



VESTIBULAR
HEALTH

Vestibular Physiotherapy as a Treatment for Dizziness After Concussions

SHALEEN SULWAY, PT

Canadian Concussion Centre Webinar Series
March 6, 2024

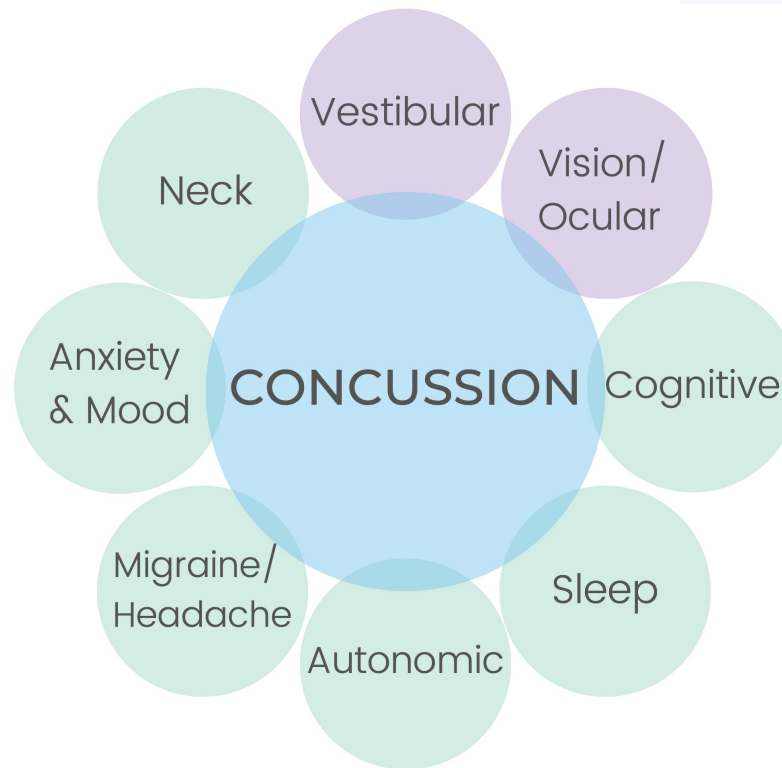


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 Otolaryngology - Head & Neck Surgery
UNIVERSITY OF TORONTO

 **UHN** Toronto
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Symptoms after a Concussion



Adapted from Collins et al 2016)

Outline

- Understand Dizziness after concussions and its relation to the vestibular system
- Review the anatomy of vestibular system
- Review causes and symptoms of vestibular problems
- Vestibular rehabilitation treatments for vertigo, imbalance and visual motion sensitivity
- Discuss some barriers to recovery

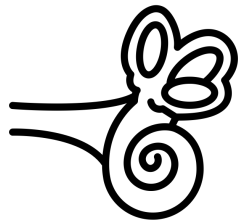
Dizziness after TBI



Linked to
#2 Symptom
Protracted
(#1 is headache)
Recovery

(Maskell, 2006; Terrio, 2009; Kontos, 2012; Ellis, 2015; Nacci 2011; Lau 2011. Meehan 2010)

Common causes of dizziness

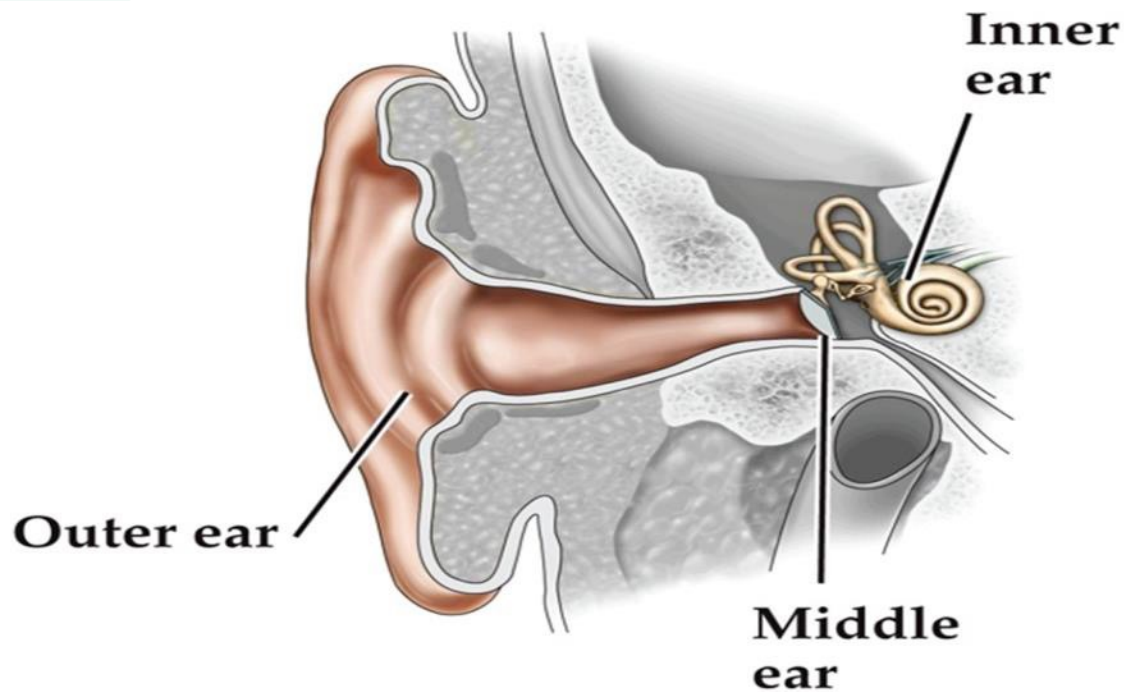


Inner Ear
(peripheral vestibular)



Brain
(central vestibular)

Dizziness and the Inner ear



Balance organs:

➤ Deep in the ear, encased in temporal bone

Inner ear is vulnerable to injury

Semi circular canals

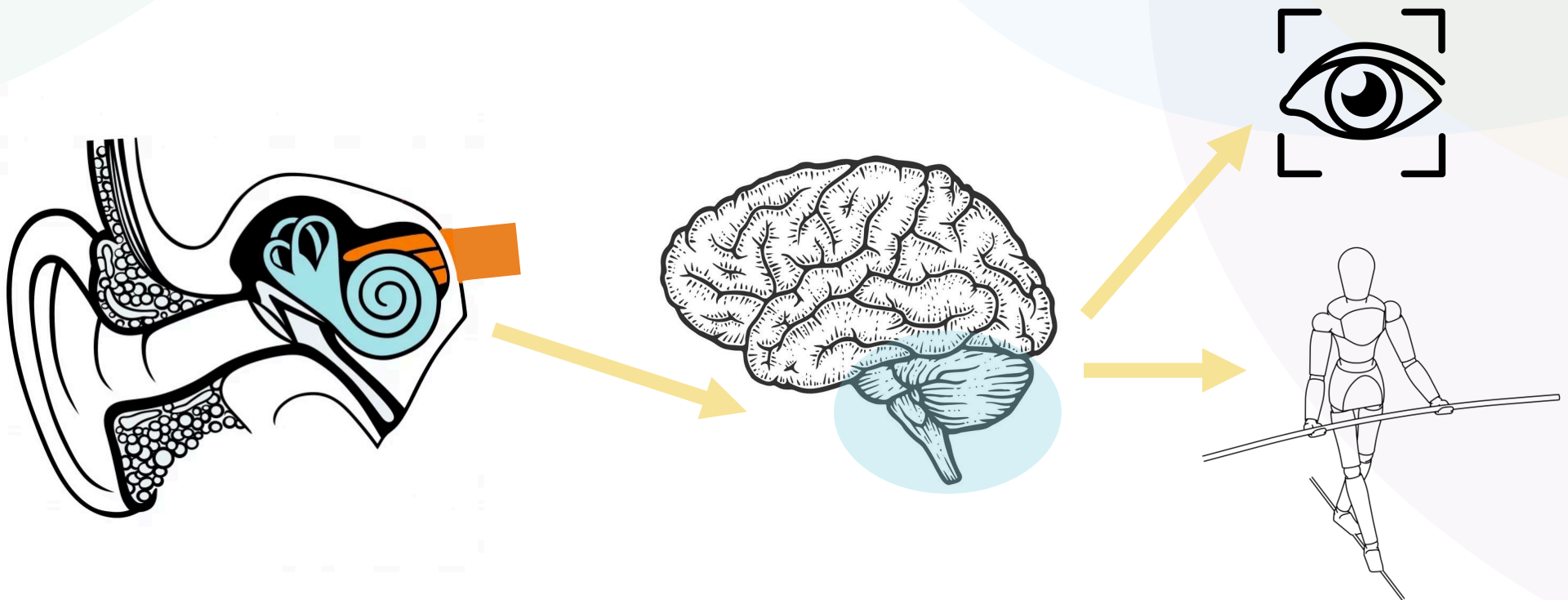
- 3 canals oriented at 90 degrees to each other: lateral, posterior and anterior
- Fluid in the canal moves in response to rotational movements of the head

Otolith Organs

- Sense gravity and linear acceleration
- Utricle and Sacculle

NEUROSCIENCE 5e, Figure 13.3 (Part 3)
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Vestibular system



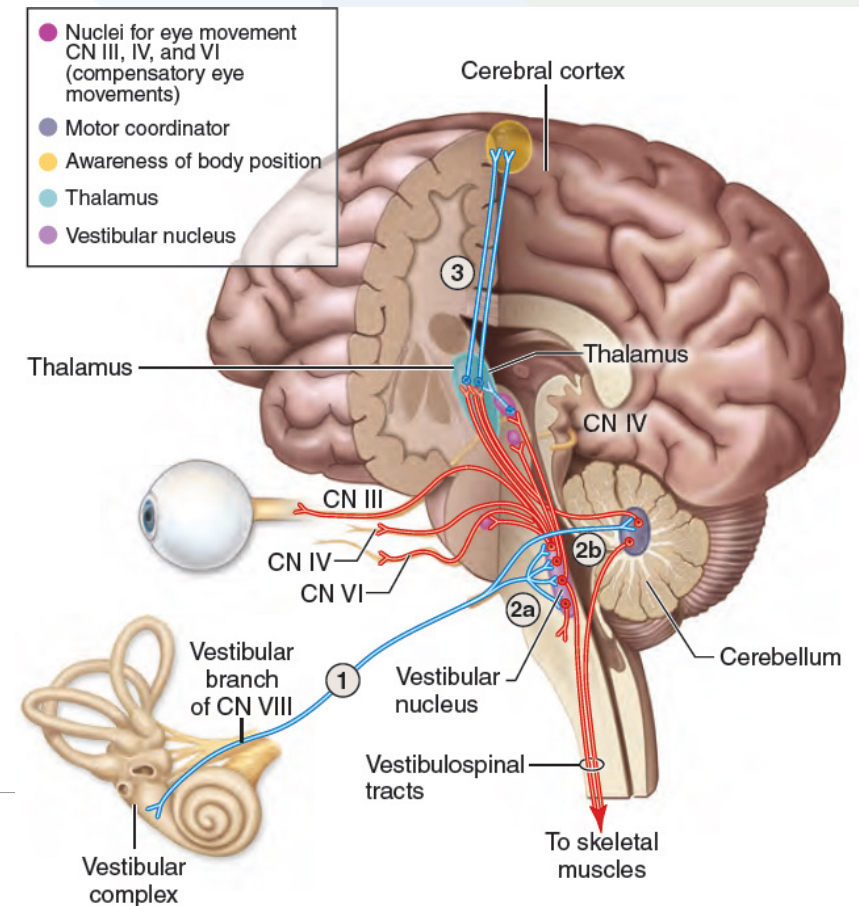
Functions of the vestibular system

- Gaze stability
- Maintaining posture & balance
- Spatial orientation

Vestibular Problems After Concussion:

