Vestibular vs Vision

When to Refer to PT vs OT?

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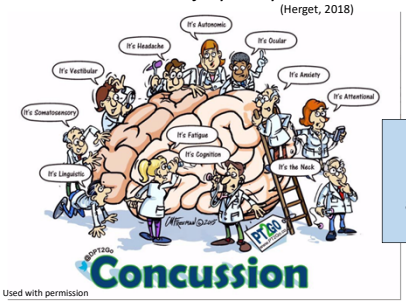
Objectives

- Identify common visual and vestibular deficits associated with concussion
- Identify multiple methods to screen for vision and vestibular dysfunction
- Identify appropriate referrals to assist with addressing dysfunction to assist with return to activity

"Concussion is an injury of dysfunction in functional environments"
(Herget, 2018)



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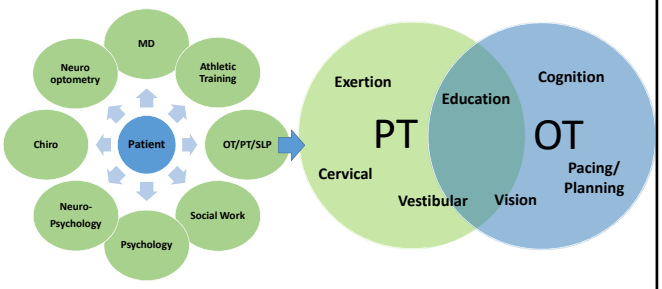
Determining the driver/drivers of the dysfunction and the appropriate treatment is the challenge

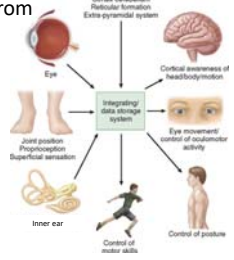
Multi-disciplinary Care-our specialties



The Systems Work Together

- To maintain balance and navigate space in our physical world, we must organize and integrate information from
  - Vision (eyes)
  - Vestibular (inner ear)
  - Proprioception (muscles and joints)

Cervical receptors provide important input to the vestibular, visual and sensorimotor control systems.



Vestibular

Impairments of the vestibular system— affect the ability to detect and interpret motion, maintain balance, coordinate head and eye movements, and stabilize vision when in motion.

Common after concussion:
- VOR impairment
- VOR cancellation impairment
- Balance Impairment
- BPPV

Athletes following sports related concussion

TEST	% Reporting Symptoms
Horizontal VOR	61%
VOR Cx (Visual Motion)	49%

Mucha, 2014

Visual

Impairments of the visual system- affect the ability to follow a target, shift eyes from target to target, maintain focus, perceive depth, and maintain awareness of surroundings

Common after concussion:

- Tracking impairment (pursuits, saccades)
- Teaming impairment (convergence, divergence)
- Eye focusing impairment (accommodation)

Vision Diagnoses After Concussion in Adolescents

69% had 1 or more of below	
Accommodative disorder	51%
Convergence insufficiency	49%
Saccadic dysfunction	46%
>1 vision diagnosis	46%

Master, Scheimann et al, 2016

Eye dysfunction following mTBI in active duty

	mTBI	Controls
Vertical Misalignments	55%	5%
Horizontal Misalignments	45%	5%
Accommodative Dysfunction	65%	15%
Convergence insufficiency	55%	5%

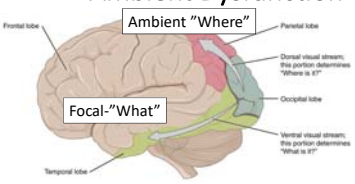
Capo-Aponte, 2012

Athletes following sports related concussion

TEST	% Reporting Symptoms
Horizontal Saccades	42%
Near Point Convergence	34%
Vertical Saccades	33%
Smooth Pursuits	33%

Mucha, 2014

Ambient Dysfunction



Over-focalization "focal binding"

-Compromises preconscious/proactive relationship between ambient, vestibular and proprioception
-Difficulty anticipating and navigating environment

Ambient	Focal
20% of visual processing -Spatial vision -Dorsal Stream -Processes visual motion -Fast Speed Processing -Large Receptive field **Interacts with other sensory systems**	80% of visual processing -Central vision -Ventral Stream -Details and color identification -Slow Speed Processing -Small receptive field

With limited visual field

With full peripheral vision

Deficits in one can impact another

- **Visual issues can impact vestibular functioning**
  - Good binocular functioning is critical to maintaining the accuracy of the VOR
  - VOR training performed prior to obtaining adequate visual skills can exacerbate symptoms of dizziness and/or nausea
- **Vestibular issues can impact visual functioning**
  - Over reliance on vision secondary to underlying vestibular dysfunction contributes to visual fatigue and difficulty in visually challenging environments
  - Visual training without integration of vestibular and proprioception training will result in decompensation of skills when functional movement is attempted

Vestibular Ocular Motor Screen (VOMs)

