POST-CONCUSSION REHABILITATION

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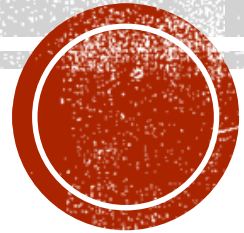


- No financial disclosures

OBJECTIVES

1. Describe various symptoms of Concussion
2. Describe some risk factors that contribute to prognosis
3. Recognize when a referral is warranted
4. Be Aware of the components of a Vestibular-Ocular Motor Screen
5. Identify Concussion Subtypes
6. Become Familiar with the 3 Systems of Balance and the CTSIB
7. Understand the components of exertional training as they relate to individual treatment plans
8. Be able to identify appropriate rehabilitation interventions, and progressions Post-Concussion
9. Describe the Return to Play protocol

FORCES CAUSING CONCUSSION

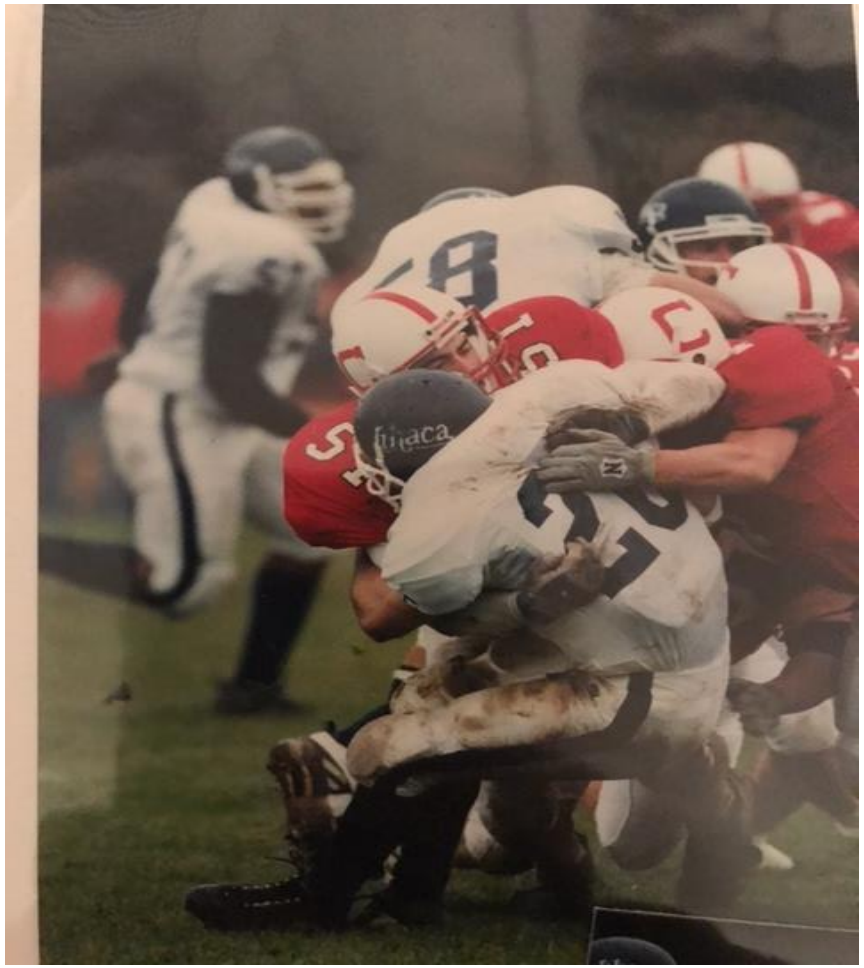
- **Linear Acceleration**
  - Various studies have looked at correlating the amount of impact with linear acceleration to injury threshold by looking at brain pressure during the peak acceleration, and the associated internal response (brain pressure) to the external forces
  - It was established that the increase in pressure in the brain leads to neurological dysfunction, with the level of dysfunction being a linear relationship to the level of pressure in the brain.

- **Rotational Acceleration**: occurs with most head impacts and results in a shear force
- Shear Forces create more tissue damage and is the predominant mechanism of injury with concussions

COMBINATION OF FORCES

- Considering the combination of head and neck movements at the time of a blow, and the type of force - each concussion is unique.

- Secondary to each concussion being unique, the associated treatment is 100% situational, and most often requires a team of healthcare professionals working together.



HOW DO WE IDENTIFY A CONCUSSION?

- Conventional imaging – MRI and CT scan are largely ineffective in recognizing and diagnosing concussions
- Research is showing some promise through investigation of the use of fMRI (abnormal cerebral blood flow volume), diffusion tensor imaging, single-photon emission computed tomography (abnormalities of brain blood flow), and some others
- Currently it is the presence of signs and symptoms that diagnose a concussion

SIGNS AND SYMPTOMS

- Signs: Loss of Consciousness, Post-Traumatic Amnesia
- Symptoms: Dizziness, Headaches, Nausea, Balance Problems, Fatigue, Fogginess, Loss of Sleep, Drowsiness, More Emotional than Usual, Irritability, Sadness, Difficulty Concentrating, Difficulty Remembering, and Visual Problems to name a few
  - Post-Concussion Symptom Scale