- Brain can receive abnormal signals regarding spatial orientation (the position and movement of the head) from the inner ear or nerve OR..
- Brain may not process the information coming from the ear properly
- If information is inaccurate, asymmetric or it is processed as inaccurate- then the output is inaccurate= SYMPTOMS (dizziness, vertigo, disequilibrium, visual symptoms)

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Vestibular symptoms

Dizziness = non-specific

- Lightheaded
- Rocking
- Swaying
- Floating
- Off balance
- Foggy
- Woozy
- Spinning

Vestibular symptoms

Vertigo = illusion of movement of self or surroundings

- Rotation, spinning, dropping, being pushed or pulled
- Triggered by head movement, position changes, or spontaneous
- Last seconds, min or hours
- +/- other ear symptoms (e.g. tinnitus, fullness, hearing)
- Nausea and vomiting

Vestibular symptoms

Disequilibrium = unsteadiness or imbalance

- “People must think I’m drunk”
- Instability standing or walking
- Worse with movement- especially head
- Worse in dark and uneven ground
- Best if still

Visual - vestibular symptoms

1. Symptoms related to Vestibular Ocular Reflex

- Blurry vision with head movement
- “Lag” - eyes do not keep up with head
- Bouncing/bobbing vision with walking

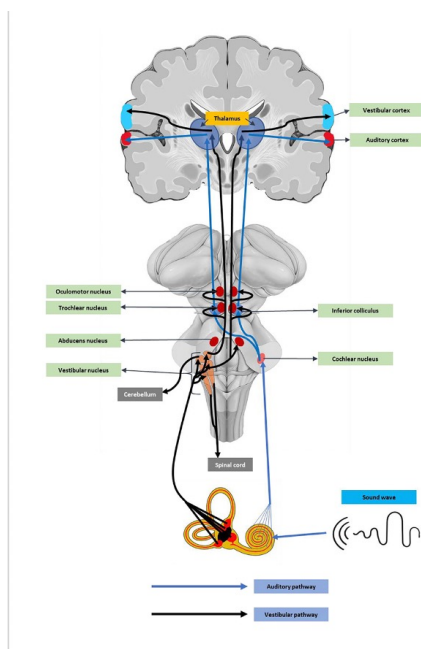
Visual - vestibular symptoms

2. Visual motion hypersensitivity

Dizziness with complex visual stimulation

- Reading
- TV
- Computer/screen
- Large or narrow spaces
- Malls
- Grocery Stores
- Traffic
- Crowds

Common vestibular causes of dizziness



- Benign Paroxysmal Positional Vertigo (BPPV)
- Vestibular hypofunction
- Persistent Postural Perceptual Dizziness
- Vestibular Migraine
- Temporal bone fracture
- Labyrinthine concussion
- Utricular or saccular injury
- Post-traumatic endolymphatic hydrops
- Perilymphatic fistula
- Superior canal dehiscence

BPPV

- Benign Paroxysmal Positional Vertigo
- The most common cause of vertigo
- Under age 50, the most common cause is head injury

BPPV

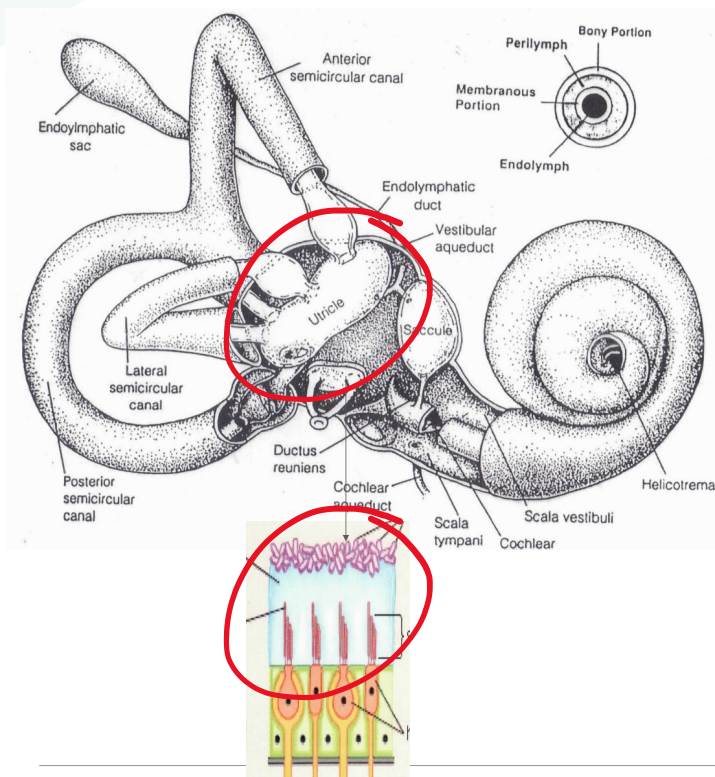
Vertigo lasting ≤ 60 sec, recurrent

Triggered by changes in head position relative to gravity

- Lying down
- Turning in bed
- Bending forward
- Looking up

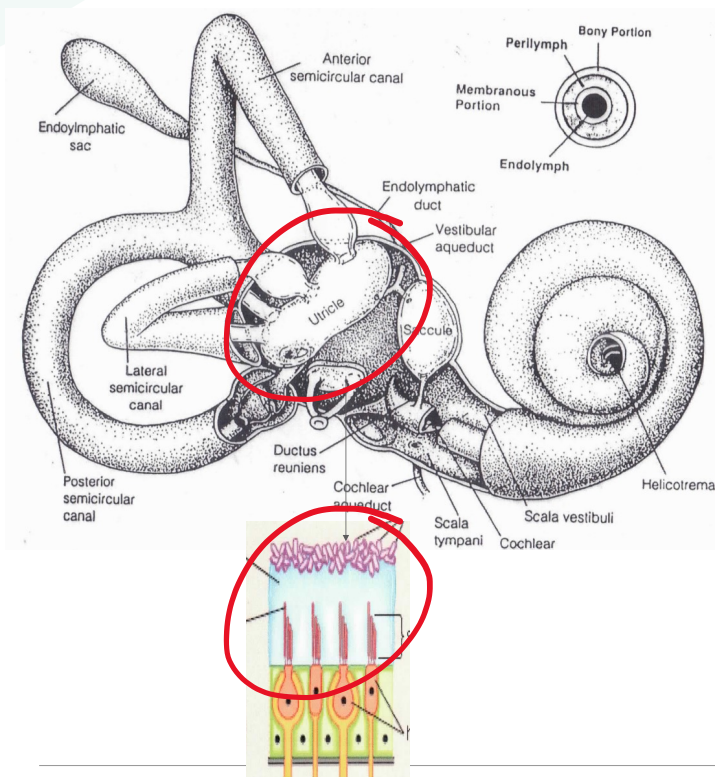
Often with nausea, vomiting, imbalance, motion sensitivity, anxiety

