

Vestibular Physiotherapy as a Treatment for Concussions and its Implications

SHALEEN SULWAY, PT

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Hertz Clinic for Meniere's Disease
and Vestibular Dysfunction



Dizziness after concussions

Post-traumatic dizziness or vertigo is one of the major complaints following head injuries (Davies and Luxon 1995; Luxon 1996; Nacci 2011)

Dizziness and unsteadiness is the second most commonly reported symptom (Meehan 2010)

Reported to occur in 23% to 81% of cases in the first days after injury (Griffiths 1979; Maskell 2006; Terrio 2009; Kontos 2012, Ellis 2015)

Dizziness was the sole on field factor predictive of protracted (>21d) time to recovery (Lau 2011)

Dizziness, Vertigo and Dysequilibrium

Dizziness: Vertigo, sense of lightheadedness, rocking or swaying, floating, dysequilibrium

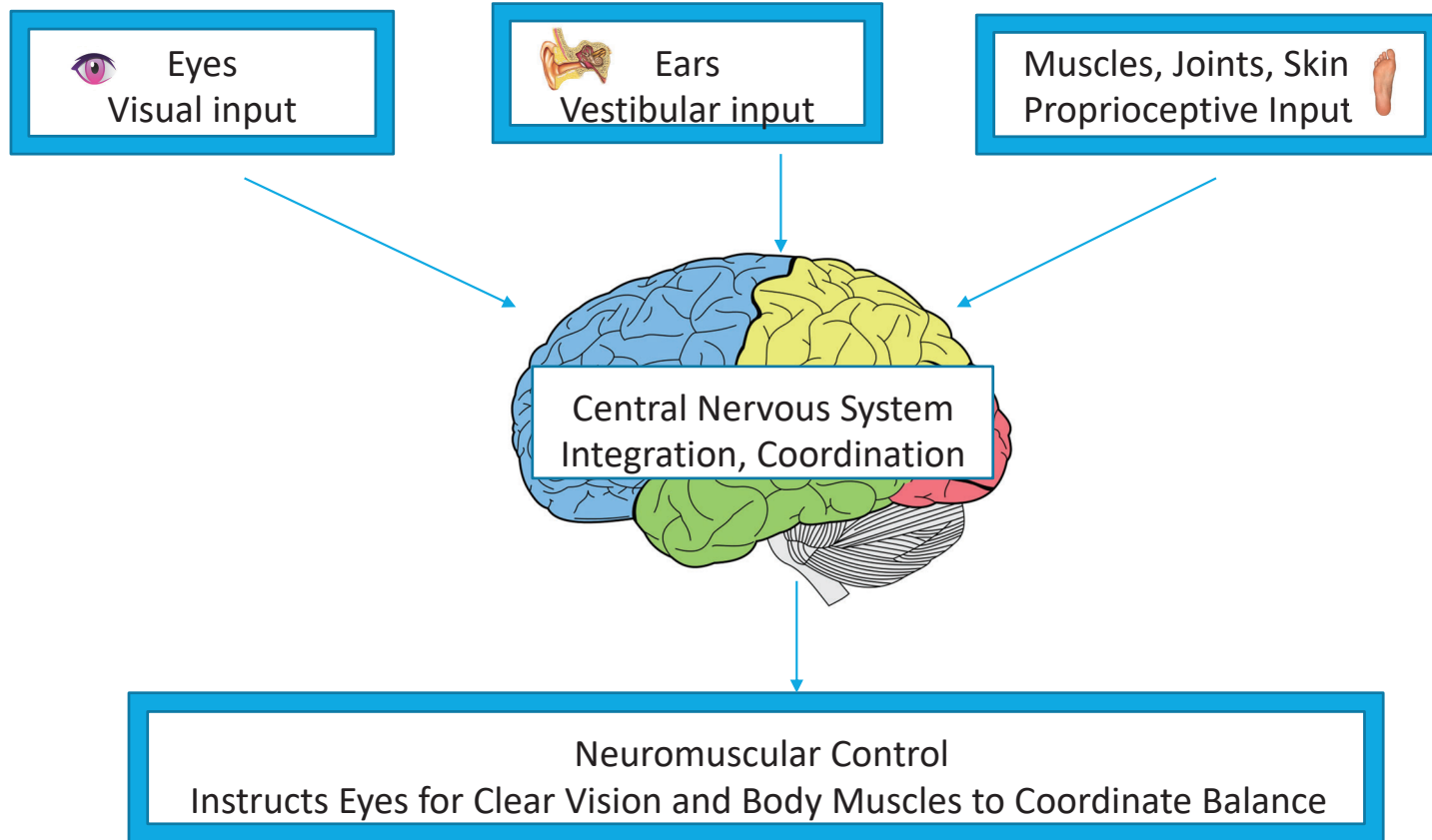
Vertigo: hallucination of movement of the self or environment. Often has a rotational, spinning component. Can be linear, tilting or pitching.

Dysequilibrium: unsteadiness, imbalance or loss of equilibrium that is often accompanied by spatial disorientation. Often made worse with head movements

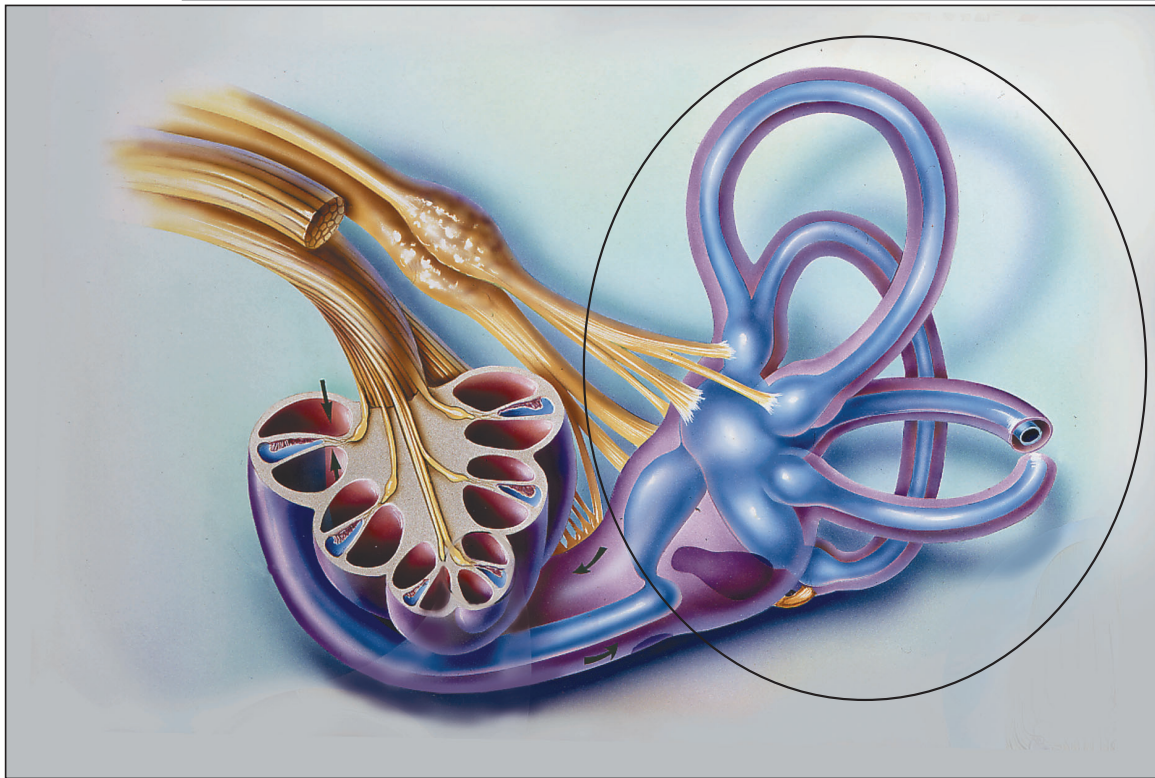
Vertigo and dizziness are not interchangeable terms

All vertigo is dizziness but not all dizziness is vertigo

Anatomy of Balance



Anatomy of Balance



Vestibular system contributes to balance, sense of spatial orientation and vision

Semi circular canals

- 3 canals oriented at 90 degrees to each other: lateral, posterior and anterior
- Fluid in the canal moves in response to rotational movements of the head

Otolith Organs

- Sense gravity and linear acceleration
- Utricle and Saccule
- Hair cells- gelatinous matrix with Calcium crystals on top

