Visuo-Vestibular Rehabilitation for Concussion/mTBI
Part 3

Phoenix Concussion Recovery
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Examination

- Ask about corrective lenses – ensure patient has their glasses for appropriate exam
- Considerations for multi-focal lenses
- For older patients especially, ensure appropriate lighting.

2

Questionnaires, Objective Measures

PCSS, DHI, BIVSS on 1st, 4th, and final module

Can also use DRS

Module 2, 4, and 6 (final)

R/G antisupp scanning ex

King Devick

Module 2, 6: mCTSIB or instrumented BESS

3

Screening

- You can choose to do acuity testing – I do not for time
- If acuity is 20/40 or poorer = can have effect on ADLs and driving
- Cheaters (presbyopia) – every 5 years over age 45 = increase
  - They may have gotten away with no readers before concussion, but this increases their eye strain post

4

Screening – All Concussion Clinicians

- All concussion providers should be able to complete a VOMs assessment.
- Exact referral guidelines have yet to be established:
  - If pursuits/saccades not resolved in 2-3 visits – refer
  - If vision is primary driver of symptoms refer immediately to vision team
  - If signs of convergence insufficiency ie: NPC > 6cm (2inches)
  - Signs of maltracking (eye abduct) refer to FCOVD and vision specialty team immediately

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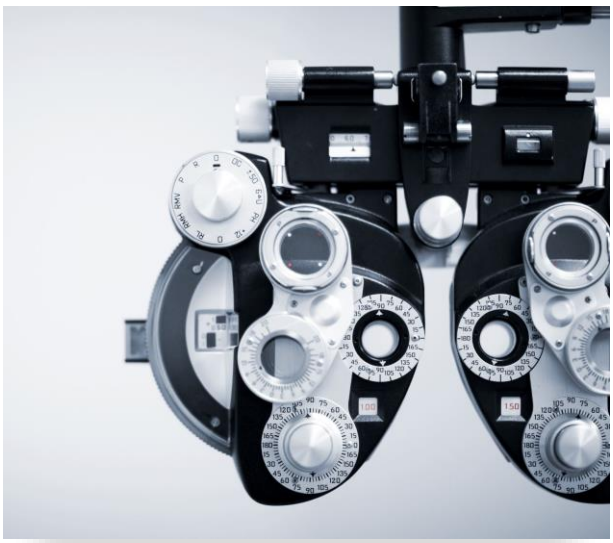
Vision Specialist Referral Requirements

- When to refer to behavioral optometry / neuro-optometry (FCOVD)
  - Once established relationship with OD – to perform vision therapy
  - 10" brock string/NPC
  - + cover/uncover test – phoria/tropia
  - Sig symptoms delaying return to work/school where accommodative lenses may improve function
  - Convergence spasm – functional
- When to send to neuro-ophthalmology or neurology
  - Vertical phoria – cover/uncover – must be r/o for CVA
  - Monocular diplopia
  - Convergence spasm – may require medication
  - Visual field deficits



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"VOMS +"

- Vergences/stereopsis:
  - More than pencil NPC!
  - Normal 2inches (6cm)
- Oculomotor control:
  - Smooth pursuits – inattention, cogwheeling
  - Saccades – over/undershoot, velocity, directional dep.
  - Ocular ROM – some clinicians are able to do during pursuit testing, some test separately
- VOR:
  - Gaze stabilization vs cancellation – identify fixation, oscillopsia, sx provocation

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Binocular vision assessment:

- Stereo: delayed, correct, OS supp
- Brock: 14" ortho, R exo
- Cover/uncover, alt cover: OD: EXO, OS: diff fixation, dizzy. Alt cover: effortful

Oculomotor assessment:

- Pursuits: Fair – horiz: HA 2pt, dizzy 2pt, diff isolation, midline catch R. vert: HA 2pt, dizzy 1pt, diff isolation, decr velocity, sacc corr sup. Diag: incr sacc corr inf R. dizzy 2pt, HA 2pt.
- Saccades: Poor-Fair – horiz: undershoot R target, vert: undershoot sup target incr effort sup, diag: incr diff sup R. diff isolation throughout, HA dizzy incr 2pt throughout, reduced velocity
- NPC: diff fixation <3", withdrawal, ANS resp, incr diff OD ADD able c effoort

Vestibular screen:

- VOR x1: 1/2cps dizzy 3pts, oscill yaw. Nausea 2pts dizzy 3pts pitch
- VOR CXL: 1/2cps dizzy 2pts, oscill L yaw, decr fixation inf oscill pitch

Determine need for referral to supervising OD

What My Exam Would Look Like

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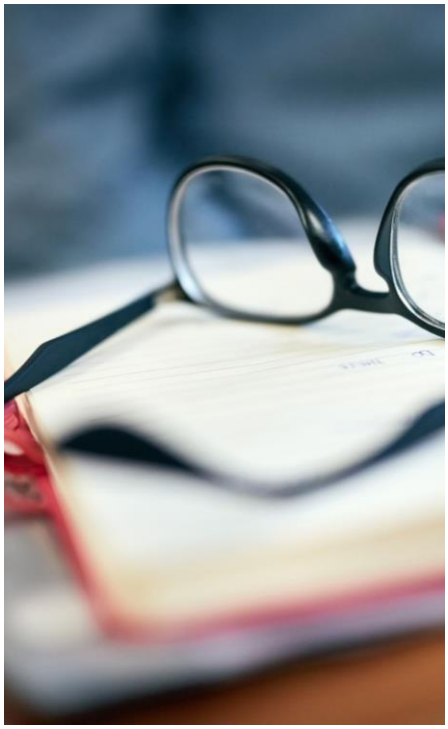

Multiple Ways to Grade the Skinning of the Cat

- NPC – ask patient when they see double – you can cue for attn and to see if improved motor control with effort
- Saccades – the OD will use Developmental Eye Movement Test (DEM) we use King Devick and oculomotor exam
- Pursuits – different patterns you can use – different equipment

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Find what works for you and be consistent!

Over time you will start to see patterns and know what to expect.

I struggle with the grading systems and “black and white”

I like to describe in detail what I see and what they experience to help me track changes and give a thorough report to my OD.

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Laurie Chaukin

- Pursuits:
  - Good = eye movements are smooth with no jerkiness
  - Fair = generally able to follow target, but goes off one to two times, with slight jerkiness
  - Poor = difficulty following target with any accuracy, very jerky or jump, nystagmoid movements, incomplete ROM
- Saccades:
  - Good = able to follow verbal commands 90% of time, with no under or overshooting, and complete eye from head isolation
  - Fair = able to maintain eyes on target with verbal command 50% of the time, with slight under or overshooting, and able to isolate eye from head movement with verbal reminders
  - Poor = inability to control eyes with verbal command, consistent over or undershooting, inability to isolate eyes from head movement

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Laurie Chaukin

- Saccades
  - i.e., Fair: diff isolation, HA, suboccipital p!, R>L nyst, Diag: undershoot sup R
- Pursuits – vs Scheiman's system – has a whole grading table
  - I describe what I see. This is agreed upon with my OD.
  - i.e., Fair-good: diff isolation, extra oc mvt, horiz: incr diff R, Vert: pain sup, R nyst, Diag: dizziness, R>L nyst (vestib = saccadic eye mvts vs nyst)
- You can (should) screen for peripheral awareness (confrontational field testing), visual neglect/inattention
  - Often, I don't have time – use my exercises to determine issues
- You can (should) screen for malalignment using a phoria rod
  - I don't, I refer the patients meeting cut-off criteria who abnormal findings and the OD completes this assessment with instrumented measures.

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Binocular Vision Assessments

- Stereopsis
- Brock String
- Cover/uncover, Alternate Cover

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Stereopsis Kit

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Brock String

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Cover/uncover, Alternate Cover