Benign Paroxysmal Positional Vertigo



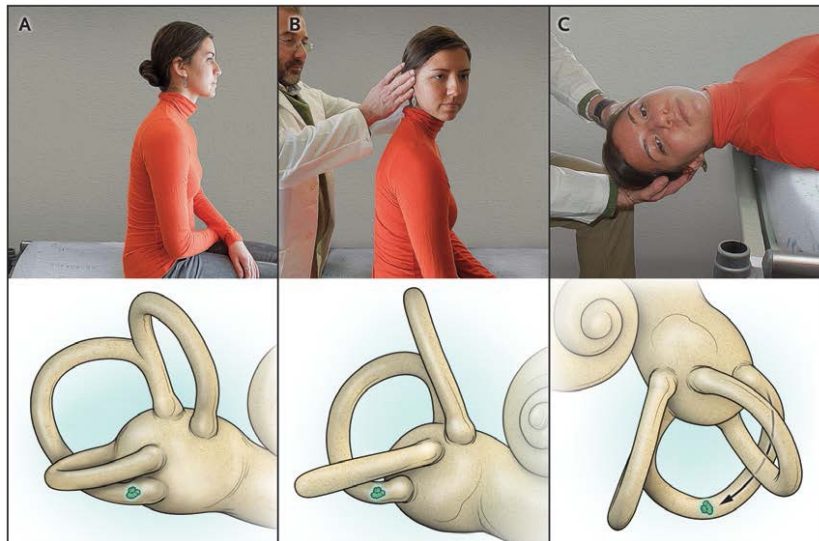
- Utricle has small crystals sitting on the hair cells- normal part of the anatomy
- Can get dislodged due to a concussive/deceleration force
- Migrate into semi circular canals

Benign Paroxysmal Positional Vertigo

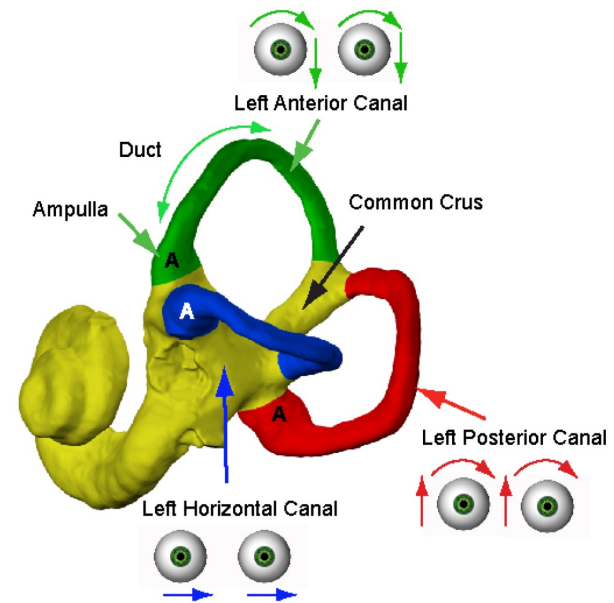


- Head movements cause crystals to move
- Sends false signals to the brain
- Triggers the VOR- vertigo (nystagmus)
- Triggers the VSR- imbalance

Testing for BPPV: Dix Hallpike

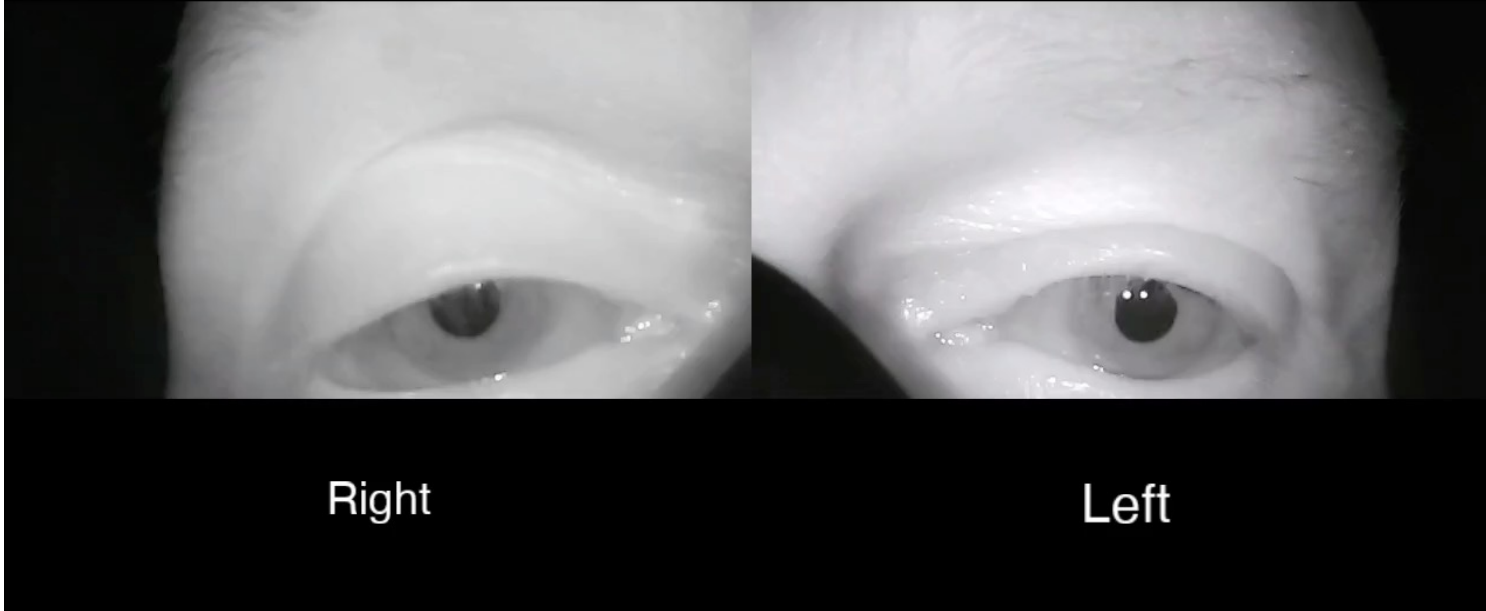
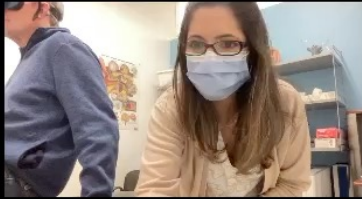