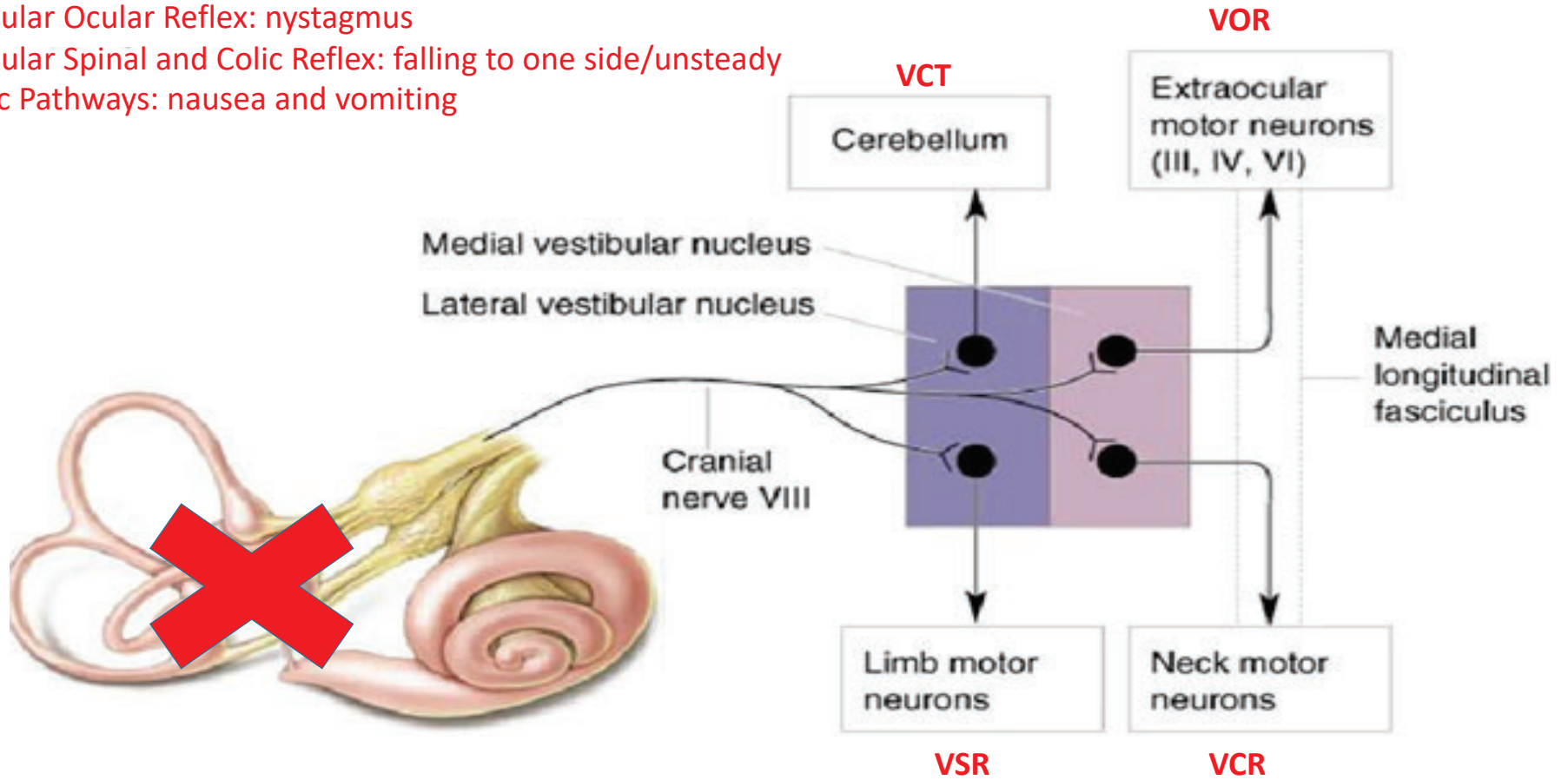
VESTIBULAR PATHWAYS AND CARDINAL SIGNS

Vestibular Cerebellar Tract: ataxia and past pointing

Vestibular Ocular Reflex: nystagmus

Vestibular Spinal and Colic Reflex: falling to one side/unsteady

Emetic Pathways: nausea and vomiting



Subjective complaints

Vertigo and/or Dizziness

- may be brought on by change in position
- may be every time they move, especially head
- may be spontaneous in onset
- may be there constantly

Imbalance

- “people must think I’m drunk”*
- worse with movement in general
- balance further worsens with head movements
- more difficult in the dark
- more difficult on uneven ground
- best if sitting still

Subjective complaints

Visual Issues (VOR)

- Blurry vision/difficulty focusing with head movement
- Eyes don't keep up with the head-lag
- Horizon is bobbing when walking

Visual Issues (Other)

- Dizzy and intolerant to complex visual stimulation
 - reading
 - computers, phones, television
 - driving
 - grocery stores/malls

Common Causes of Dizziness after Head Injury

PERIPHERAL CAUSES

Benign Paroxysmal Positional Vertigo (BPPV)

Vestibular Hypofunction

- Temporal bone Fracture

Labyrinthine Concussion

Utricular or Saccular Injury

Post-Traumatic Endolymphatic
Hydrops/Meniere's

Perilymphatic Fistula

Superior Canal Dehiscence

CENTRAL CAUSES

Post Traumatic Migraine

Brainstem Concussion

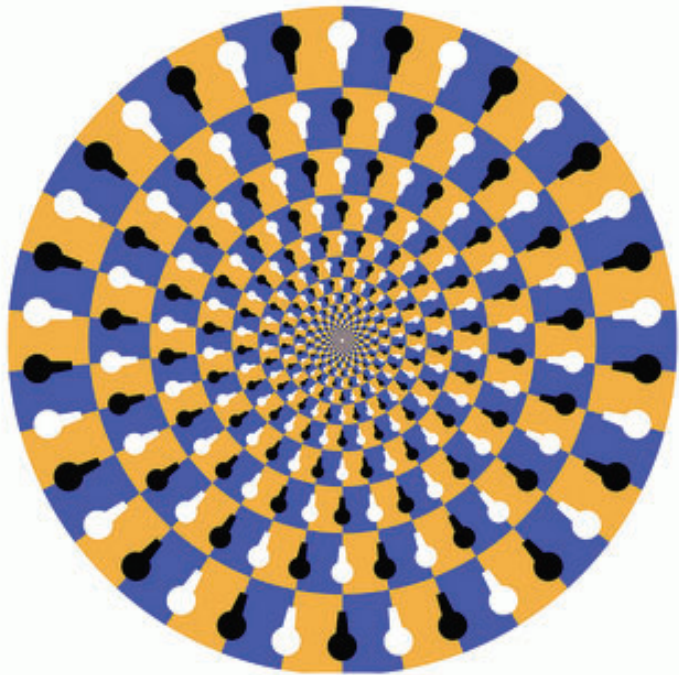
Vestibulocerebellar Dysfunction

Oculomotor Issues

Visual Vertigo/Motion Sensitivity

Secondary Anxiety and Depression

Benign Paroxysmal Positional Vertigo



A clinical syndrome characterized by **brief (<60s)** recurrent episodes of vertigo **triggered by changes in head position with respect to gravity.**