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Oculomotor Assessments

- Smooth Pursuits
- Saccades
- Near Point Convergence

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Smooth Pursuits

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Saccades

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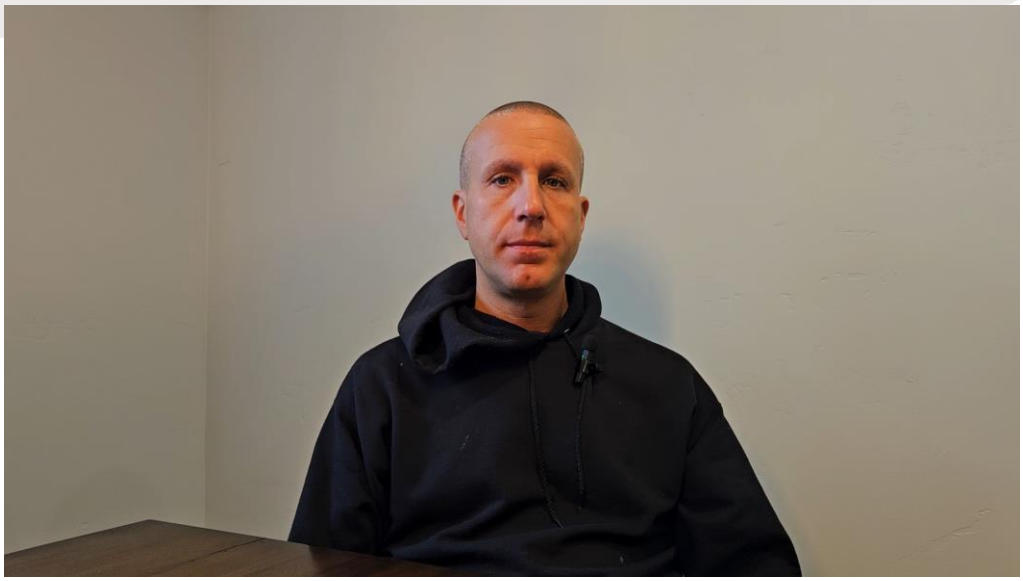
Near Point Convergence



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Vestibular Screen

VOR x1

VOR CXL

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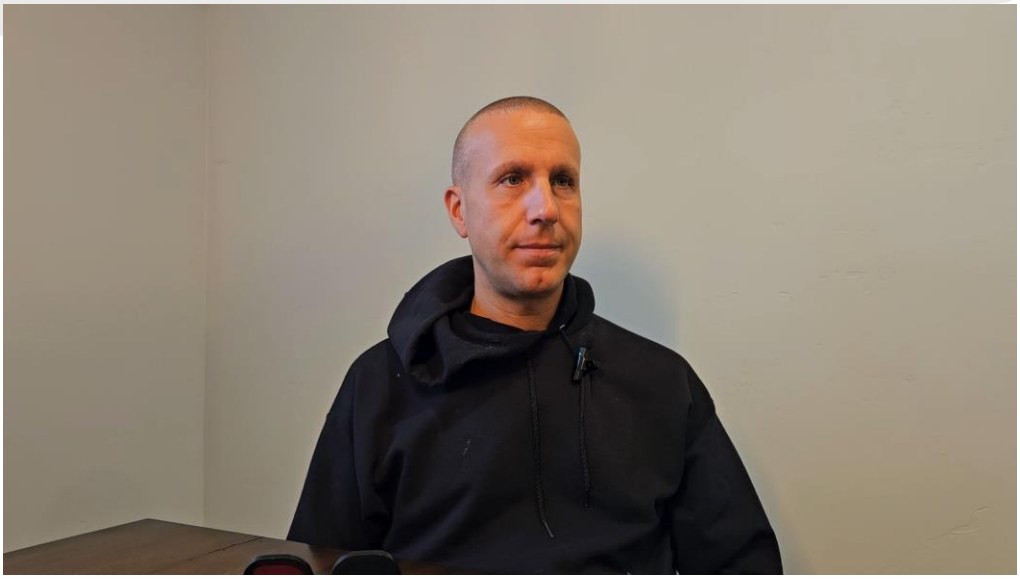
VORx1



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VOR CXL

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Complete VOMS + Examination

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DVA

- Clinical note – you can use DVA to quantify line loss for your patients.
  - Quantify VOR gain – looking for VOR gain to = 1
- As these are functional challenges, I often do not complete a DVA unless I'm using C3Logix.
- Exercise caution with speed – you can modify from 2cps to 1.5cps for concussion
- Method:
  - Use Snellen chart – measure acuity binocular at rest
  - Measure acuity with head rotations (45degrees – caution not to over turn the head), cervical flex 30deg
- Outcome:
  - 3 line loss @ 2cps
  - 2 line loss @ 1.5cps

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ZINC Modules 2, 4, 6
Assessments & Documentation

- Novel Binocular Vision Assessment Tool – Goal 60sec, symptom free
  - Red / green antisupp scanning
  - OD A-Z XX seconds, XX cues, XX symptoms
    - "cues for supp" etc
  - OS 1-26 XX seconds, XX cues, XX symptoms
    - "cues for supp" etc
- King Devick: Goal <45seconds, symptom free
  - XX date: 1:01.45 2E, 58.35 0E, 2/10 HA, 1/10 dizzy

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Novel Binocular Vision Assessment Tool