CARDINAL SIGN BPPV: NYSTAGMUS



Picture Courtesy of GM Halmagyi/M Welgampola/H MacDougall

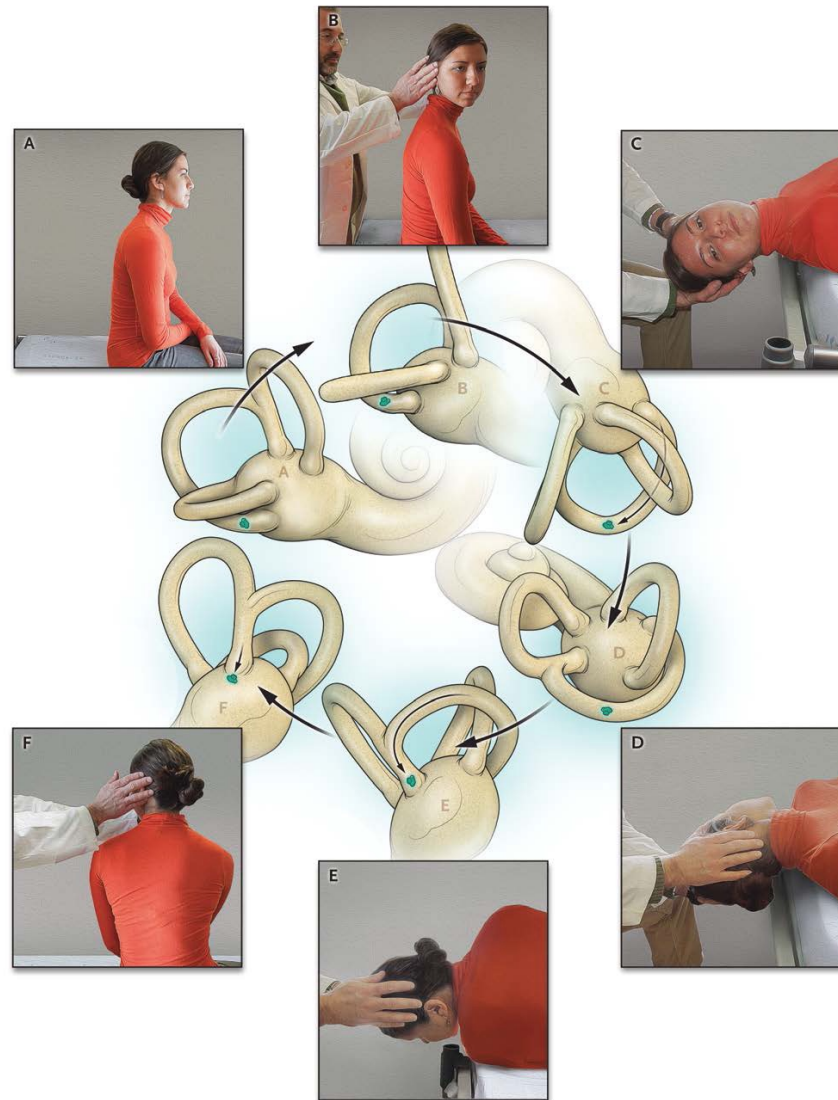
Dix-Hallpike



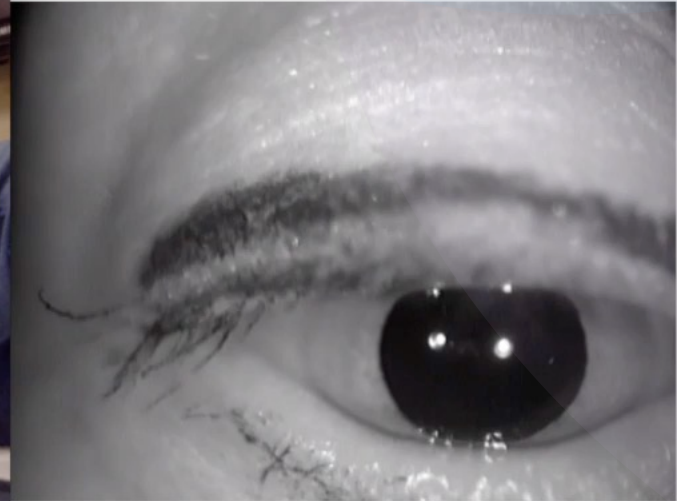
Right

Left

Treatment

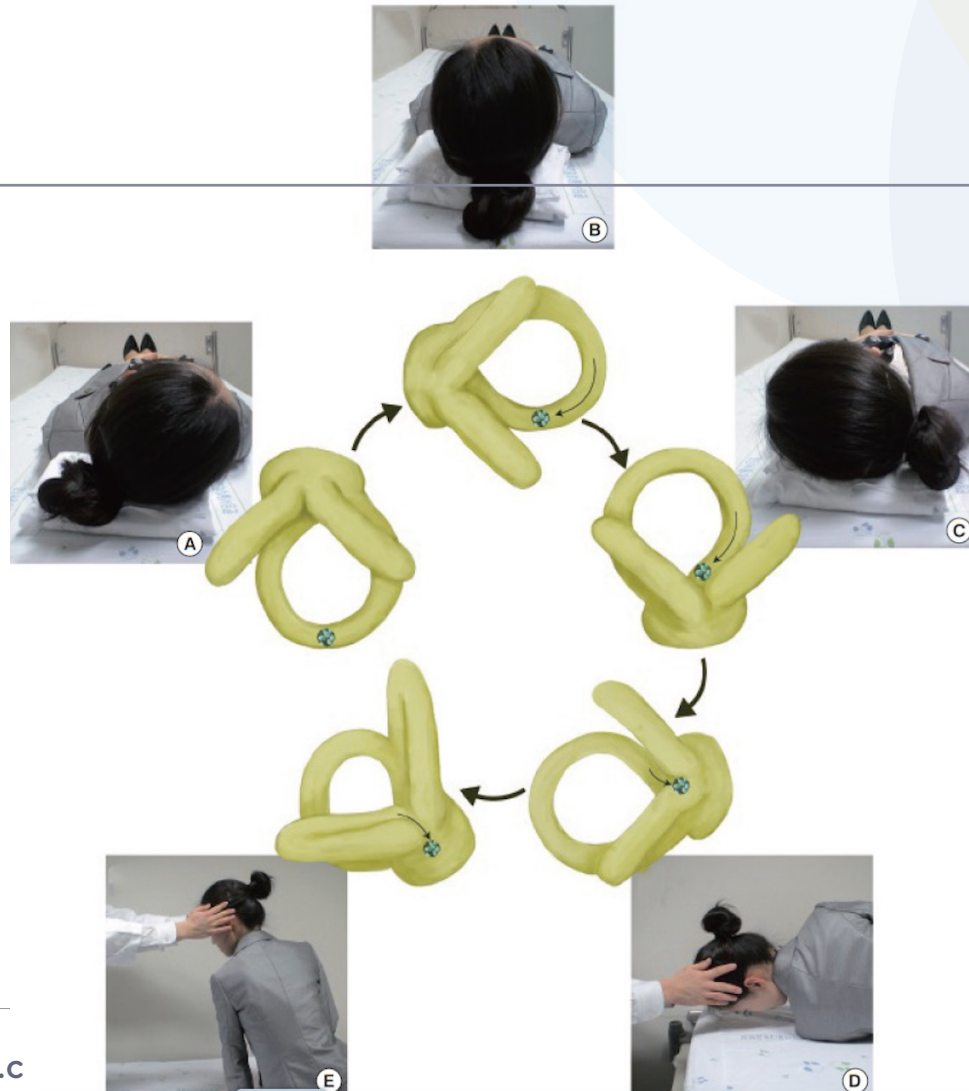


Supine Roll test: Horizontal canal



Connect audio using an "RCA" audio cable.

Treatment



BPPV Treatment

Clinical Practice Guideline

Clinical Practice Guideline: Benign Paroxysmal Positional Vertigo (Update)

**Neil Bhattacharyya, MD¹, Samuel P. Gubbels, MD²,
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SAGE

Strong Evidence to
support diagnostic
assessments and
treatment maneuvers

80-90% success rate
within 1-3 treatments

Post-traumatic BPPV

BPPV due to head injury is often more complex & difficult to treat

- 67% require multiple treatments (vs. 14% idiopathic)
- 25% bilateral (vs. 2% idiopathic)