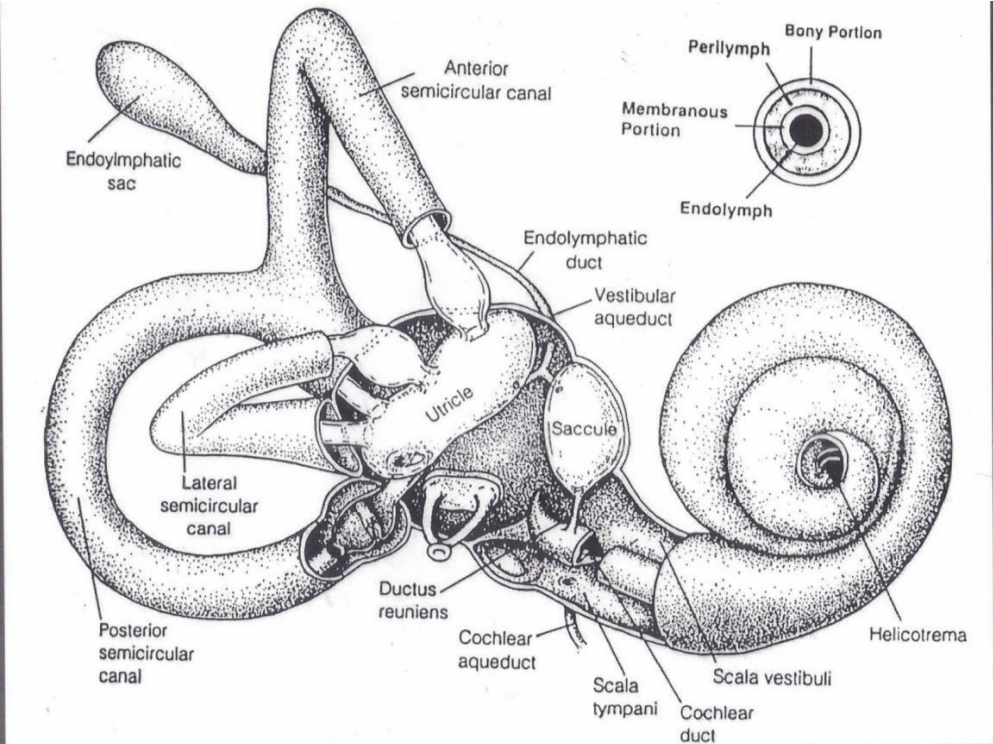
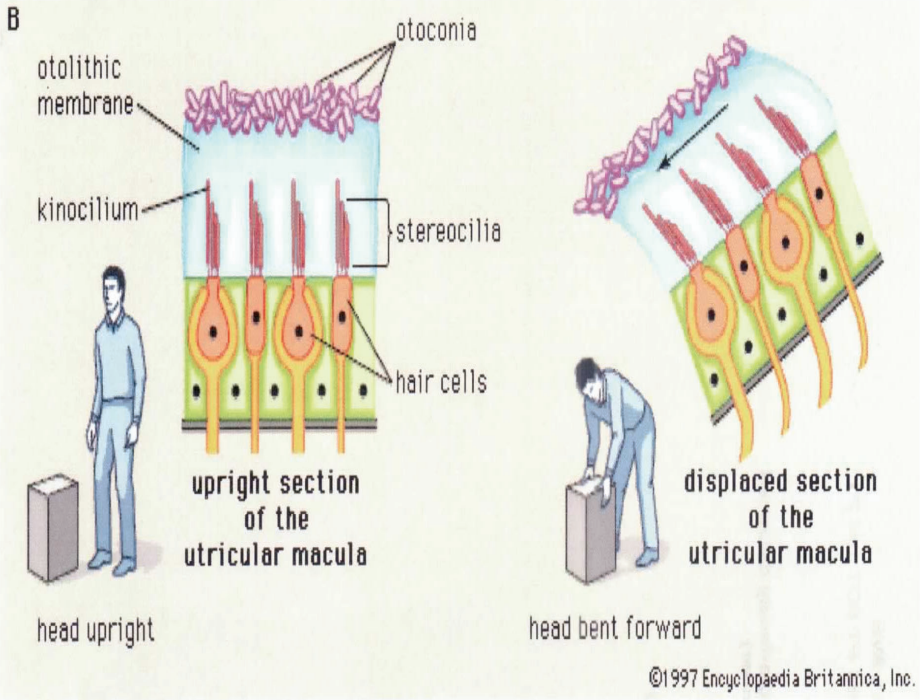
- Bending forward, lying down, looking up, rolling over

Associated with nausea, vomiting, postural instability, motion sensitivity, anxiety

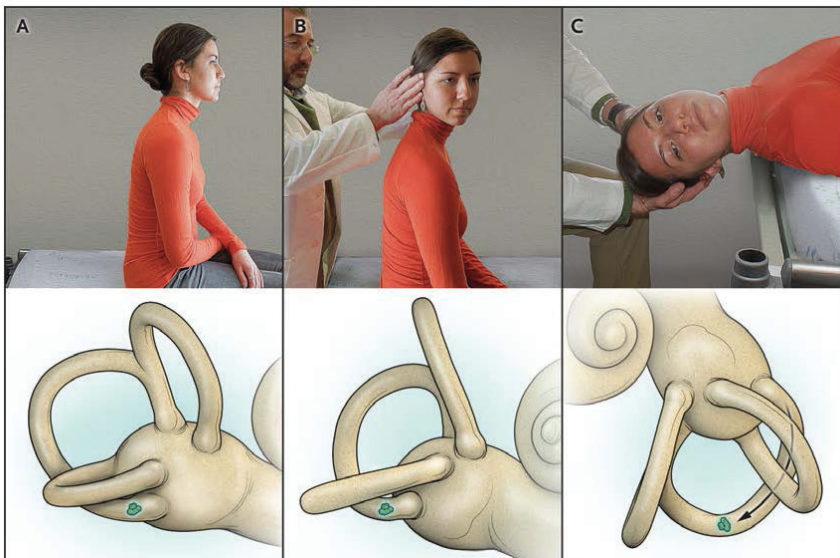
Most common presentation of vertigo in adults

- under age 50, most common cause is head injury

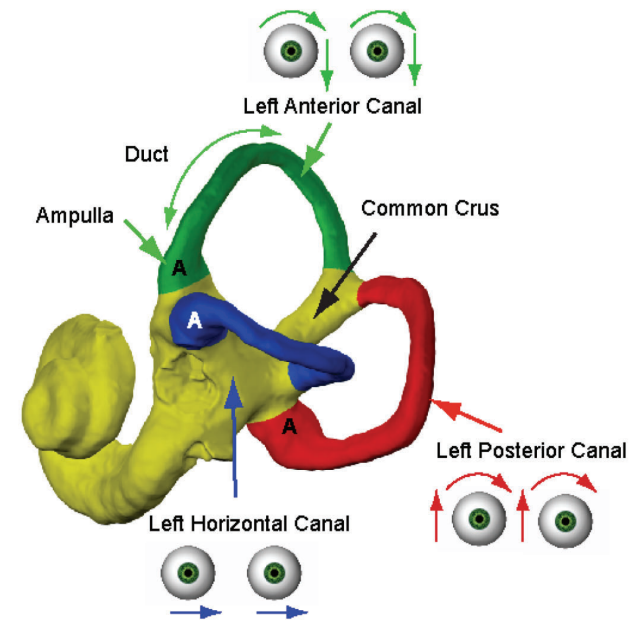
Pathophysiology



Testing for BPPV: Dix Hallpike



CARDINAL SIGN BPPV: NYSTAGMUS



Vestibular Assessment for the dizzy patient



Dizziness history

Detailed history (60-70%)

Subjective questionnaires

- Well Validated in Vestibular Population
 - Dizziness Handicap Inventory
 - Activities Specific Balance Confidence Scale
 - Positive and Negative Affect Scale
 - Toronto Dizziness Catastrophization Scale (UHN)
 - Disability Score

1. Clinical Exam- Oculomotor

Oculomotor tests

- Spontaneous nystagmus
- Gaze holding nystagmus
- Smooth pursuit
- Saccadic Eye movements
- VOR cancellation/suppression test

Look for abnormalities

- Suggests central vestibular pathology
- Refer to neurology for further evaluation

Look for symptom provocation

- If normal results, but symptoms are provoked, can treat with habituation techniques
- Measure intensity of symptoms of dizziness, fogginess, headaches, nausea and measure timing

2. Clinical Exam– Peripheral Vestibular

Peripheral Vestibular Tests

- Head Impulse Test
- Post Head Shake Nystagmus
- Dynamic Visual Acuity test
- BPPV Positional Testing (Dix Hallpike, Head Roll)

Dynamic Visual Acuity

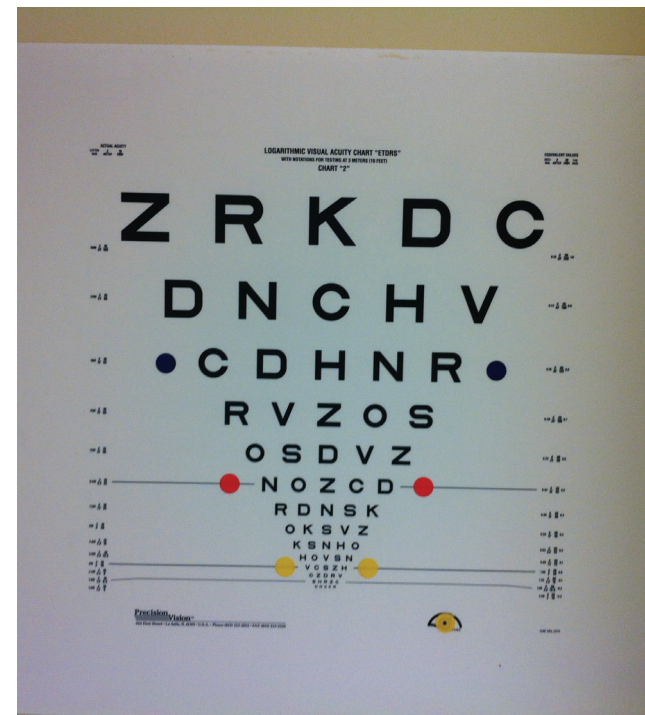
Functional test of VOR

Looking at the difference between static and dynamic acuity

Patient reads the chart while still, then while the examiner passively rotates the head at 2Hz