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Assessment tools KD

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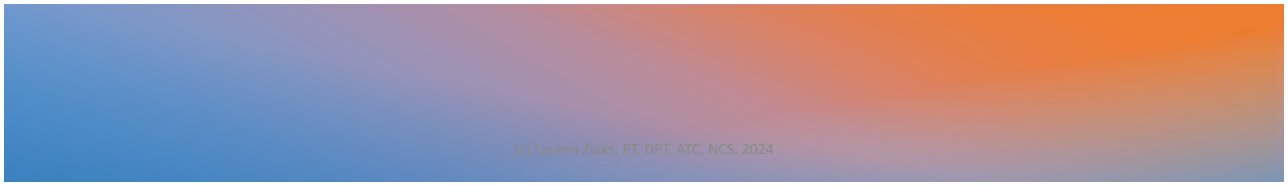
Thank you
See you for Part 4



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References:

1) Ahluwalia R, Miller S, Dawoud FM, et al. A pilot study evaluating the timing of vestibular therapy after sport-related concussion: is earlier better? Sport Health 2021;13(6):573-9
2) Alsalaheen B, Mucha A, Morris LO, et al. Vestibular rehabilitation for dizziness and balance disorders after concussion. *J Neurol Phys Ther*. 2010;34(2):87-93. http://doi.org/10.1097/npt.0b013e3181dde568.
3) Barlow KM, Crawford S, Stevenson A, Sandhu SS, Belanger F, Dewey D. Epidemiology of postconcussion syndrome in pediatric mild traumatic brain injury. *Pediatrics*. 2010;126(2):e374-81. http://doi.org/10.1542/peds.2009-0925
4) Bogner J, Brenner L, Kurowski B, et al. Does sleep quality influence recovery outcomes after post concussive injury in children and adolescents? *J Head Trauma Rehabil*. 2023;38:240-248
5) Brooks, M. A., Peterson, K., Biese, K., Sanfilippo, J., Heiderscheit, B. C., & Bell, D. R. (2016). Concussion increases odds of sustaining a lower extremity musculoskeletal injury after return to play among collegiate athletes. *The American journal of sports medicine*, *44*(3), 742-747.
6) Centers for Disease Control and Prevention. Heads up: What is a concussion? Available at: https://www.cdc.gov/headsup/basics/concussion_whatis.html. Accessed September 1, 2017.
7) Clark J, Hasselfeld K, Bigsby K, Divine J. Colored glasses to mitigate photophobia symptoms posttraumatic brain injury. *Journal of Athletic Training*. 2017;52:725-729.
8) De Beaumont L, Henry LC, Gosselin, N. Long-term functional alterations in sports concussion. *Neurosurg Focus*. 2012;33(6):E8. http://thejns.org/doi/abs/10.3171/2012.9.FOCUS12278.
9) Eisenberg MA, Meehan WP, Mannix R. Duration and course of post-concussion symptoms. *Pediatrics*. 2014;133(6):999–1006. http://doi.org/10.1542/peds.2014-0158.
10) Ellis, M. J., Cordingley, D., Vis, S., Reimer, K., Leiter, J., & Russell, K. (2015). Vestibulo-ocular dysfunction in pediatric sports-related concussion. Journal of Neurosurgery: Pediatrics, 16(3), 248-255.
11) Ellis MJ, Leddy JJ, Willer B. Physiological, vestibulo-ocular and cervicogenic post-concussion disorders: An evidence-based classification system with directions for treatment. *Brain Inj*. 2005;29(2):238-248. http://doi.org/10.3109/02699052.2014.965207.
12) Esterov D, Greenwald BD. Autonomic dysfunction after mild traumatic brain injury. *Brain Sciences*. 2017;7:100.
13) Ettenhofer ML, Remigio-Baker RA, Bailie JM, Cole WR, Gregory E. Best practices for progressive return to activity after concussion: lessons learned from a prospective study of US military service members. *Neurotrauma Reports*. 2020;1:137-145.
14) Fife TD, Kalra K. Persistent vertigo and dizziness after mild traumatic brain injury. Ann. N.Y. *Acad Sci*. 2015;1343:97–105. http://doi.org/10.1111/nyas.12678.
15) Fife T, Satya-Murti S, Burkard R, Carey J. Vestibular evoked myogenic potential testing. *Neurol Clin Pract*. 2018:8(2)
16) Gallaway M, Scheiman M, Mitchell GL. Vision therapy for post-concussion vision disorders. *Optom Vis Sci*. 2017;94(1):68-73.
17) Giza C, Prins ML, Hovda DA. It's not all fun and games: sports, concussions, and neuroscience. *Neuron*. 2017;94(6):1051-1055. https://doi.org/10.1016/j.neuron.2017.05.003.
