vision Integrator (SVI) & Senaptic

Polec's Essential Referrals

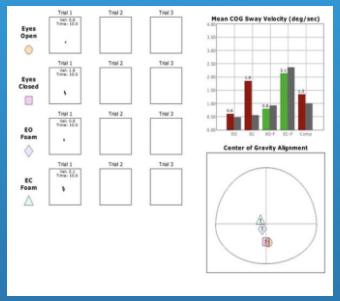
- **Nutrition** – refer out for management (NMD's, Neuro Pharmacologist)
- **Body Structure** – Osteopathic Manipulation, Cranial Sacral, Visceral Manipulation
- **Injections for head/body pain** – Musclo Skeletal Physician
- **Body Integration** - Physical Therapy
- **Daily Living Skills** – Occupational Therapy
- **Speech Delays**– Speech Therapy
- **Supportive Care/ Testing** – Athletic Trainers / School Nurses

Dynamic VMLS Assessment

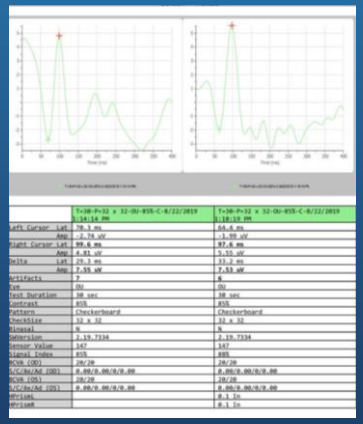
11 yr. old Female Gymnast

1. *Dynamic* VMLS- Left/Posterior- Gait analysis with stand/walk/stop/walk/stand

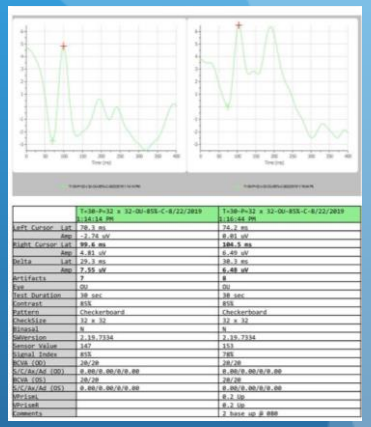
2. Force Plate
   Habitual – no rx



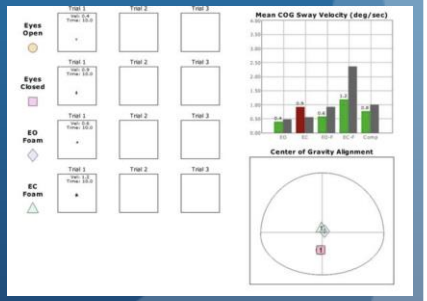
3. VEP
   OD 1 BI
   OS 1 BI



4. VEP
   OD 2 @ 060
   OS 2 @ 060



5. Force Plate
   OD 2 @ 060
   OS 2 @ 060



11 yr. old Female Gymnast

Vergences – were restricted at near and distance

VA: 20/25 OD, OS, OU

Accommodation – spasm equally restricted for OD, OS

NPC: x/12/15

10 sessions 1 x per week

1-4 with 2 @ 060

focused on core body/neck strengthening, slight aerobic activity (refer SPARCC)

NVPT (building periphery/body)

Alpha/omega (20 mins (3xweekly) – 1

Cranial sacral/ visceral manipulation

No HA and back to school full time - switched interest to Competitive Diving !

5-6 re-evaluated VMLL 1 @ 090

Stopped syntonics

Added aerobic level with SPARCC

Added +0.50 0.5 BI OU reading

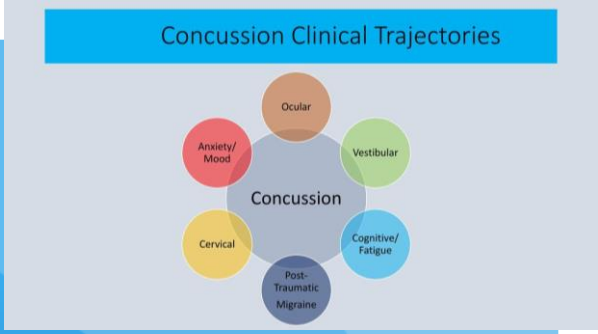
7-10 no prism

Continued Add only at need basis

Normalized training

Vision therapy/cognitive speed

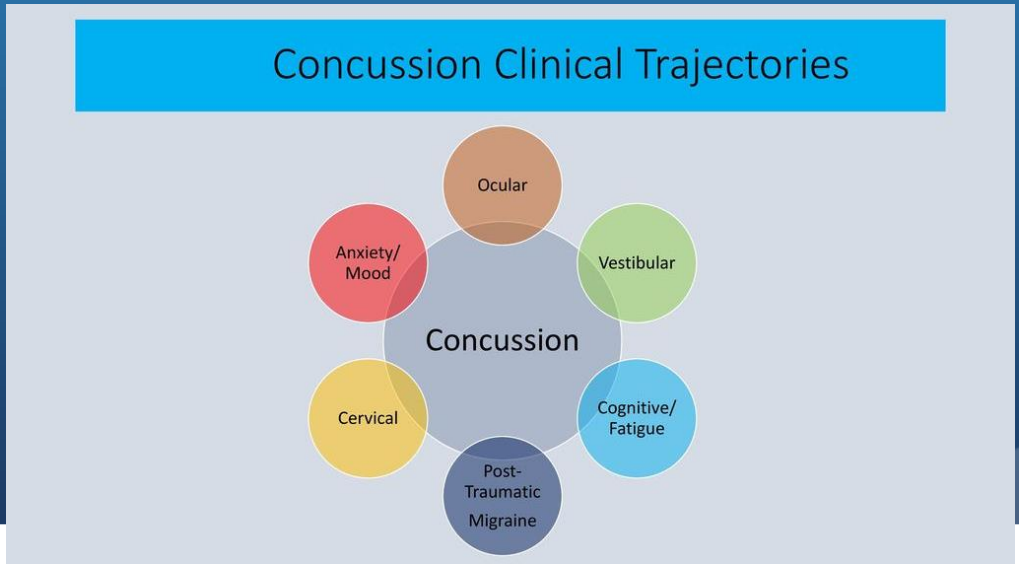
Multi Disciplinary Model



- Concussion Clinic that is Comprehensive
- Understands Vision deficits and evaluation
- Recognizes the primary and secondary effects of vision
- Vision often the primary or central profile/domain
- Educate patient about vision deficits/treatment early

Multi Disciplinary Model

- Bring in Vision Team in timely manner with PPCS
- Early intervention group for severe deficits?
- Ongoing integrative care to manage all profiles around a focused central vision domain



He who studies medicine without books sails an uncharted sea, but he who studies medicine without patients does not go to sea at all.

- William Osler -