<2 lines is normal

Generally loss of 3-6 lines consistent with UVL and 7+ lines with BVL



3. Clinical Exam– Balance and Gait

Balance assessment (mCTSIB)

- Static posturography
- Dynamic movements/perturbations

Gait assessment

- Dynamic Gait Index and Functional Gait Analysis
 - Quality and speed
 - Tandem gait
 - Walking moving head left/right/up/down
 - Changing gait speed or sudden stops
 - 180/360 turns
 - Walking in dark
 - Stepping over and around obstacles
 - Stairs

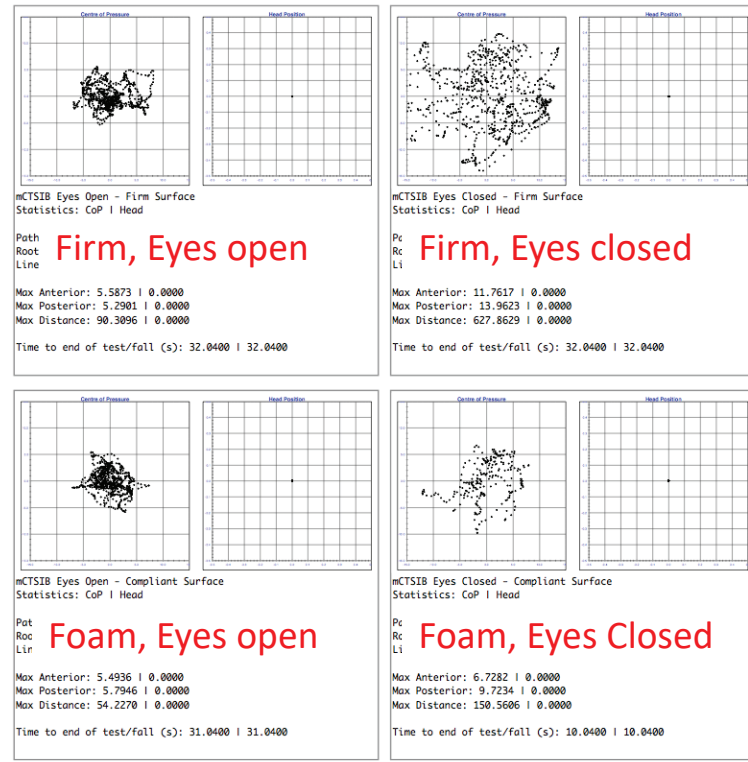
Modified Clinical Test of Sensory Interaction in Balance (mCTSIB)

1. Stable ground/ eyes open
2. Stable ground/ eyes closed
3. Compliant surface/ eyes open
4. Compliant surface/ eyes closed

Assesses the influence of vestibular, somatosensory and visual inputs on postural control.



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Treatments in Vestibular Rehabilitation

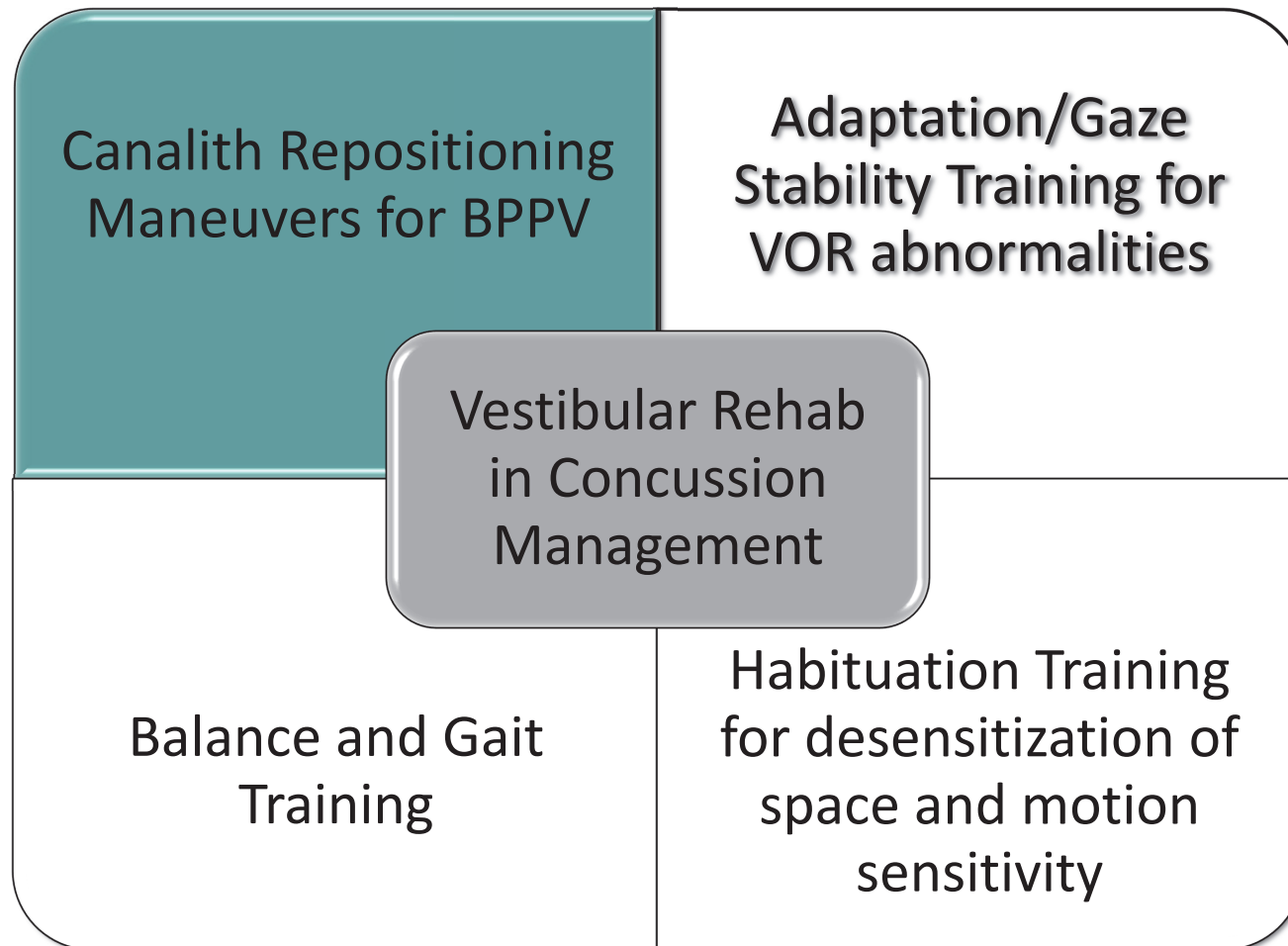
In the case of BPPV, goal is to reposition the crystals back into the utricle through use of physical therapy maneuvers specific to the canal affected

With vestibular hypofunction: goal is to develop an exercise based program designed to promote central nervous system compensation for inner ear deficits