POST CONCUSSION SYMPTOMS SCALE

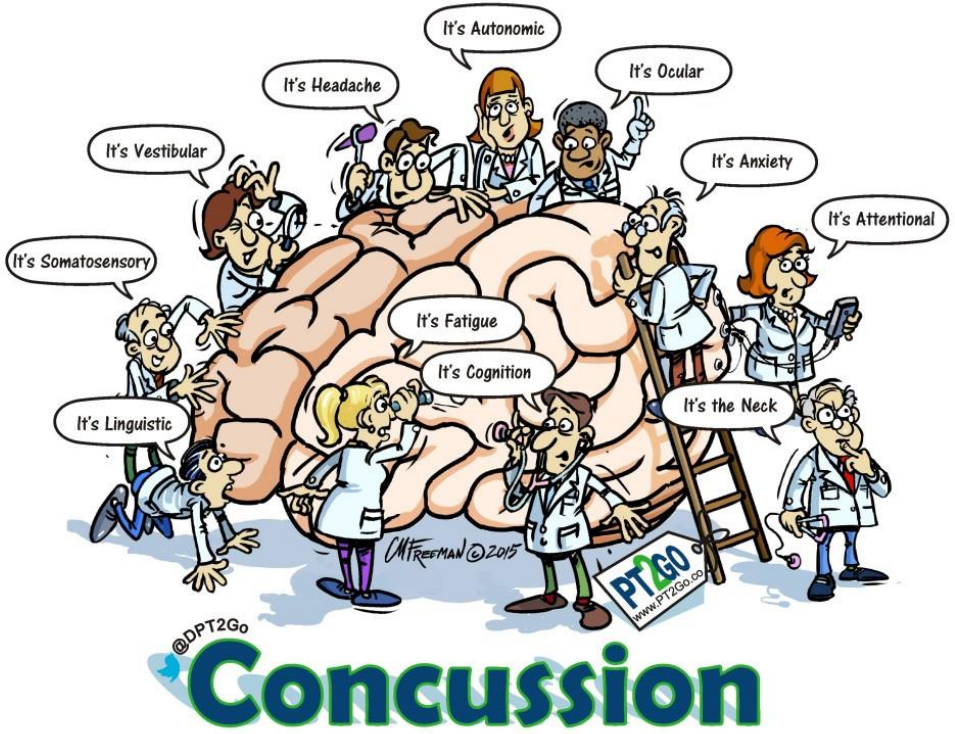
	Symptoms	none	mild		moderate		severe	
Physical	Headache	0	1	2	3	4	5	6
	Nausea	0	1	2	3	4	5	6
	Vomiting	0	1	2	3	4	5	6
	Balance Problems	0	1	2	3	4	5	6
	Dizziness	0	1	2	3	4	5	6
	Visual Problems	0	1	2	3	4	5	6
	Fatigue	0	1	2	3	4	5	6
	Sensitivity to Light	0	1	2	3	4	5	6
	Sensitivity to Noise	0	1	2	3	4	5	6
	Numbness/Tingling	0	1	2	3	4	5	6
Thinking	Feeling Mentally Foggy	0	1	2	3	4	5	6
	Feeling Slowed Down	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
Sleep	Drowsiness	0	1	2	3	4	5	6
	Sleeping Less than Usual	0	1	2	3	4	5	6
	Sleeping More than Usual	0	1	2	3	4	5	6
	Trouble Falling Asleep	0	1	2	3	4	5	6
Emotional	Irritability	0	1	2	3	4	5	6
	Sadness	0	1	2	3	4	5	6
	Nervousness	0	1	2	3	4	5	6
	Feeling more Emotional	0	1	2	3	4	5	6
Pain other than Headache		0	1	2	3	4	5	6

DIAGNOSIS – MOVING TARGET

- No Clear Diagnosis
- No specific timeline of onset: symptoms may be immediate or delayed, making it difficult to recognize that the symptoms may be secondary to the concussion
- No single assessment or diagnostic tool
- Clinical Impression is the Gold Standard

POST-CONCUSSION SYNDROME

- Most concussion symptoms resolve after a couple of days or weeks
- No Clear Timeframe defined for PCS
- These are the people that especially need to be referred for further treatment and evaluation
- The severity of the concussion does not appear to be directly related to developing the syndrome



RISK FACTORS FOR PROGNOSIS AND PROLONGED RECOVERY

Female

History of Depression

Prior Concussions

Learning Disability

Cervical Spine Dysfunction

History of Anxiety

History of Migraines

Initial c/o Dizziness

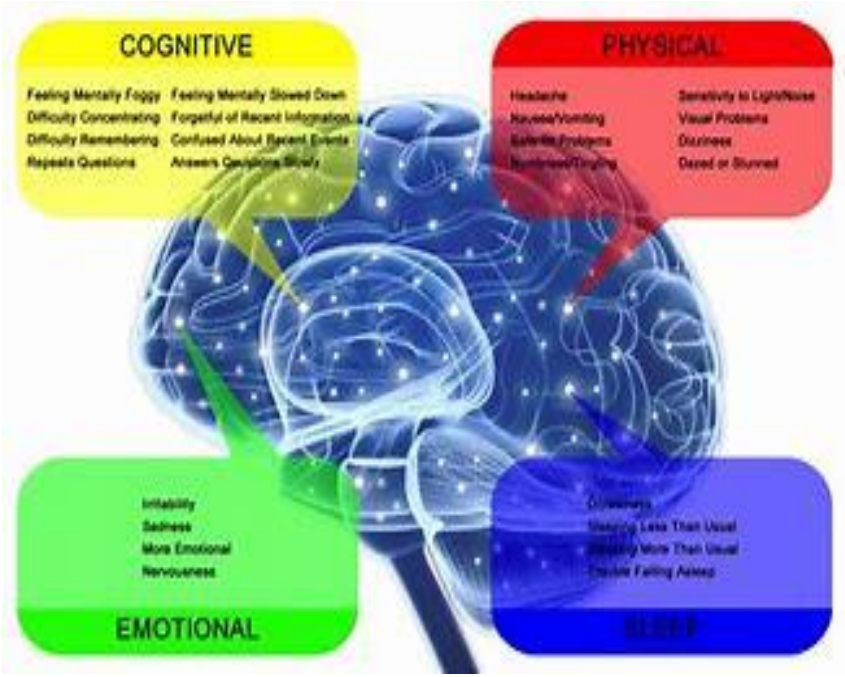
Age

POST-CONCUSSION REHABILITATION

- Early rehabilitation will overlap with Return to Learn protocol for most athletes
- Rule of Three
- Consider the environment of the treatment session
- Each Post-Concussion Disorder is described by persistent pathophysiological alterations in specific neurological sub-systems

CONCUSSION SUBTYPES

- Vestibular
- Ocular
- Post-Traumatic Migraine
- Cervical
- Anxiety/Mood
- Cognitive/Fatigue
- Subtypes RARELY occur in isolation, and often overlap



THE IMPORTANCE OF RECOGNIZING THE CERVICAL SPINE IN CONCUSSION RECOVERY

- The challenges with diagnosis:
  - Similar Mechanism of Injury
  - Limited Clinical tests for diagnosing cervical symptoms in patients that have sustained a concussion
  - Nearly undistinguishable Symptoms
- Therefore symptoms and causes alone may not be sufficient enough to distinguish between a patient with a concussion, and a patient with a cervical injury
- Differentiating between a concussive pathology versus a cervical injury is vital for timely and appropriate intervention

RECOGNIZING THE CERVICAL SPINE IN CONCUSSION RECOVERY

Signs and Symptoms		Concussion	Cervical Injury
Headache	Irritability	x	x
Neck Stiffness	Sleep Disturbance	x	x
Tinnitus	Blurred Vision	x	x
Dizziness	Depression	x	x
Balance Disturbance	Memory Deficits	x	x
Decreased Isometric Cervical Strength	Cognitive and Attention Deficits	x	x
Chronic Traumatic Encephalopathy		x	
Decreased C-spine ROM			x