- 3x more likely to be in multiple canals
- 57% had recurrence (vs. 19% idiopathic in 22 month f/u)

(Gordon, 2004; Liu H, 2012)

Vestibular Hypofunction

- Loss of balance activity in one or both ears
- Causes: temporal bone fracture, injury to canals, utricle or saccule or the vestibular nerve
- Symptoms: Dizziness, Vertigo, Imbalance, Oscillopsia- will last hours to days
- Treatment: Teach brain to compensate for asymmetric vestibular signals through exercise

Assess: Vestibular Ocular Reflex

- Assess VOR with Head Impulse Test clinically
- Can do video Head Impulse Test if access to lab tests

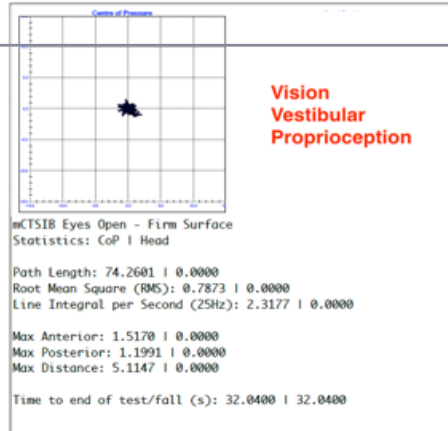
Vestibular Ocular Reflex training

- Maintain visual fixation on targets during head movements- target must stay stable and in focus
- Start with stationary targets and progress to complex targets and eventually moving targets
- 12-20 minutes per day