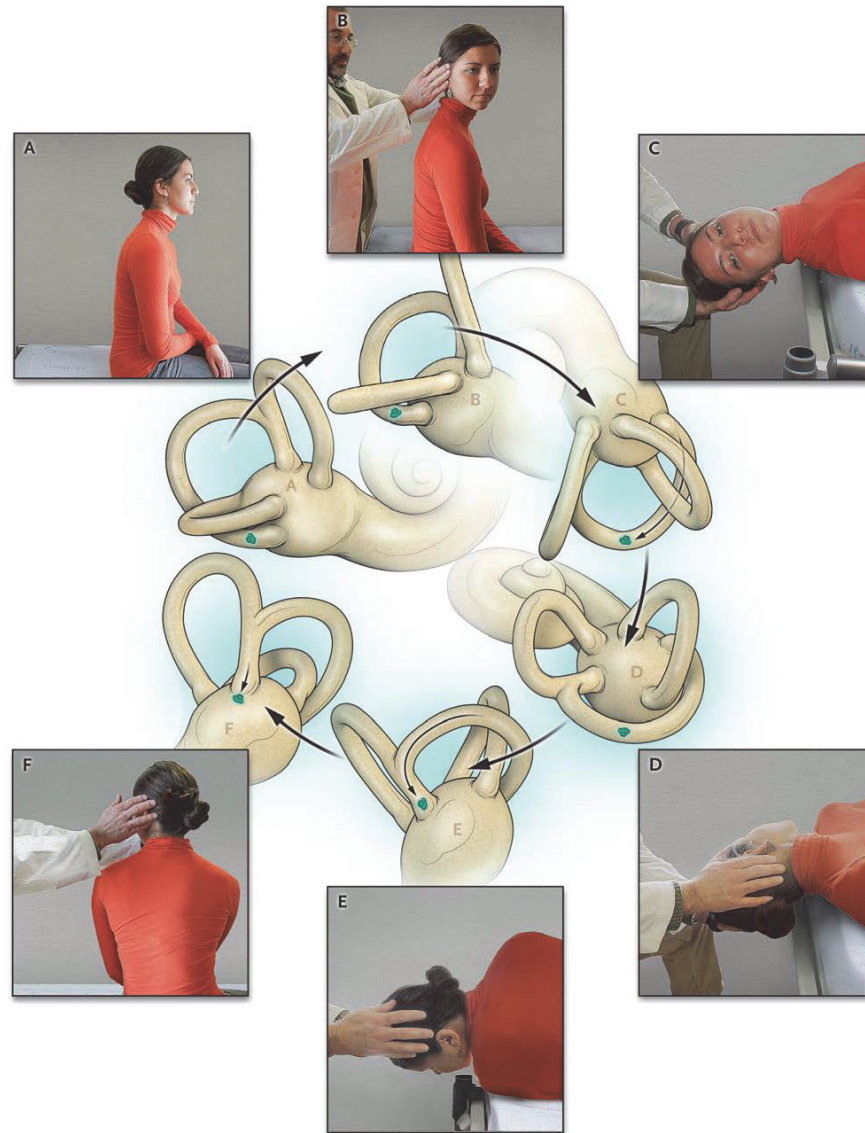
- VRT does not actually involve regeneration or recovery of the damaged vestibular end organ

With persistent dizziness that is aggravated by visual stimuli or motion, work on reweighting the sensory systems and habituation to provocative stimuli

Focus on return to optimal functional levels: better balance and less/no dizziness



BPPV Treatment



BPPV Efficacy

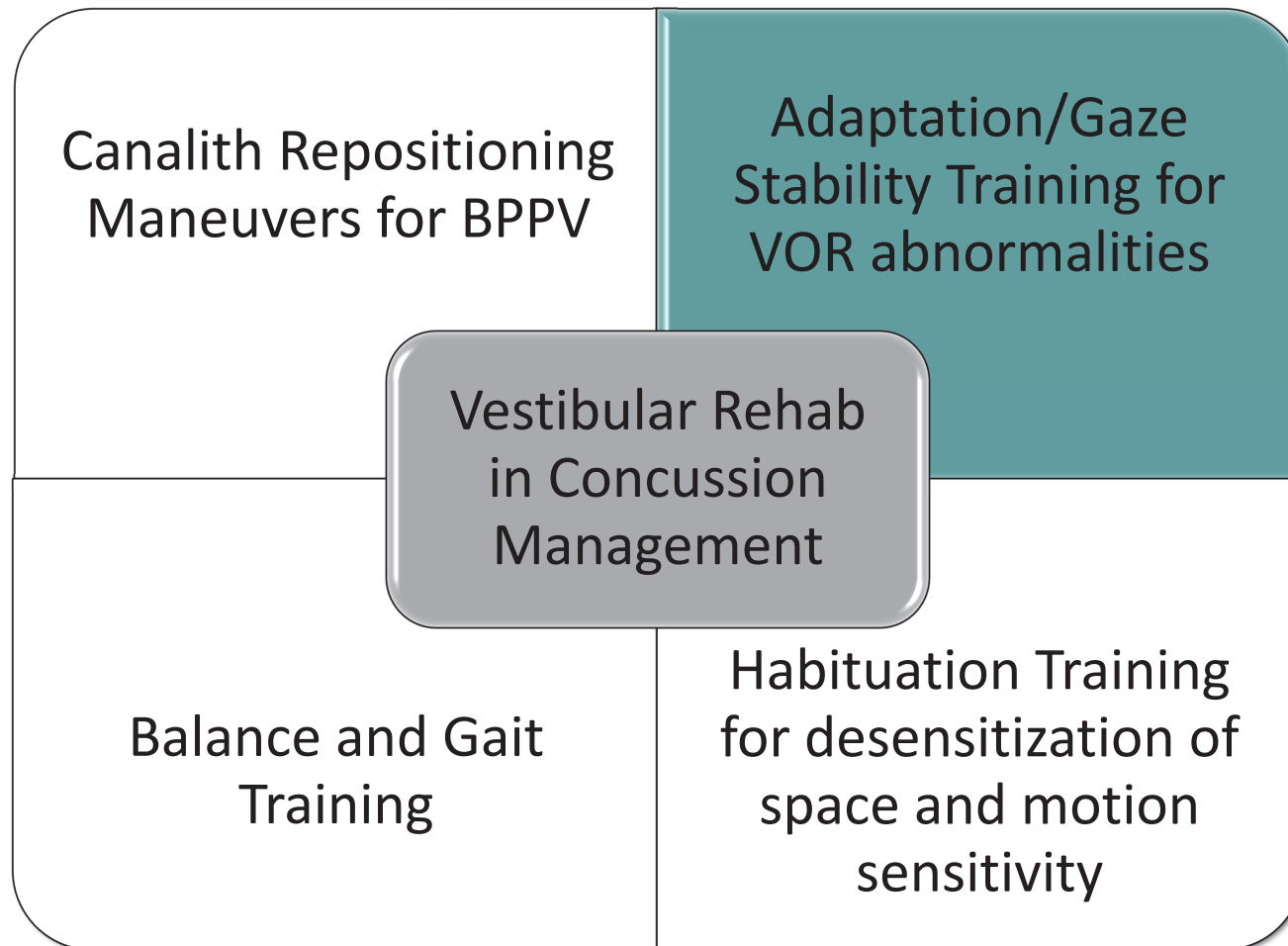
Strong evidence to support use of bedside canalith repositioning maneuvers (CRM)

RCTs indicate successful remission is obtained in 67-94% of all pts treated with CRM compared with 0-48% with no treatment (Lynn et al 1995, Lempert et al 1997, Froehline et al 2000 and Helminski et al 2010)

67% of post traumatic BPPV vs 14% idiopathic require multiple treatments (Gordon, 2004)

57% post traumatic had recurrence vs 19% of idiopathic (22 month avg f/u) (Gordon, 2004)

25% post traumatic BPPV is likely to be bilateral compared with only 2% in idiopathic BPPV (Liu H, 2012)



VOR Adaptation training

Improve gaze stability and tolerance to head movements and complex visual stimuli