18) Grupe DW, Nitschke JB. Uncertainty and anticipation in anxiety: an integrated neurobiological and psychological perspective. Nat Rev Neurosci. 2013;14:488–501. doi:10.1038/nrn3524.
19) Guideline for Concussion/Mild Traumatic Brain Injury & Prolonged Symptoms. 3rd Edition, for Adults over 18 Years of Age. Ontario Neurotrauma Foundation. https://braininjuryguidelines.org/concussion/
20) Han BI, Song HS, Kim JS. Vestibular rehabilitation therapy: review of indications, mechanisms, and key exercises. *J Clin Neurol*. 2011;7(4):184-196. http://doi.org/10.3988/jcn.2011.7.4.184.
21) Kapoor N, Ciuffreda KJ, HanY. Oculomotor rehabilitation in acquired brain injury: a case series. *Arch Phys Med Rehabil*. 2004;85:1667-1678.
22) Karmali S, Beaton MD, Babul S. Outlining the invisible: Experiences and perspectives regarding concussion recovery, return-to-work, and resource gaps. *Int J Environ Res Public Health*. 2022;19:8204.
23) Katsarkas A. Benign paroxysmal positional vertigo (BPPV): Idiopathic versus post-traumatic. *Acta Otolaryngol*. 1999;119(7):745-749.
24) Kontos, A. P., Collins, M. W., Holland, C. L., Reeves, V. L., Edelman, K., Benso, S., Schneider, W., & Okonkwo, D. (2018). Preliminary Evidence for Improvement in Symptoms, Cognitive, Vestibular, and Oculomotor Outcomes Following Targeted Intervention with Chronic mTBI Patients. *Military medicine*, *183*(suppl_1), 333–338.
25) Kontos AP, Deitrick JM, Collins MW, Mucha A. Review of vestibular and oculomotor screening and concussion rehabilitation. *J Athl Train*. 2017;52(3):256-261. http://dx.doi.org.ezproxy.neu.edu/10.4085/1062-6050-51.11.05.
26) *Kontos* Current Sports Medicine Reports: March 2019 - Volume 18 - Issue 3 - p 82-92. doi: 10.1249/JSR.0000000000000573
27) Lau BC, Kontos AP, Collins MW, Mucha A, Lovell MR. . Which on-field signs/symptoms predict protracted recovery from sport-related concussion among high school football players? *Am J Sports Med*. 2011; 39 11: 2311– 2318.
28) Leddy JJ, Baker JG, Willer B. Active rehabilitation of concussion and post-concussion syndrome. *Phys Med Rehabil Clin N Am*. 2016;27(2):437-54. http://doi.org/10.1016/j.pmr.2015.12.003.
29) Leddy JJ, Burma JS, Toomey CM, et al. Rest and exercise early after sport-related concussion: a systematic review and meta-analysis. *Br J Sports Med*. 2023;57:762-770.
30) Lehman RK, Schor NF. Neurologic evaluation. In: Kliegman RM, Stanton BF, St Geme JW, Schor NF, eds. *Nelson Textbook of Pediatrics*. 20th ed. Philadelphia, PA: Elsevier; 2016:Chap 59.
31) Lundblad, M. (2017). A conceptual model for physical therapists treating athletes with protracted recovery following a concussion. *International journal of sports physical therapy*, *12*(2), 286.
32) Marzo S, Leonetti JP, Raffin MJ, Letarte P. Diagnosis and management of post-traumatic vertigo. *Laryngoscope*. 2004;114(10):1720-1723.
33) Master CL, Gioia GA, Leddy JJ, Grady MF. Importance of 'Return-to-Learn' in Pediatric and Adolescent Concussion. *Pediatric Annals*. 2012;41(9).
34) Master CI, Scheiman M, Gallaway M, et al. Vision diagnoses are common after concussion in adolescents. *Clin Ped*. 2016;55(3):260-267. http://doi.org/10.1177/0009922815594367.
35) McCrory P, Meeuwisse W, Dvorak J, et al. Consensus statement on concussion in sport—the 5th international conference on concussion in sport held in Berlin, October 2016. *Br J Sports Med*. [Epub ahead of print] http://doi.org/10.1136/bjsports-2017-097699.