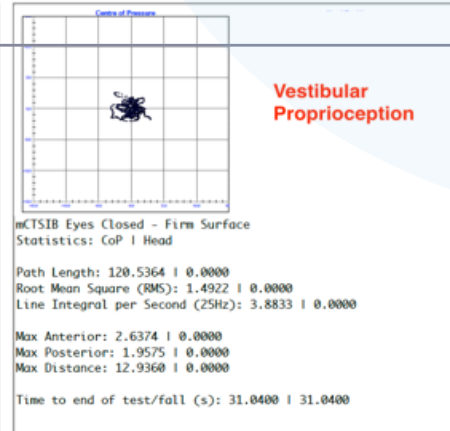
Assess: Vestibular Spinal Reflex

Firm surface
Eyes open

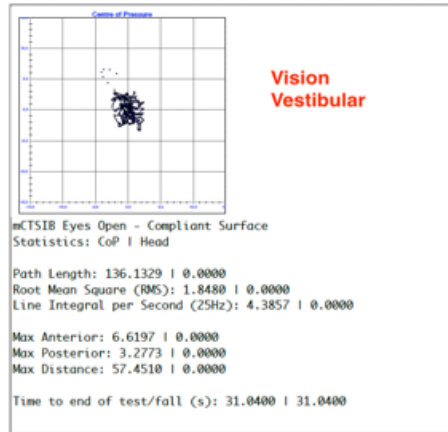


**Vestibular
Proprioception**

Firm surface
Eyes closed

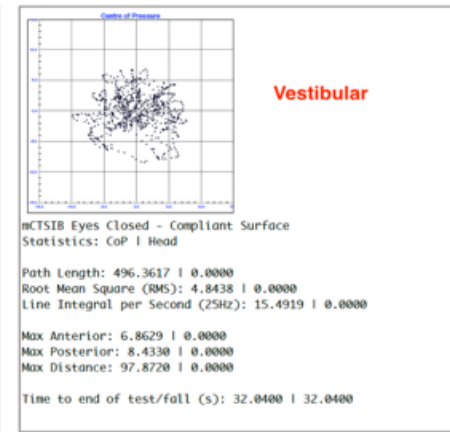


Compliant surface
Eyes open



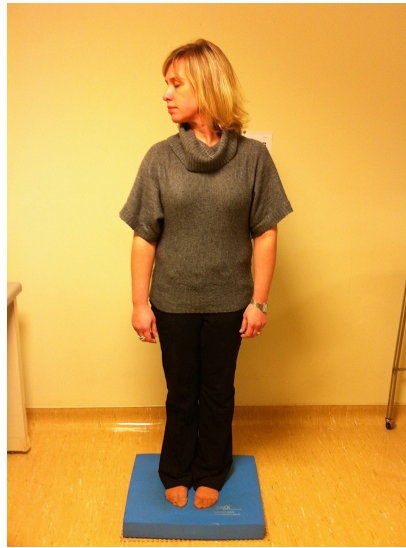
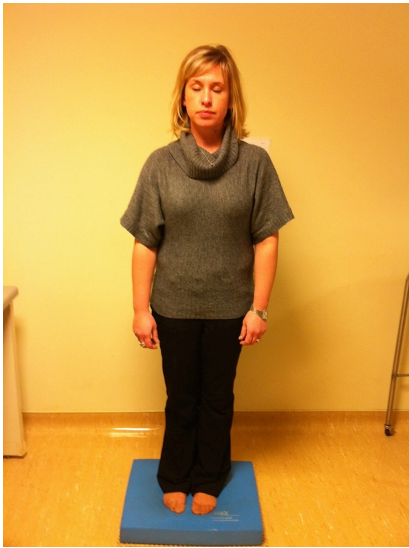
Vestibular

Compliant surface
Eyes closed



Balance Training

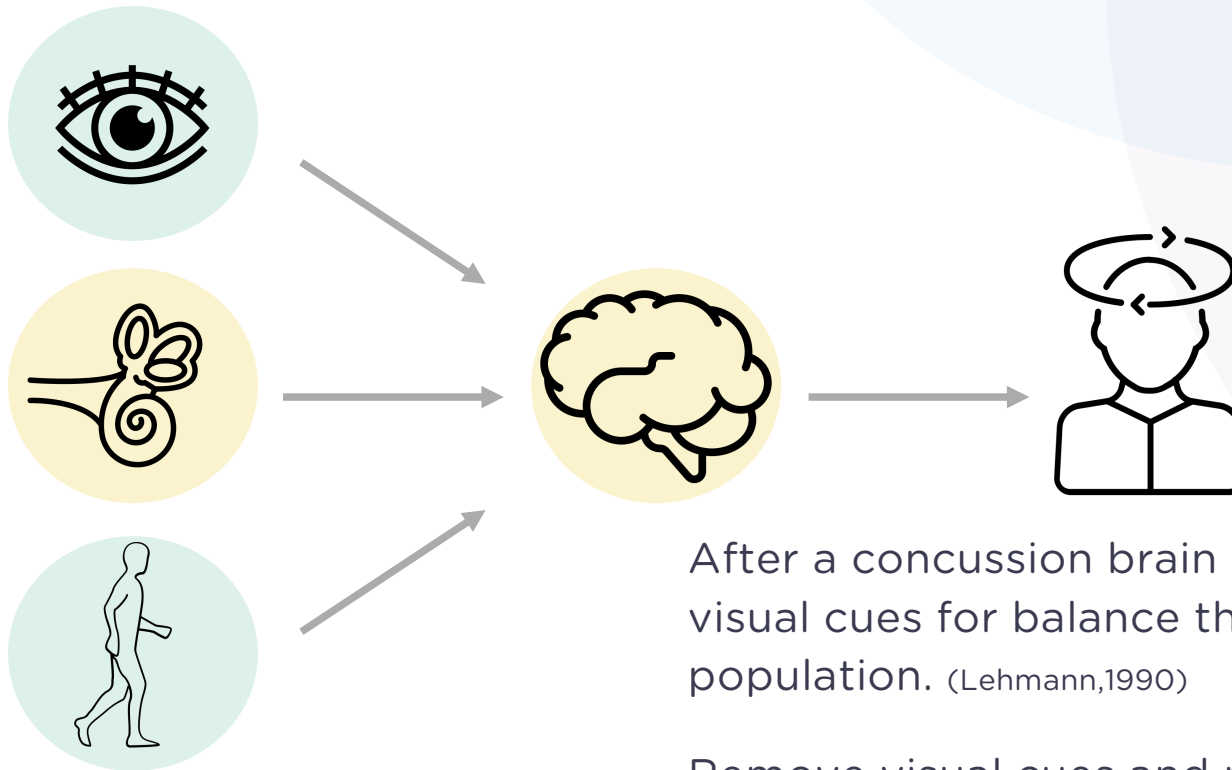
- When standing on a compliant surface with vision removed, this preferentially challenges the vestibular system