CERVICAL SPINE DYSFUNCTION FOLLOWING PEDIATRIC SPORTS-RELATED HEAD TRAUMA

- Ellis et al: study of 246 patients diagnosed with sport-related concussion 32.5% met criteria for a cervical spine dysfunction as well
- More Females than Males identified – 42.5% vs. 24.1%
- No significant difference found with age (study range 9-19 years old)
- Patients with both diagnoses:
  - Higher PCSS scores
  - More likely to demonstrate subjective and objective findings of vestibulo-ocular dysfunction
  - Exercise Intolerance with graded aerobic treadmill testing: 24.1%
  - Significantly longer recover times

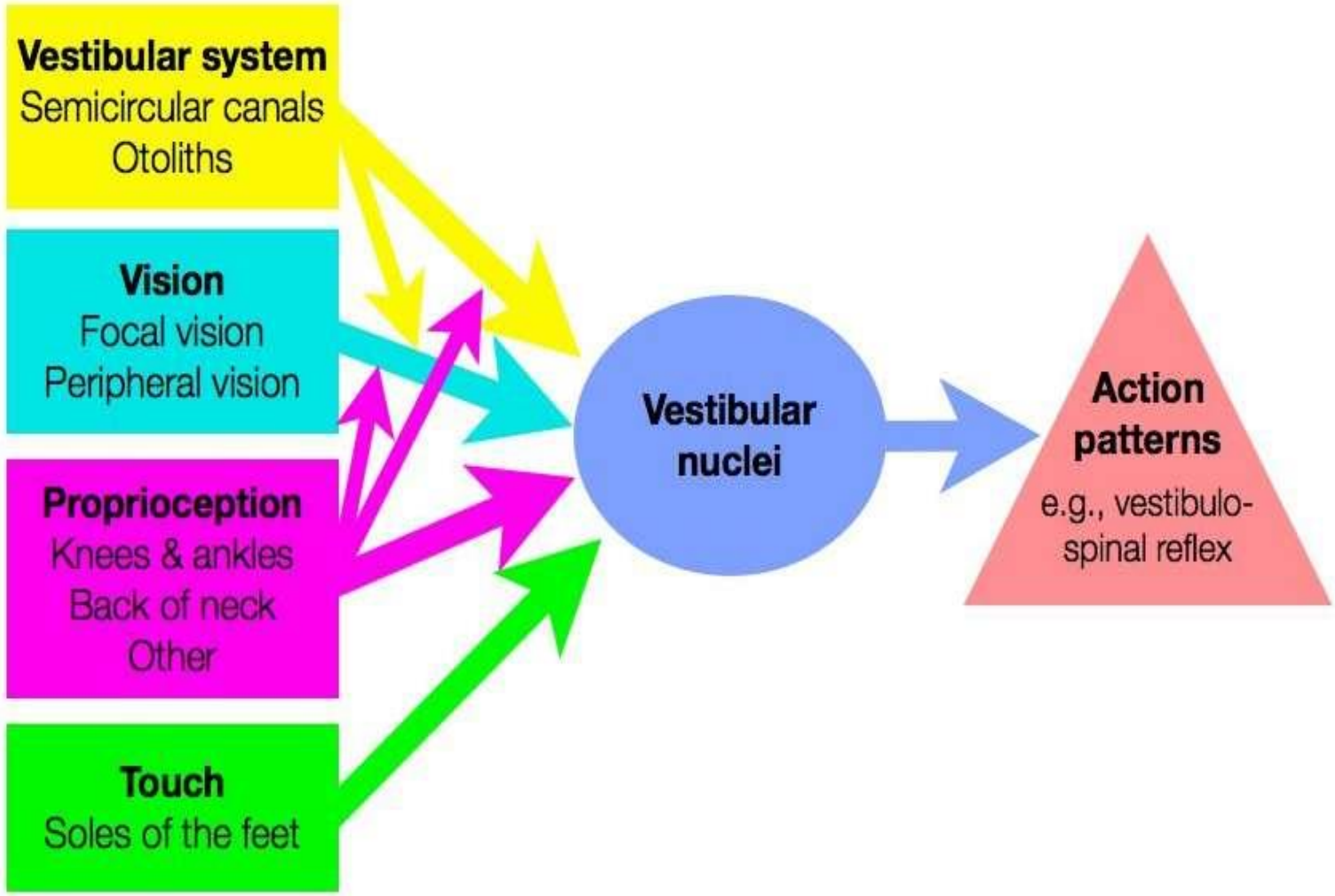
CERVICOGENIC OR VESTIBULAR?

- Head-Neck Differentiation Test
  1. Stabilize head and rotate body on the swivel chair
  2. Cervical Spine AROM right and left rotation
  3. Rotate head and body en block on the swivel chair

- Smooth Pursuit Neck Torsion Test
  - Assess if cervical spine is contributing to sense of dizziness and imbalance, or isolated vestibular
  - Smooth pursuit in midline, and at right and left 45 deg rotation