Vestibular/Ocular-Motor Screening (VOMS) for Concussion

Vestibular/Ocular Motor Test:	Not Tested	Headache 0-10	Dizziness 0-10	Nausea 0-10	Fogginess 0-10	Comments
BASELINE SYMPTOMS:	N/A					
Smooth Pursuits						
Saccades – Horizontal						
Saccades – Vertical						
Convergence (Near Point)						(Near Point in cm): Measure 1:_____ Measure 2:_____ Measure 3:_____
VOR – Horizontal						
VOR – Vertical						
Visual Motion Sensitivity Test						

Vision

Vestibular

Monitor for: Symptoms, Quality of movements, Compensation strategies

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Beyond the VOMS

- Personal and family medical history
- Symptom reports
- Balance screen
- Targeted activity questions
- Observation
- Additional testing

"Assessing SRC should be comprehensive and multimodal, incorporating not only vestibular and oculomotor screening but also a comprehensive clinical interview and medical history and neurocognitive, balance, and other assessments" Collins, 2014

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Personal and family medical history

- Risk factors
  - Vestibular
    - History of motion sensitivity
  - Vision
    - History of strabismus or lazy eye
- Additional questions
  - Last eye exam (consistent use of corrective lenses)
  - Hx of monovision, eye surgery or patching
  - Hx of learning disability
  - Hx of migraines
- Medication review

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Common Symptoms

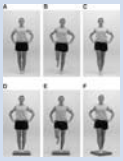
Vision	Vestibular
Headache (frontal)	**Dizziness**
Blurring/Double Vision	Fogginess
Light Sensitivity	Nausea
Fatigue	Feeling Slowed down
Difficulty Concentrating	Visual Blurring (w/mvmt)
Memory Dysfunction	Balance Problems
Fogginess	Fatigue

Targeted Symptom Scales

Vision	Vestibular
Convergence Insufficiency Scale/ ABI questionnaire	Dizziness Handicap Inventory (DHI)
Visual Vertigo Analogue Scale	

Balance Screen

BESS	Modified Romberg
6 conditions Scored accumulation of points Norms by age 20 secs, eyes closed, hands on hips Point Hands off hips Open Eyes Step, stumble, fall Abd>30 Forefoot/head lifted Out of position>5"	4 conditions Scored pass/fail Can complete each 2x Fail Needing to open eyes Moving their arms or feet Beginning to fall Can also include time to fail measurement



Test Condition	Description	Sensory inputs
1	Eyes open, firm surface	Visual, proprioceptive, vestibular
2	Eyes closed, firm surface	Proprioceptive, vestibular
3	Eyes open, compliant surface	Visual, vestibular
4	Eyes closed, compliant surface	Vestibular only

Targeted Activity Questions

- Vestibular
  - "Do you experience symptoms when looking up/down, turning your head, walking down a busy hallway?"
  - "Do you have difficulty closing your eyes in the shower or reaching down to tie your shoes?
  - "Do you have difficulty getting in and out of bed or rolling in bed?"
- Vision
  - "Do you experience headaches, blurred or double vision when reading or using the computer?
  - "Do you notice significant fatigue when completing school work-math and science?"
  - "Difficulty shifting focus from the board to your notes?"
  - "Do your headaches increase throughout the day?"
  - "Do you notice tunneling of your vision or running into things?"

Any activities that you are avoiding?

Observation

- Head tilt/face turn/chin elevation or depression
- Navigation of the room and clinic
  - Watching their feet, touching walls, stopping when people pass
- Avoidance of head movements or body movement
- Difficulty with changes in light
- Frequent shifting of gaze

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Additional Testing

Vision	Vestibular
DEM/ADEM/King Devick	DVA
Cover/Uncover/Cross Cover	Head Thrust
Maddox Rod	DGI/TTG
Confrontation testing	Fukuda Step Test
Amplitude of accommodation	Dix Hallpike
EOMs with gaze holding	

Computerized Neurocognitive Test

Vision	Vestibular
Deficits with reaction time Deficits with visual memory (encoding rather than retrieval)	Deficits primarily with Visual Motor Speed

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Other considerations

- Cervical
  - Cervical injury disrupts sensory integration between vision, vestibular, and proprioception
  - Injury to the cervical spine can lead to dizziness, vertigo, visual disturbance, gait instability, motion sensitivity, fogginess, and postural imbalance" (Ellis, 2018)
  - Pain or decreased ROM further stresses the visual system as it attempts to compensate
- Anxiety
  - Generally normal vision and vestibular testing, but c/o symptoms with testing
  - Extended stress can increase light sensitivity, blurred vision and loss of peripheral awareness
- Migraine
  - Co-exists frequently with vestibular and/or anxiety subtype
  - Causes visual disturbances, light sensitivity, headache, nausea/vomiting

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Summary

- Vision and vestibular dysfunction are common following concussion and have been identified as factors that can prolong recovery
- A normal functioning VOR is dependent on a normal functioning visual system
- Skills must be integrated in order to function properly.
- Vision (OT) and vestibular (PT) dysfunction can be treated through active rehabilitation to assist with return to previous activities
- Cervical, anxiety and migraine can also impact vision/vestibular functioning and should be considered during screening

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