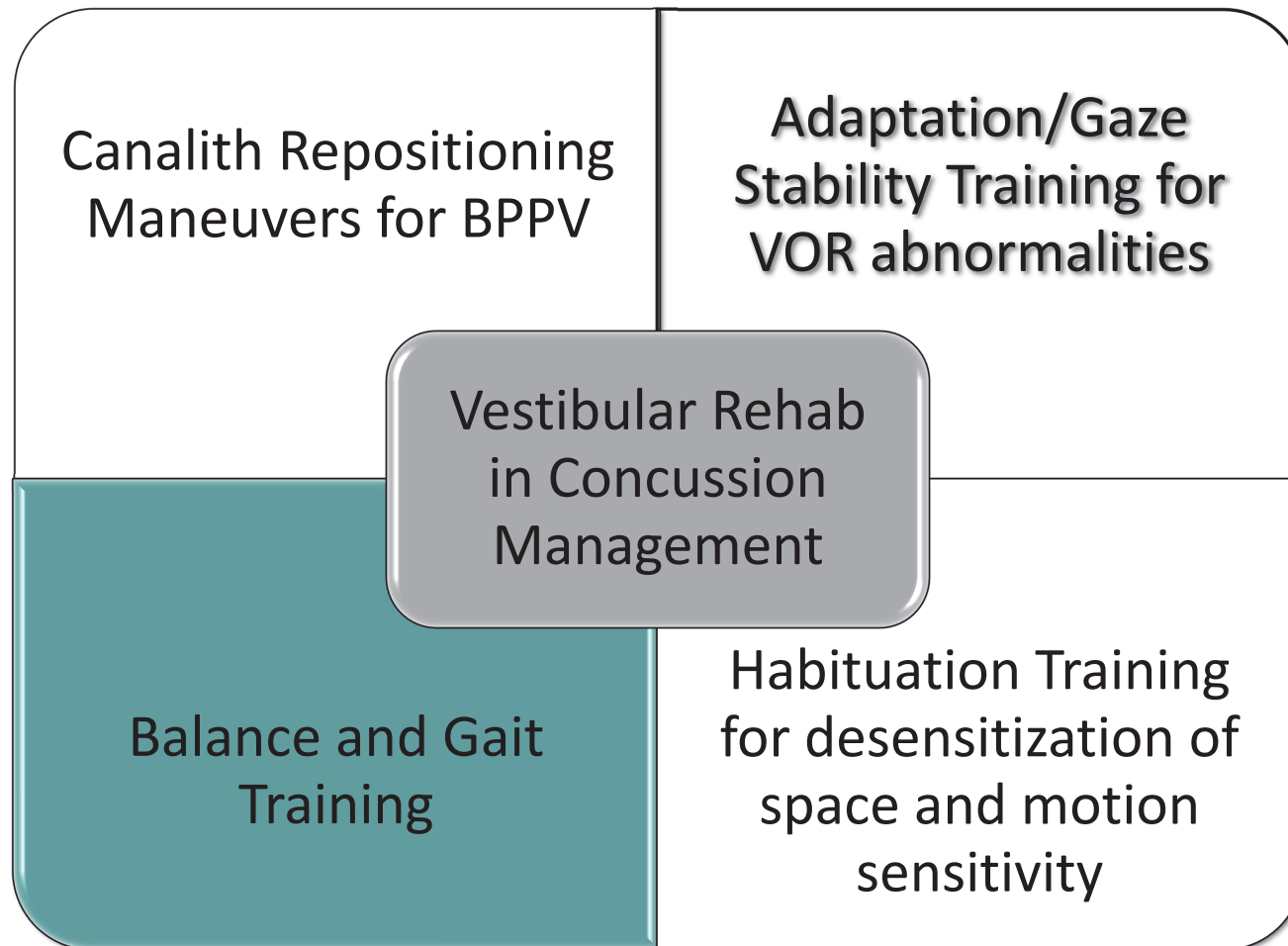
Maintain visual fixation on targets during head movements and aim to increase speed upto 2Hz

VOR training- 1 min 3-5 times per day

Desensitization- may be as low as 5 repetitions 3-5 times a day

Monitor for symptoms: avoid exacerbation
Symptoms should settle in 15-20 minutes



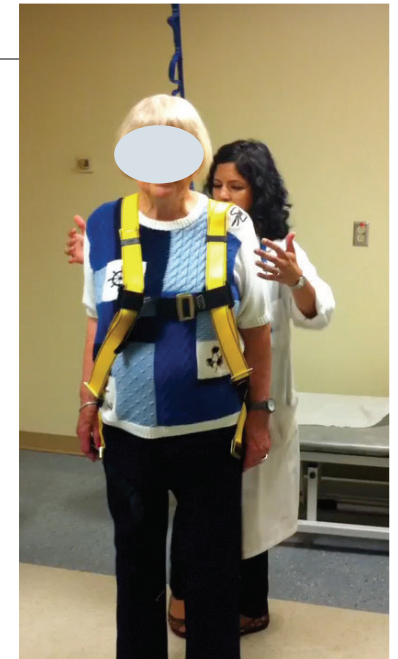


Balance Training

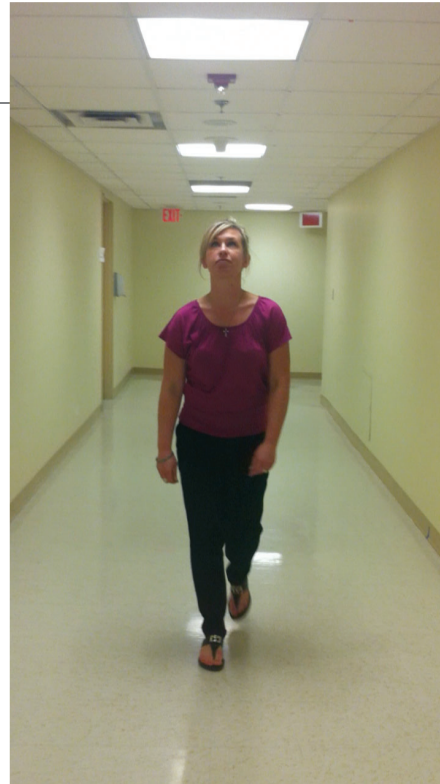
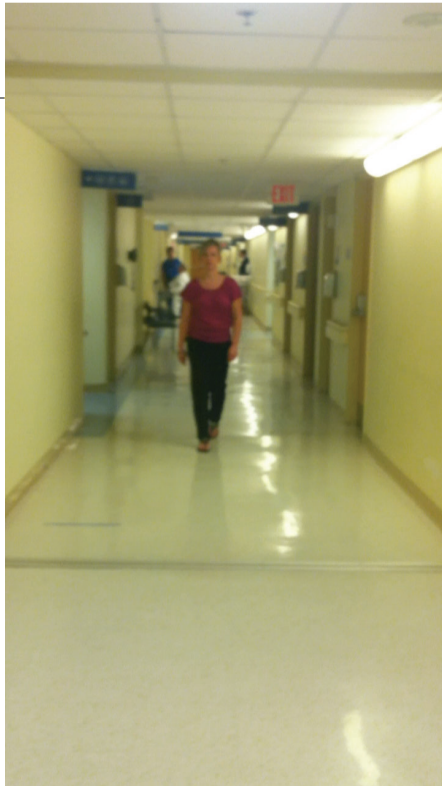
Vestibular patients often rely on visual cues for balance and accurate somatosensory information

Exercises often involve closing eyes and altering proprioceptive cues

Add head movements for additional challenge



Balance and Gait Treatments



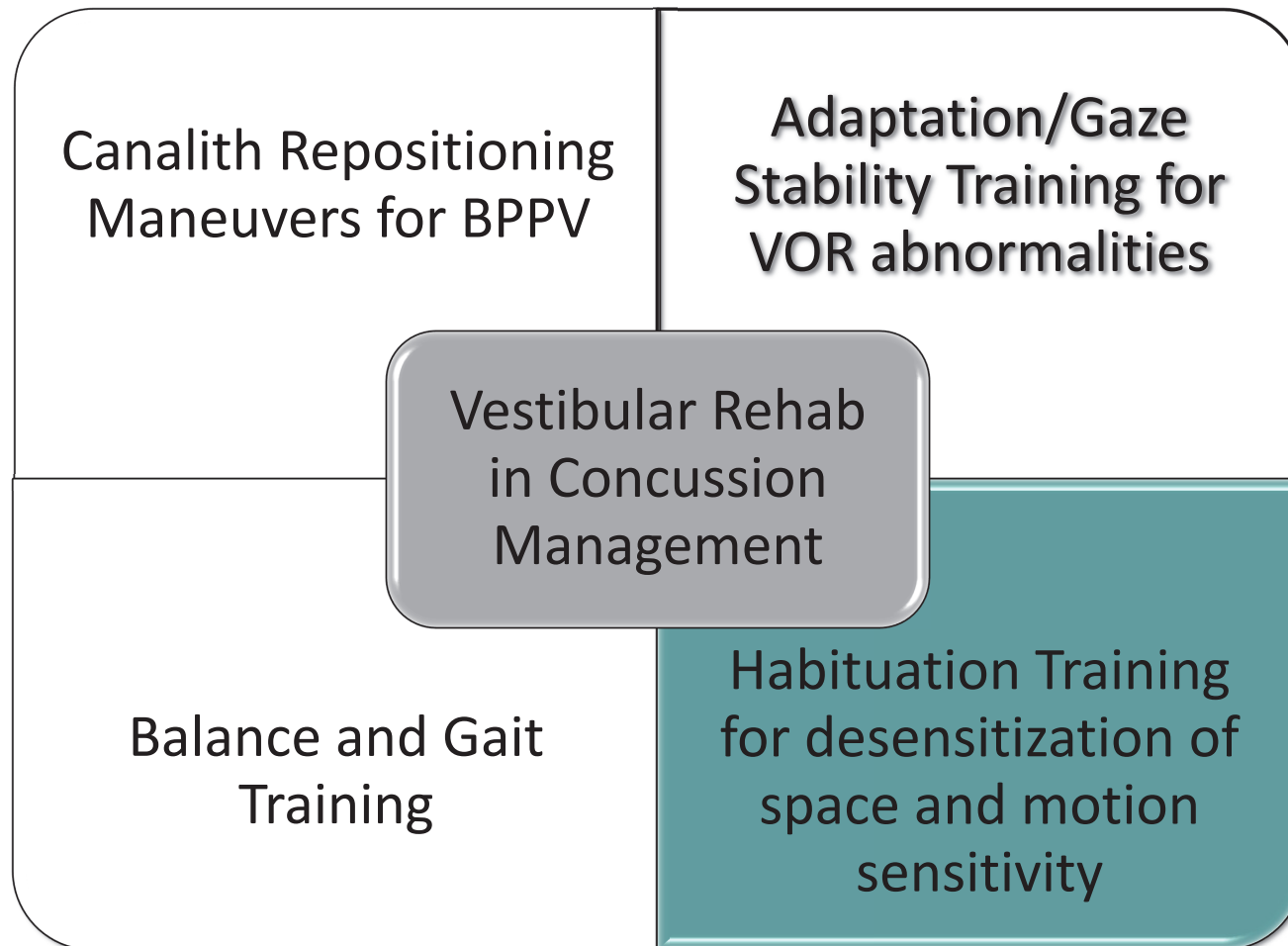
General Aerobic Exercise Training

Include an outdoor walking program to start- 20 min

Benefits include:

- Facilitates vestibular stimulation and allows the brain to compare vision, vestibular and somatosensory inputs especially with walking outside
- Helps to maintain fitness levels
- Reduces anxiety
- Allow for BDNF which help with compensation and healing

Goal is to remain below symptom threshold and gradually incorporate higher intensity/exertion



Visual symptoms



Balance control- dynamic interplay of info from vision, somatosensory and vestibular system

- Information is referenced to one another to maintain accurate control

Vestibular Dysfunction (with or without head injury): brain will **over-utilize/process visual information** -> leads to feeling dizzy with complex visual stimuli- grocery stores, scrolling, TV

Persistent Postural Perceptual Dizziness?: New diagnostic category in ICD 11th ed.

- Non-spinning vertigo, perceived unsteadiness, exacerbation when upright and in situations with moving visual stimuli or complex visual patterns
- Symptoms last for hours; may wax and wane in severity; present on most days for at least 3 months
- Vestibular event -> leads to involuntary maladaptation of postural control strategies, an over-reliance on visual stimuli for spatial orientation and excessive vigilance about the physical symptoms

Visual symptoms- Treatment



Re-weight the sensory systems to decrease visual over-reliance

Up-train somatosensory cues

Normalize vestibular cues and increase use of these inputs

Visual stimulation- repeated exposure to allow the brain to adapt and habituate

Start slow, monitor symptoms response and minimize symptom provocation

If symptoms are provoked they have strategies to de-escalate.

De-escalation Strategies

When symptoms reach a 3/10, STOP

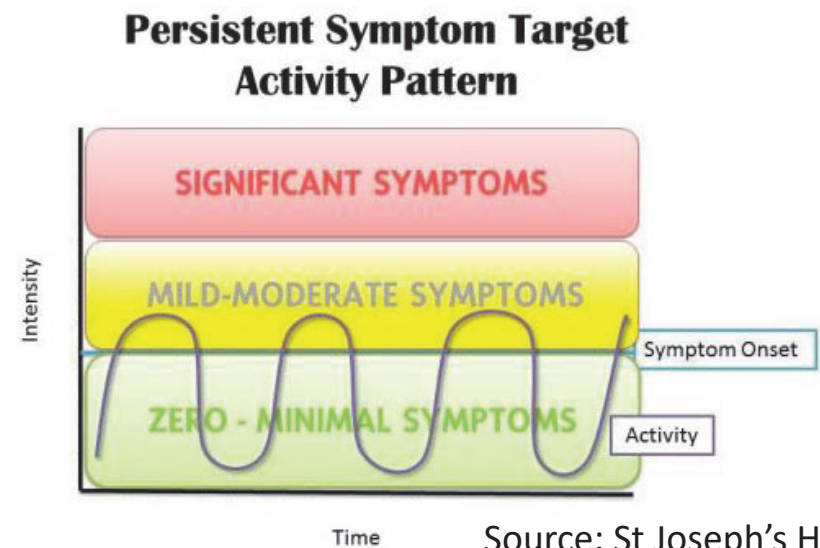
Close Eyes (or extended blinks) to shut down visual system

Surface Orientation- allow brain to use proprioceptive cues

Deep breathing- reduces anxiety response

Distract

Once symptoms are better- re-expose again!



Habituation through Video



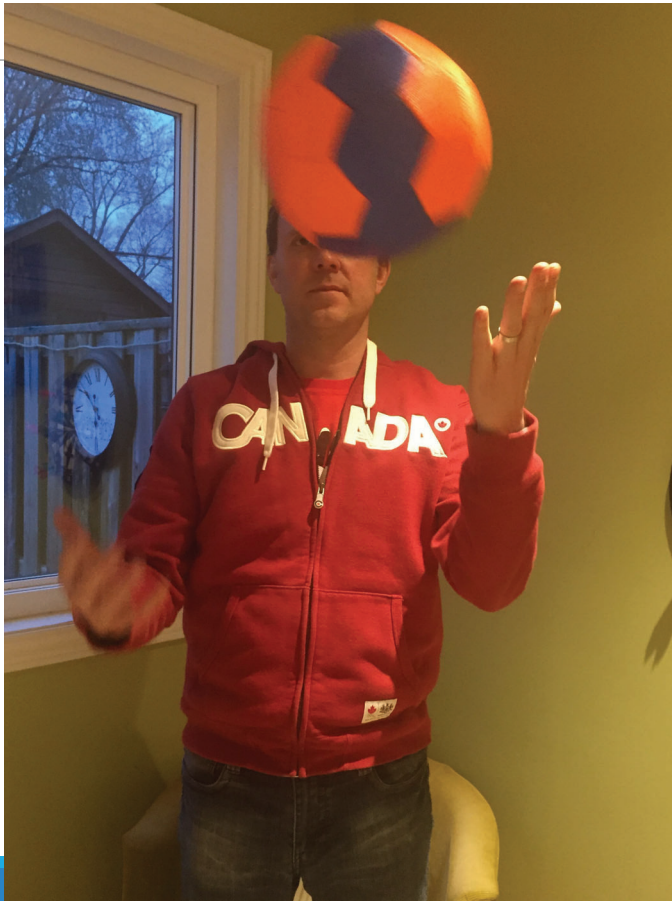
Pursuit training and Visual fixation with head movements



Horizontal and Vertical Saccades



Visual Tracking and Convergence training



Motion Sensitivity Assessment

Motion Sensitivity Testing

Intensity: 0-5

5-10s = 1
11-30s = 2
>30s = 3

Score=
Intensity +

Baseline Symptoms	Intensity	Duration	Score
1. Sitting to Supine			
2. Supine to Left side			
3. Supine to Right side			
4. Supine to sitting			
5. Left Dix-Hallpike			
6. Up from left			
7. Right Dix-Hallpike			
8. Up from right			
9. Sitting, head tipped left knee (18" apart)			
10. Head up from left knee			
11. Sitting, head tipped to right knee (18" apart)			
12. Head up from right knee			
13. Sitting head turns (5)			
14. Sitting head pitches (5)			
15. In stance, 180 degree turn to right			
16. In stance, 180 deg turn to left			
		Total	
MSQ=total score x (# pos's)/20.48		MSQ	

Mild= 0-10%
Moderate= 11-30%
Severe= 30-100%

Moderately provocative motions used for treatment

3-5 repetitions of movement, 3 sets, 3 times a day.