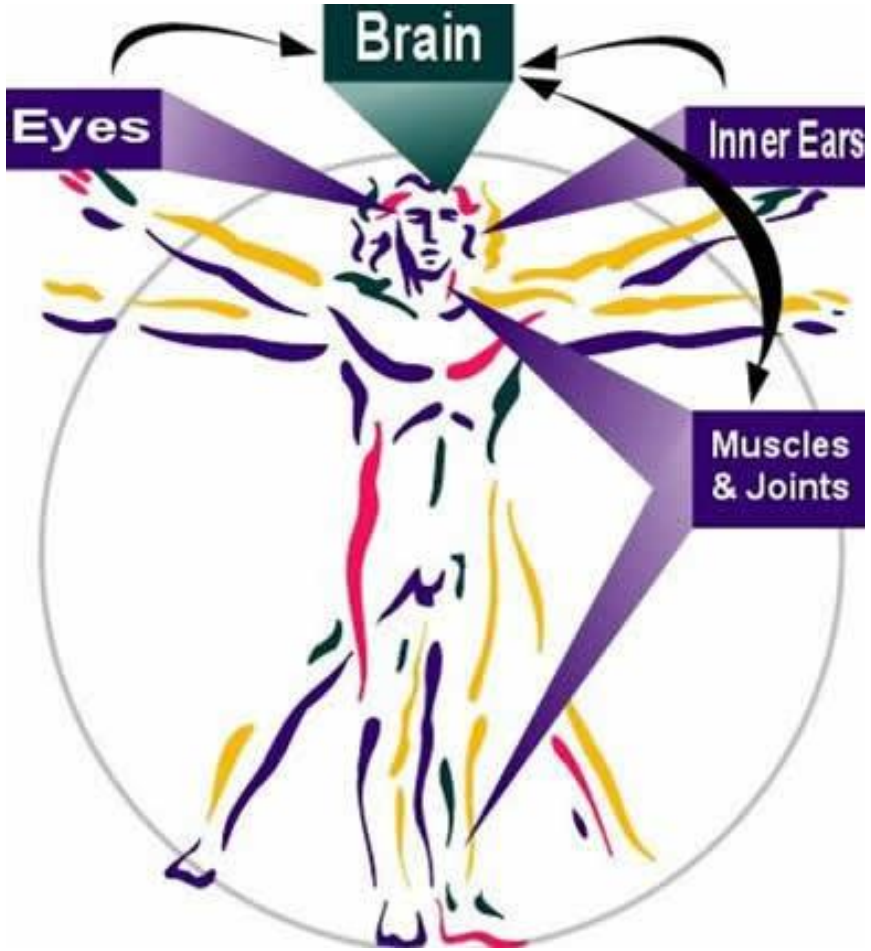
THE SYSTEMS OF BALANCE

- Vestibular System
- Visual System
- Somatosensory System



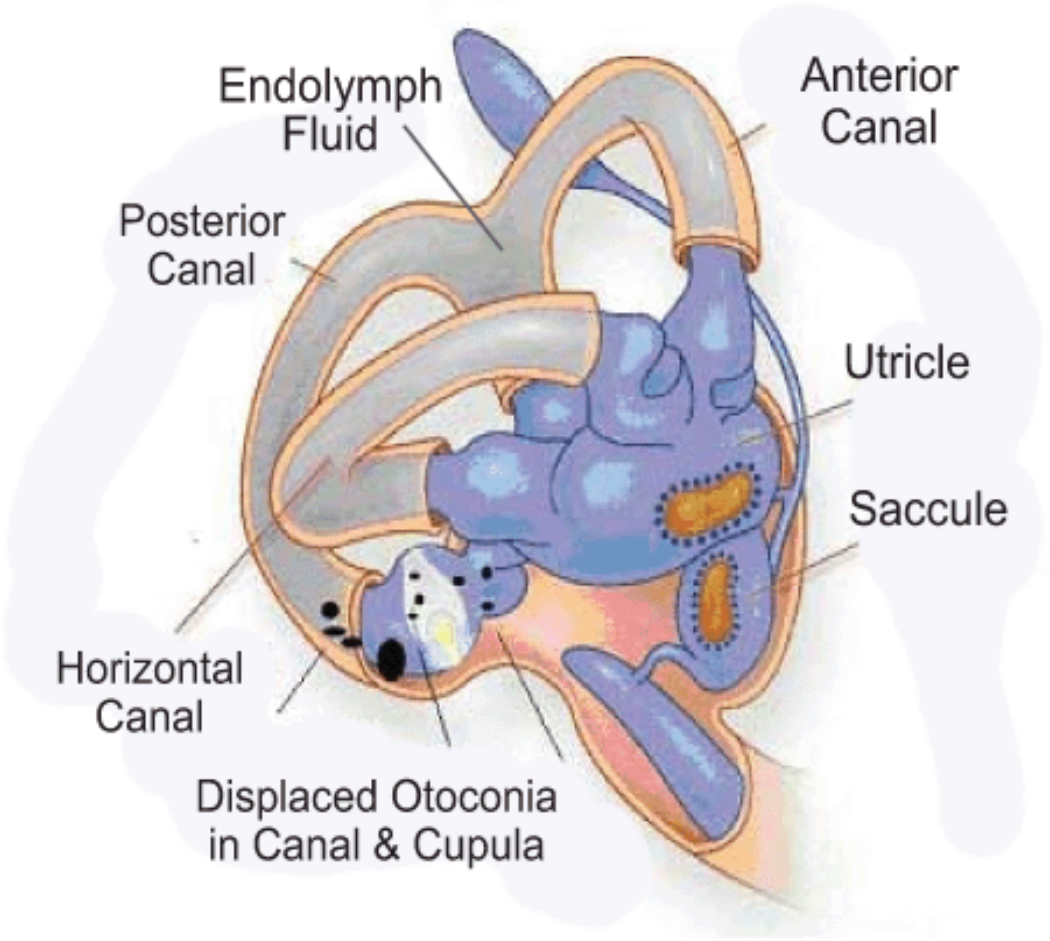
THE VESTIBULAR SYSTEM

- What does this system do?
  - Senses head motion in order to assist with maintaining posture
  - Stabilizes images on the fovea of the retina during movement of the head



THE VESTIBULAR SYSTEM

- Otolith Organs
  - Utricle and Saccule
    - Head's linear motion
    - Head's position relative to gravity
- Semi-Circular Canals: detects head's rotation
  - Anterior Canal
  - Posterior Canal
  - Horizontal Canal



Motion is converted into Neural Activity

VESTIBULAR-OCULAR MOTOR SCREENING

Brief assessment of the visual and vestibular systems

- Smooth Pursuits
- Saccades
- Near Point Convergence
- Vestibular Ocular Reflex (VOR)
- Visual Motion Sensitivity

SMOOTH PURSUITS

- Test ability to follow a slow moving target
- Examiner holds finger 3 feet distance in front of patient
- Horizontal – 1.5 feet to the right and to the left
- Vertically – 1.5 feet up and down
- Perform two repetitions each
- Record Symptoms

SACCADES

- Tests Ability to move eyes quickly between targets
- Horizontal - Examiner holds two points 3 feet in front of patient, at 1.5 feet distance each direction from midline (allowing for 30 deg gaze to right and left)
- Vertical – Examiner holds two points 3 feet from patient, 1.5 feet distance above and below midline (allowing for 30 deg gaze angle above and below midline)
- Perform 10 repetitions each
- Record Symptoms

NEAR POINT CONVERGENCE

NEAR POINT CONVERGENCE

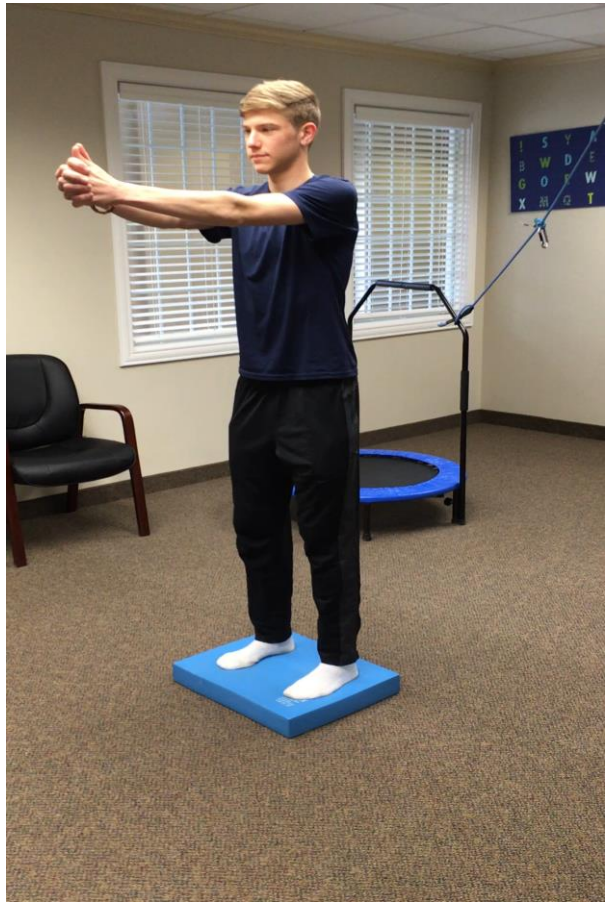
- Measures ability to view near point target without double vision
  - Ability of the eyes to move simultaneously and equally in an opposite direction
- Target at arms length in front of nose and move slowly toward nose with instruction to stop when vision of target zippers (becomes two distinct images)
- Measure the distance from tip of the nose to the target
- Goal Distance: Less than 6 cm
- Record Symptoms