36) Mucha A, Collins MW, Elbin R, et al. A brief Vestibular/Ocular Motor Screening (VOMS) assessment to evaluate concussions: preliminary findings. Am J Sports Med. 2014;42(10):2479-2486
37) Mucha, A., Fedor, S., & DeMarco, D. (2018). Vestibular dysfunction and concussion. Sports Neurology, 158, 135–144. https://doi.org/10.1016/b978-0-444-63954-7.00014-8
38) Quatman-Yates et al. Physical Therapy Evaluation and Treatment after Concussion/Mild Traumatic Brain Injury. *JOSPT*. 2020:50(4)
39) Reneker JC, Hassen A, Phillips RS, et al. Feasibility of early physical therapy for dizziness after a sports-related concussion: a randomized clinical trial. Scand J Med Sci Sports, 2017;27:2009-18
40) Scheiman M. Understanding and Managing Visual Deficits After TBI. San Diego, CA 2015
41) Scheiman M. *Understanding and Managing Vision Deficits: A Guide for Occupational Therapists*. 2nd ed. Thorofare, NJ: Slack Inc; 2002.
42) Sharp DJ, Jenkins PO. Concussion is confusing us all. *Pract Neurol*. 2015;15(3):172-186. http://doi.org/10.1136/practneurol-2015-001087.
43) Skop, K. Traumatic Brain Injury and Concussions: An Advanced Vestibular-Balance Course. 2015 June 27-28; Las Vegas, NV: North American Seminars Inc.
44) Sophie Su YR, Veeravagu A, Grant G. Neuroplasticity after Traumatic Brain Injury. In: Laskowitz D, Grant G, eds. *Translational Research in Traumatic Brain Injury*. Boca Raton, FL: CRC Press/Taylor and Francis Group; 2016.
45) Sufrinko AM, Kegel NE, Mucha A, Collins MW, Kontos AP. History of High Motion Sickness Susceptibility Predicts Vestibular Dysfunction Following Sport/Recreation-Related Concussion. *Clin J Sport Med*. 2019;29(4):318-323. doi:10.1097/JSM.0000000000000528
46) Sussman ES, Ho AL, Pedharkar AV, Ghajar J. Clinical evaluation of concussion: the evolving role of oculomotor assessments. *Neurosurg Focus*. 2016;40(4):E7. http://doi.org/10.3171/2016.1.FOCUS15610.
47) Treleaven, J. (2017). Dizziness, unsteadiness, visual disturbances, and sensorimotor control in traumatic neck pain. *Journal of orthopedic & sports physical therapy*, *47*(7), 492-502.
48) Ventura RE, Balcer LJ, Galetta SL. The concussion toolbox: the role of vision in the assessment of concussion. *Semin Neurol*. 2015;35(5):599-606. http://doi.org/10.1055/s-0035-1563567.
49) Wong, C. K., Ziaks, L., Vargas, S., DeMattos, T., & Brown, C. (2021). Sequencing and integration of cervical manual therapy and vestibulo-oculomotor therapy for concussion symptoms: retrospective analysis. *International journal of sports physical therapy*, *16*(1), 12.
50) Wortzel HS, Frey KL, Anderson CA, Arciniegas DB. Subtle neurological signs predict the severity of subacute cognitive and functional impairments after traumatic brain injury. *J Neuropsychiatry Clin Neurosc*. 2009;21(4);463-466. http://doi.org/abs/10.1176/jnp.2009.21.4.463.
51) Ziaks, L., Giardina, R., & Kloos, A. (2019). Integration of Vision and Vestibular Therapy for Vestibulo-Ocular Post-Concussion Disorder–A Case Study. *Internet Journal of Allied Health Sciences and Practice*, *17*(3), 11.
52) Ziaks L, Brown C, Iversen M. (2021) Physical Examination Findings in Patients with Protracted Concussion and the Impact of an Integrative Concussion Rehabilitation Protocol. The Internet Journal of Allied Health Sciences and Practice. Jan 01;19(1), Article 6.
53) Ziaks, L., Tucker, J., Koc Jr., T., Dowdell, M., Giorello, G. (2024). "A Novel Approach to Integrative Concussion Rehabilitation: A Pragmatic Study". *Physical Medicine and Rehabilitation - International*. (11) 1: 1222.

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