Symptoms no more than 3-4/10 and last less than 1 min

After 2-3 weeks symptom duration and intensity decreases

Is Vestibular PT effective post concussion

114 post concussion patients seen for balance/vestibular rehabilitation at UPMC

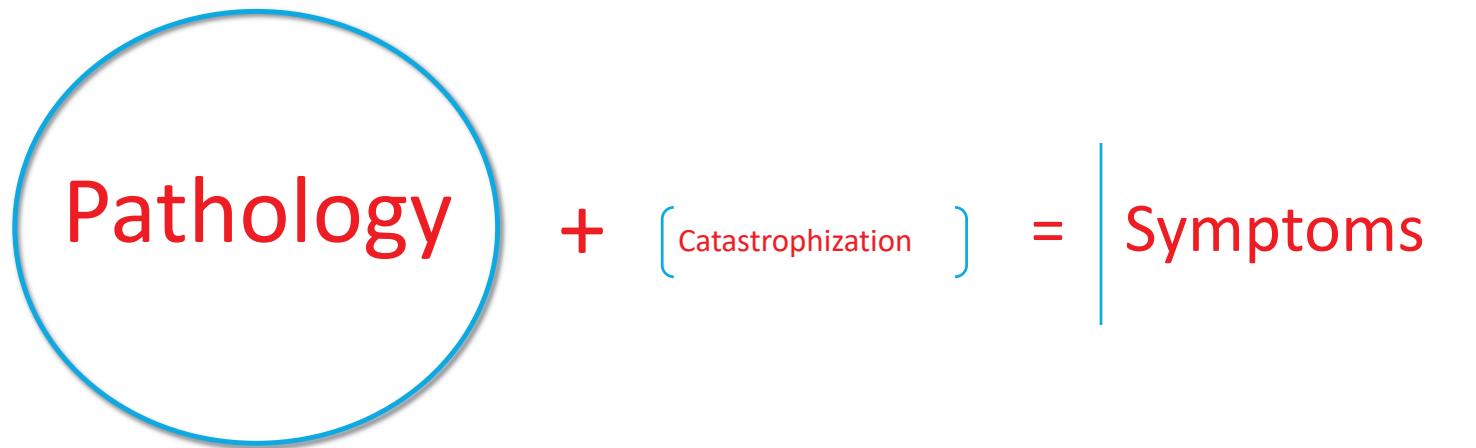
Significant improvements in

- Activity Specific Balance Confidence Scale
- Dizziness Handicap Inventory
- Gait speed
- Sensory Organization Test
- Dynamic Gait Index
- Functional Gait Assessment
- 5 times sit to stand
(Alsalaheen et al 2010)

Barriers to recovery

WHY PATIENTS DON'T GET BETTER DESPITE OUR BEST EFFORTS





Dizziness Catastrophization Scale

0	1	2	3	4
Not at all	To a slight degree	To a moderate degree	To a great degree	All the time

	Statement	Rating
1	I worry all the time about whether the dizziness will end	
2	I feel I can't go on	
3	It's terrible and I think it's never going to get any better	
4	It's awful and I feel that it overwhelms me	
5	I feel I can't stand it anymore	
6	I become afraid that the dizziness will get worse	
7	I keep thinking of other events of dizziness	
8	I anxiously want the dizziness to go away	
9	I can't seem to keep it out of my mind	
10	I keep thinking about how much trouble my dizziness gives me	
11	I keep thinking about how badly I want the dizziness to stop	
12	There's nothing I can do to reduce the intensity of dizziness	
13	I wonder whether something serious may happen	

Research

JAMA Otolaryngology–Head & Neck Surgery | Original Investigation

Association Between Catastrophizing and Dizziness-Related Disability Assessed With the Dizziness Catastrophizing Scale

David D. Pothier, MBChB, MSc, FRCS(ORL-HNS), DOHNS; Parita Shah, BSc; Lena Quilty, PhD; Miracle Oozoude, HBS; Wanda A. Dillon, RN; John A. Rutka, MD, FRCS(C); Philip Gerretsen, MD, PhD, FRCP

Supplemental content

IMPORTANCE Catastrophizing is a maladaptive thought process that involves irrational fear and worry about anticipated or actual symptoms. Although clinically relevant, the role of catastrophizing in patients with chronic dizziness or imbalance has not yet been explored to our knowledge.

OBJECTIVES To validate a measure of dizziness catastrophizing and to assess its association with dizziness-related disability compared with other negative affect constructs (eg, anxiety and depression).

DESIGN, SETTING, AND PARTICIPANTS For this retrospective medical record review, the Dizziness Catastrophizing Scale (DCS), a dizziness-specific catastrophizing assessment tool, was adapted from the previously validated Pain Catastrophizing Scale. Psychometric evaluation of the DCS was performed. In addition, the associations of dizziness catastrophizing and positive and negative affectivity with dizziness-related disability were assessed using structural equation modeling and regression analyses. Data were collected using a retrospective medical record review from April 27, 2010, to June 25, 2014. The dates of analysis were June 3 to August 15, 2017. The setting was the Multidisciplinary Neurotology Clinic at the Toronto General Hospital (Toronto, Ontario, Canada). Participants were 457 adult outpatients with dizziness or imbalance who were referred to the clinic.

MAIN OUTCOMES AND MEASURES Psychometric properties of the DCS and its association with dizziness-related disability, as measured with the Dizziness Handicap Inventory.

RESULTS Among 457 patients (mean [SD] age, 53.4 [15.4] years; 154 [33.7%] male), the DCS demonstrated good convergent ($r = 0.78, P < .001$) and discriminant validity ($r = -0.40, P < .001$) with the negative and positive affectivity, respectively, internal consistency ($\alpha = .95$), and test-retest reliability (intraclass correlation coefficient, 0.92; $P < .001$ at the 95% CI). An exploratory dimension reduction analysis revealed a single latent component of the DCS. The results of the structural equation modeling and regression analyses revealed that dizziness catastrophizing, although associated with negative affectivity (eg, symptoms of anxiety and depression), was independently associated with dizziness-related disability (standardized $\beta = 0.378; P < .001$). Furthermore, a strong association was found between catastrophizing and dizziness-related disability across different dizziness-related diagnoses ($r \geq 0.6; P < .001$).

CONCLUSIONS AND RELEVANCE In this study, the DCS was a valid and reliable measure for evaluating catastrophic thinking in patients with dizziness, which was independently associated with dizziness-related disability. Future studies should investigate the influence of alleviating symptoms of catastrophizing on functional outcomes in patients with dizziness or imbalance, the results of which will help guide novel approaches to the clinical care of patients with chronic dizziness.

Author Affiliations: Author affiliations are listed at the end of this article.

Corresponding Author: Philip Gerretsen, MD, PhD, FRCP, Multimodal Imaging Group, Research Imaging Centre, The Centre for Addiction and Mental Health, 250 College St, Toronto, ON M5T 1R8, Canada (philgerretsen@yahoo.com; philip.gerretsen@camh.ca).

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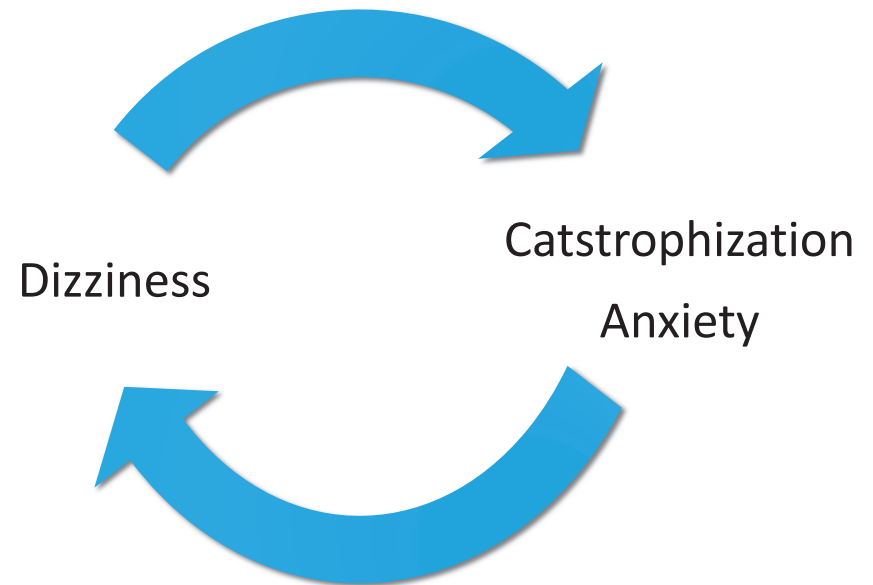
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Psycho-education

- Create Awareness of the vicious cycle of dizziness and anxiety
- Neurons that fire together, wire together (Norman Doidge)
- Anxiety can inhibit the brain and prevent adaptation
- Ensure the exercise program does not increase anxiety levels- focus on DE-ESCALATION vs ESCALATION
- Incorporate mindfulness meditation and mindfulness balance exercises
- If no improvements in a couple of sessions, consider referring to primary care or psychiatry



Summary

Dizziness is a common symptom after concussions and is often accompanied by balance impairments

Initial presentation of dizziness is an important clinical finding and an adverse prognostic indicator- should be evaluated further with vestibular and balance testing if not resolving

BPPV is the most common inner ear disorder- position triggered vertigo and responds well to treatment

Management of concussions is a team approach. Vestibular Physiotherapy is an integral part to reduce symptoms of dizziness and improve balance and gait!

Recognize and address the anxiety/catastrophization- may worsen the impact of vestibular symptoms and delay functional recovery

Thank you

SHALEEN@VESTIBULARHEALTH.CA