VESTIBULAR-OCULAR REFLEX (VOR)

- Assesses ability to stabilize gaze with simultaneous head movements
- Target at 3 feet distance from patient
- Horizontal: rotation of head to the right and left 20 deg from midline
- Vertical: nodding head up and down 30 deg from midline
- Speed of Movement: 180 bpm (one beat each direction)
- Perform 10 repetitions each direction
- Record Symptoms

VISUAL MOTION SENSITIVITY

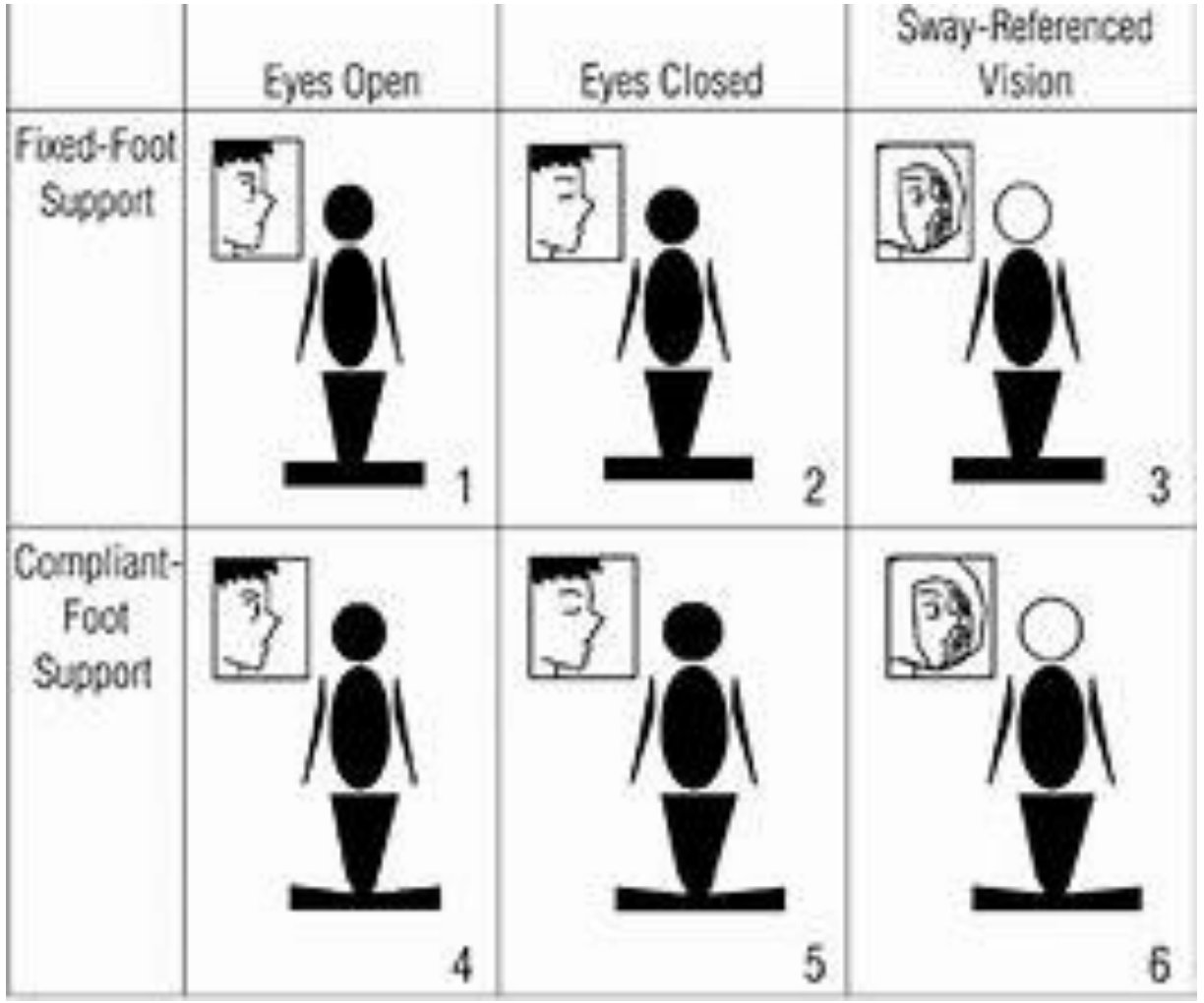
- Tests visual motion sensitivity and the ability to inhibit vestibular motion response with the use of vision/gaze stabilization
- Patient stands with feet at shoulder width, arms outstretched with hands clasped, focus on the thumb
- Rotate head, trunk, and arms altogether to right and left 80 deg, at 50 bpm (one beat each direction)
- 5 repetitions
- Record symptoms



ASSESSING POSTURAL CONTROL

- BESS Test
- CTSIB
- Computerized Posturography - Sensory Organization Test

CTSIB


Eyes Open
Eyes Closed
Sway-Referenced Vision
Fixed-Foot Support
Compliant-Foot Support
1
2
3
4
5
6

CTSIB – GUIDELINE FOR TREATMENT

- Condition 1
  - All Senses: Vision greater than surface dominant
- Condition 2
  - Perform Well: Somatosensory dominant
  - Perform Poorly: Visually dependent, Vestibular Weakness
- Condition 3
  - Measures Visual Preference over Somatosensory
  - Perform Well: Somatosensory dominant
  - Perform Poorly: Visually Dependent

CTSIB – GUIDELINE FOR TREATMENT

- Condition 4
  - Performed Well: Vision is dominant
  - Perform Poorly: Somatosensory Dependent
- Condition 5
  - Predominantly measures function of Vestibular System
  - Perform Well: Vestibular System is dominant
  - Perform Poorly: More surface dependent than vision
- Condition 6
  - Predominantly measures function of Vestibular System
  - Perform Well: Vestibular System Dominant
  - Perform Poorly: More Vision Dependent than Surface

WHAT DOES THIS MEAN FUNCTIONALLY?

- Visually Dependent
- Surface Dependent
- Surface-Visual Dependent

MODIFIED BALKE TREADMILL PROTOCOL

- This protocol is used to identify a potential blood flow problem, and aerobic capacity following a concussion
- Also used to establish the threshold for aerobic/exertional activities

ADMINISTERING THE MODIFIED BALKE TREADMILL PROTOCOL

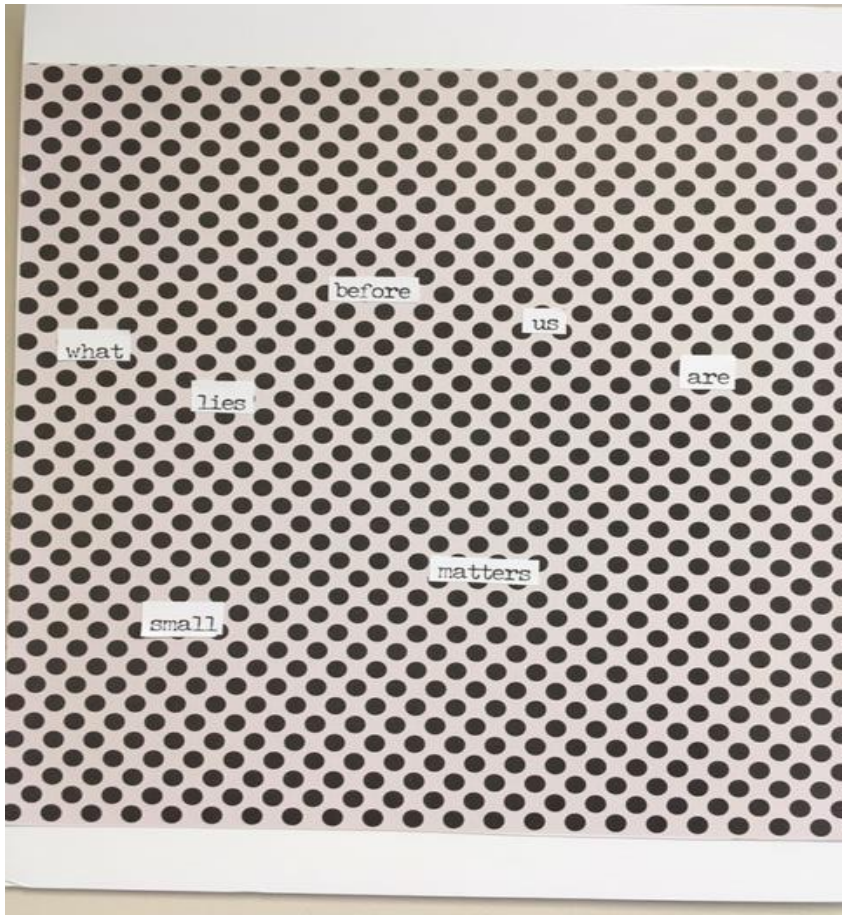
- For use with patients 14 years old and older
- Treadmill speed remains at 3.3mph (for Men), 3.0mph (for Women)
- Buffalo Concussion Treadmill Test indicates speed based on height – 3.6mph over 5'5", and 3.2mph for those under 5'5"
- Following the first minute increase the grade of the treadmill by 2%, and then each following minute increase the grade by 1%
- Document BP, HR, and RPE: prior to starting the test, the end of the test, and every 5 minutes during the test
- Administer the test until:
  - 15 minute test completion time
  - Patient reaches max HR (220-age)
  - First sign of symptom exacerbation
  - Patient reports exhaustion based on Borg Scale of RPE

USE OF TREADMILL TEST FOR TREATMENT

- Submaximal symptom threshold is identified
- Aerobic activity is performed at 80% of the submaximal threshold heart rate, 20 minutes/day, or until symptoms exacerbation
- Repeat test at 2-3 weeks to determine the new threshold level heart rate until symptoms are no longer exacerbated with the treadmill testing
- Aerobically when are we ready for return to play protocol?
  - Performing aerobic activity to 85-90% of age-predicted maximal HR for 20 minutes, without exacerbation of symptoms

GENERAL PROGRESSION GUIDELINE – VESTIBULO-OCULAR

- Dual Tasking
- Plain vs. Busy Background
- Speed
- Distance
- Stable vs. Unstable Surfaces



OCULAR SUBGROUP

- Symptoms
  - Eye strain, frontal headaches, difficulty with visually dominant activity
  - Blurred or double vision
  - Difficulty reading
- Signs
  - Trophia or Phoria with cover/uncover test
  - Deficits with convergence, divergence, or accommodation
  - Impaired smooth pursuits or saccades

OCULOMOTOR INTERVENTIONS

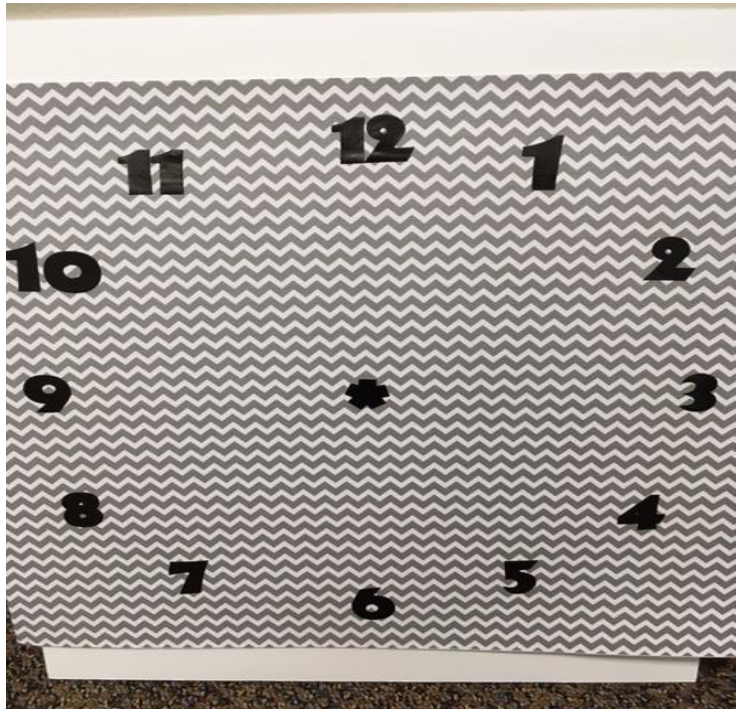
- EyeCanLearn.com
- Convergence Insufficiency:
  - Pencil Push-ups
  - Brock Strings
  - Marsden Ball
  - Use of any sports ball
- Saccades
  - Eye Clocks
  - Letter finding

OCULOMOTOR INTERVENTIONS

- Vestibular Ocular Reflex: VORx1, VORx2
- Visual Conflict: Ball Arcs, Visual Motion Sensitivity
- Smooth Pursuits: following a moving object
  - Eye Maze
  - Following a moving object on a screen, or watching a ball game and stabilize gaze on moving ball or puck
  - Disco Ball
  - Laser on a wall
  - Ball Tosses

OCULOMOTOR EXERCISES

Eye Clock



Saccade Chart

OCULOMOTOR EXERCISE

Eye Maze

Marsden Ball

GOALS FOR VESTIBULAR REHAB

- Improve stability of gaze with head movements
- Decrease sensitivity to motion
- Improve static and dynamic postural stability
- Principles of Rehabilitation:
  - Adaptation
  - Habituation
  - Substitution

SPECIFIC INTERVENTIONS FOR VESTIBULAR HYPOFUNCTION

- 7 head positions
- Jumping : vertically, laterally, single leg, double leg, jumping on trampoline, performing with eyes opened and eyes closed
- Bed Mobility Positional Changes: sidelying to sit, supine to sit, rolling in bed, eyes opened and eyes closed
- Head Turns: walking, running, eyes opened eyes closed, cutting and lateral movements
- Joint Position Error: this also gets into cervicogenic proprioception
- Keep in mind sport specific planes: inverted positions (handstand), flips, flies, tumbling

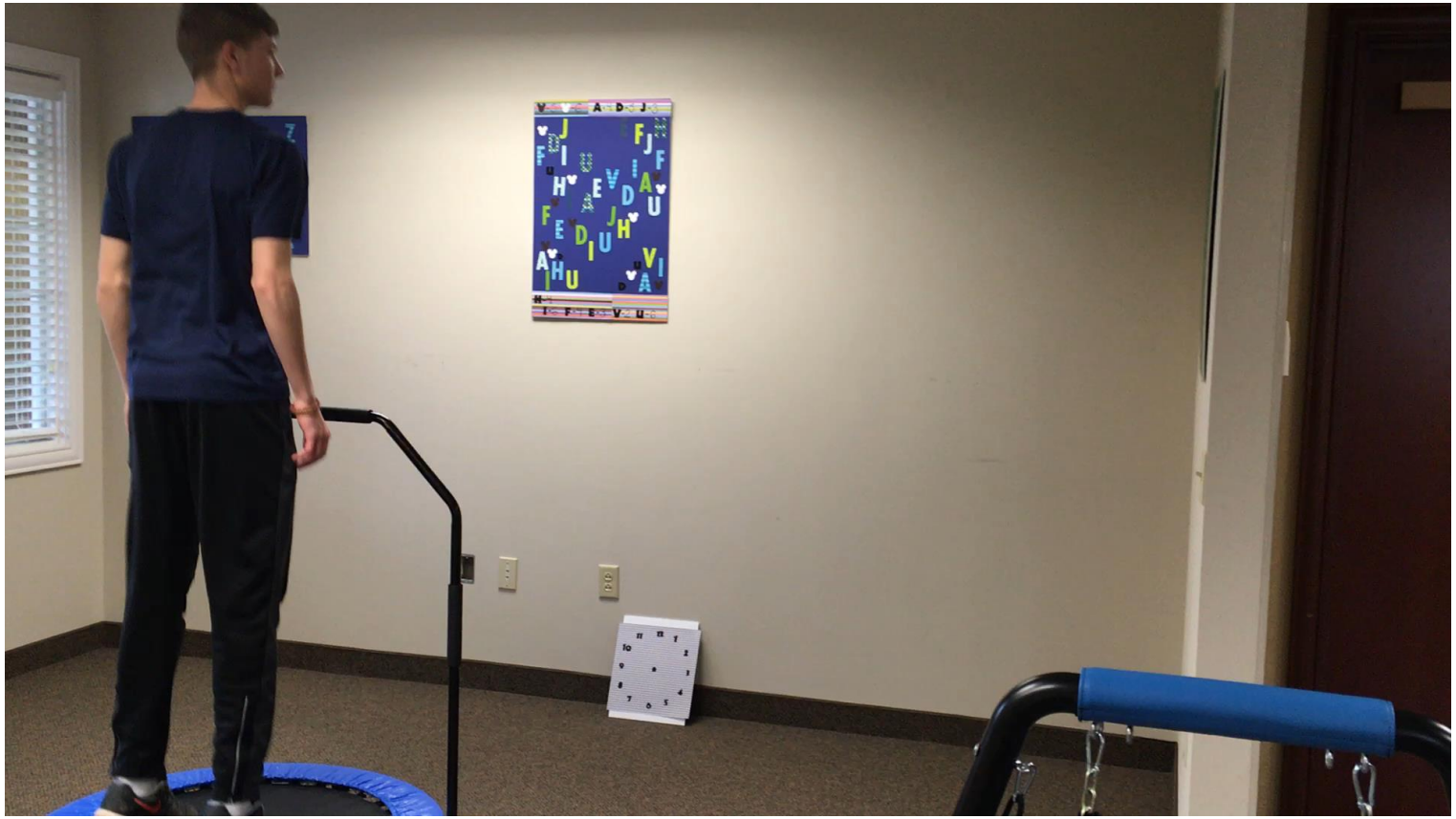
DUAL TASKING

- Challenge more than one system of balance, can also challenge aerobic capacity with dual tasking
- Weighting the Systems of Balance – use the findings from CTSIB assessment to guide this

SPORT SPECIFIC DUAL TASKING

- Sport Specific Tasks that encompass functional eye movements, changes in head position, cognitive challenges, and aerobic exertion

SPORT SPECIFIC DUAL TASKING



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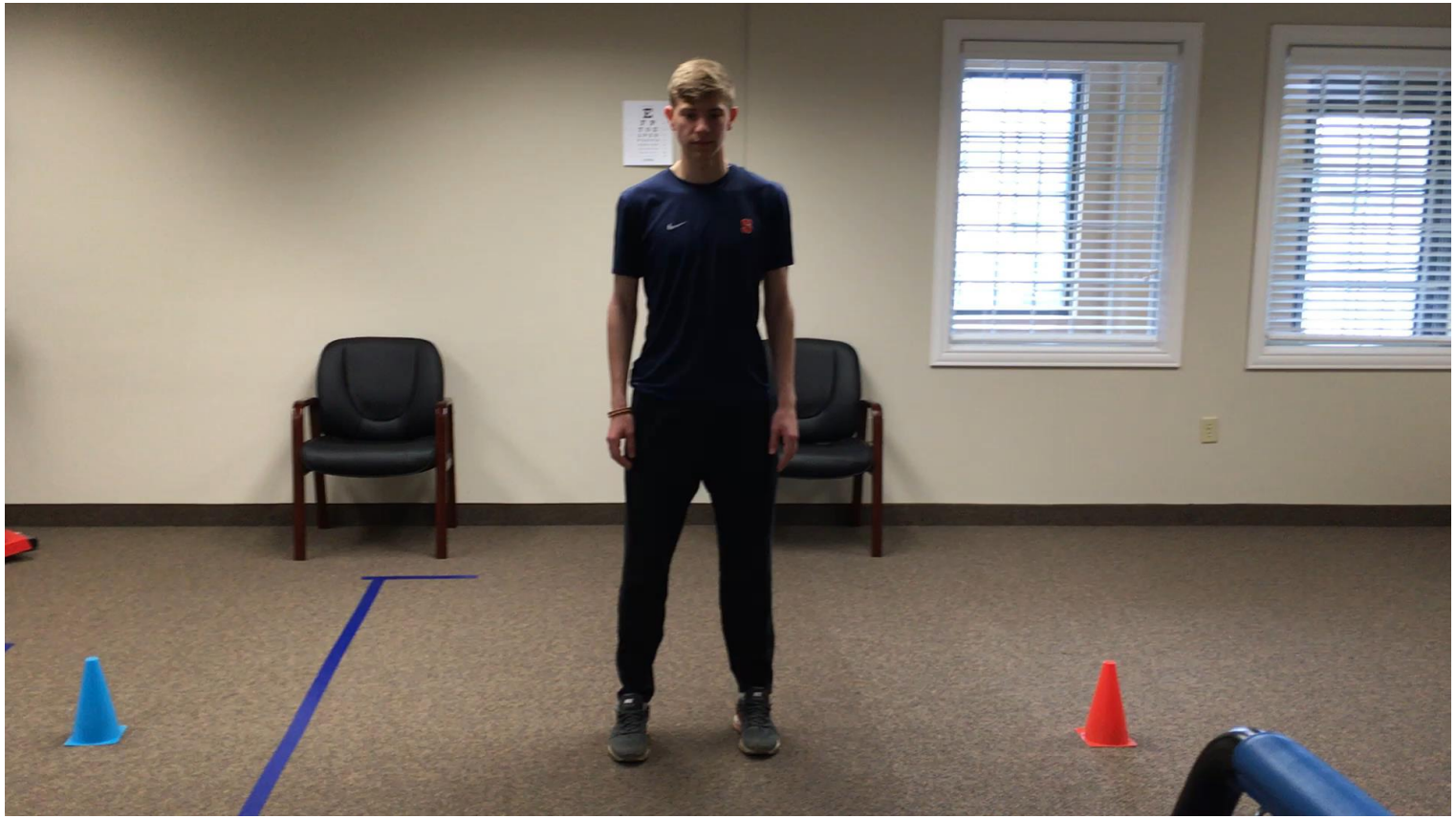

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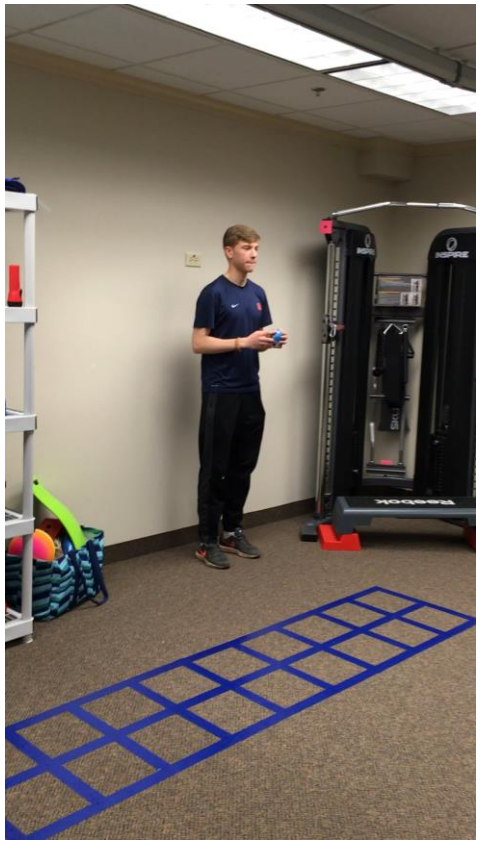

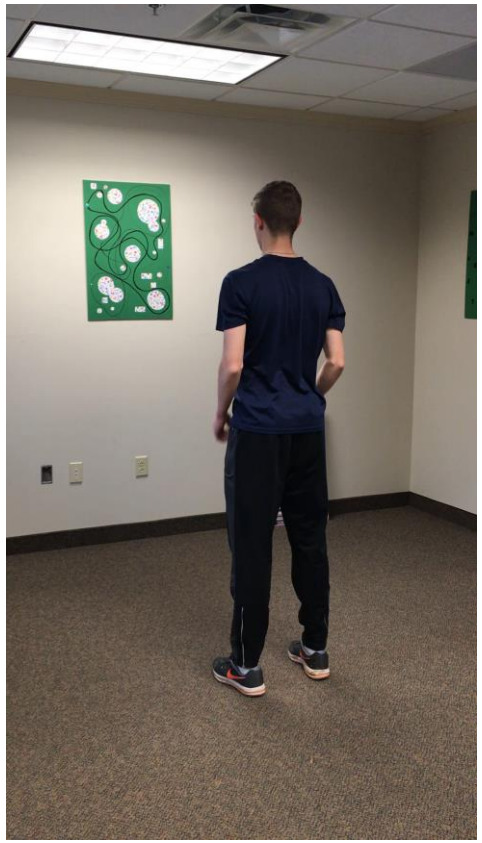

TREATMENT FOR BPPV

- Occurs in the canals of the inner ear
  - Horizontal Canal
  - Vertical Canals: Anterior and Posterior
- Positional Testing
  - Dix Hallpike Testing
  - Supine Roll Test
- Treatment
  - Posterior Canal
  - Horizontal Canal
  - Anterior Canal

RETURN TO PLAY PROGRESSION

1. **Light Aerobic Activity**: Return to School with minimal symptoms then progress to non-contact light aerobic activity – brisk walking, cycling, etc. No exacerbation of symptoms.
2. **Sport Specific Training**: Symptom-free in school and can tolerate light aerobic activity (no symptoms with treadmill testing) then start sport-specific training – moderate jogging/running, moderate intensity cycling, throwing a baseball, kicking a soccer ball, etc. No head impact activities
3. **Sport Specific Drilling**: No symptom exacerbation with sport specific activity progress to non-contact drilling and high intensity aerobic conditioning – sprinting, weight training program, and sport-specific drills
4. **Full contact Play**: start with practice, and then progress to games.

QUESTIONS?

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