Persistent Postural Perceptual Dizziness

- Symptoms
 - Nearly constant dizziness (non-spinning)
 - Floating, swaying or rocking
 - Sense of unsteadiness
- Duration: present for more than 3 months
- Worse : upright posture, motion, fatigue, complex visual stimulation

Persistent Postural Perceptual Dizziness



After a concussion brain often relies more on visual cues for balance than an able-bodied population. (Lehmann,1990)

Remove visual cues and patients post concussion often have a hard time balancing. (Guskiewicz, 2001)

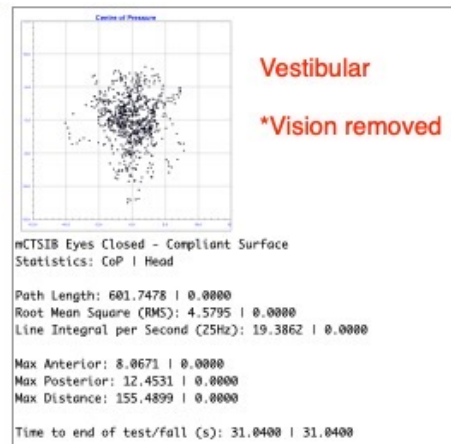
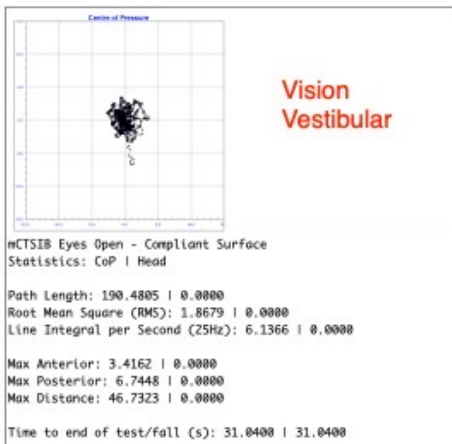
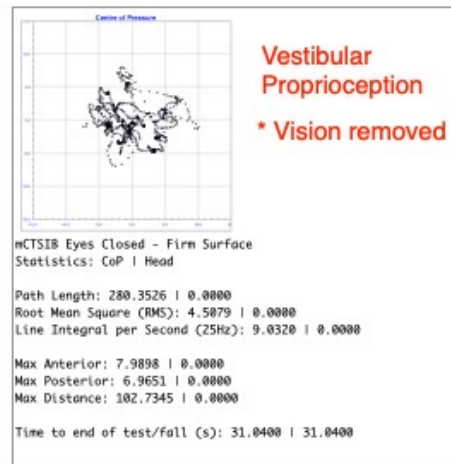
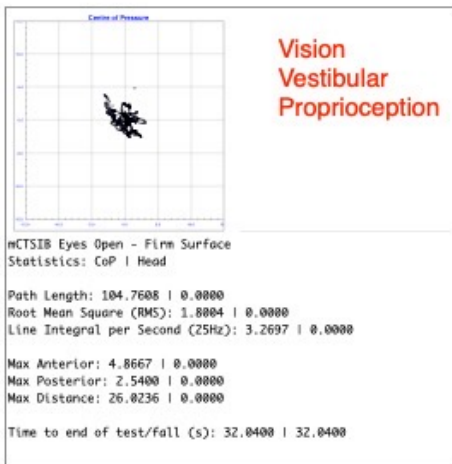
Persistent Postural Perceptual Dizziness

Overusing visual information for balance

- dizziness with complex visual stimuli
- hypersensitivity to visual motion

mCTSIB

Jun 27, 2022, 2:05:09 PM



Persistent Postural Perceptual treatment

Sensory re-weighting

- Normalize vestibular inputs
- Relearn how to use of vestibular inputs
- Down-regulate dependence on vision
- Up-regulate use of proprioception

Persistent Postural Perceptual treatment

Habituation

- Gradual repeated exposure
- Allows brain to adapt & desensitize
- Build tolerance

Persistent Postural Perceptual treatment

De-escalation strategies

- Close eyes
- Surface orientation
- Breathing control
- Cognitive reframing
- Distraction

Need to address

- Anxiety
- Mood
- Catastrophization
- Fear-avoidance behaviours

What is vestibular rehab?

- Exercise based program
- Delivered by specially trained physiotherapists
- Improve problems caused by vestibular disorders

Goals of vestibular rehab

Promote central compensation for the vestibular loss

- Reduce vertigo and dizziness
- Improve balance/mobility/confidence
- Prevent falls
- Improve visual symptoms/gaze stability

What does therapy involve?

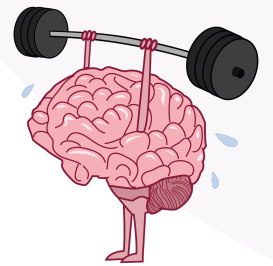
Comprehensive assessment

- Understanding your symptoms and priorities
- Clinical tests of inner ear and central vestibular function
- Evaluate balance and walking abilities
- Establish a diagnosis and prognosis

What does therapy involve?

Treatment guided by assessment & your goals

- Individualized and targeted
- Active and exercise based
- Focused on meaningful activities and improving function
- Home exercise program



Aerobic exercise

Walking x 20-30 min

Gradually increase time and intensity

Benefits:

- Facilitate vestibular stimulation
- Allow the brain to compare vision, vestibular, & proprioceptive inputs
- Increase BDNF → helps neuroplasticity
- Improve fitness & activity tolerance
- Reduce anxiety & improve mood

Is vestibular rehab effective?

CLINICAL PRACTICE GUIDELINES

Vestibular Rehabilitation for Peripheral Vestibular Hypofunction: An Evidence-Based Clinical Practice Guideline

FROM THE AMERICAN PHYSICAL THERAPY ASSOCIATION
NEUROLOGY SECTION



Cochrane Database of Systematic Reviews

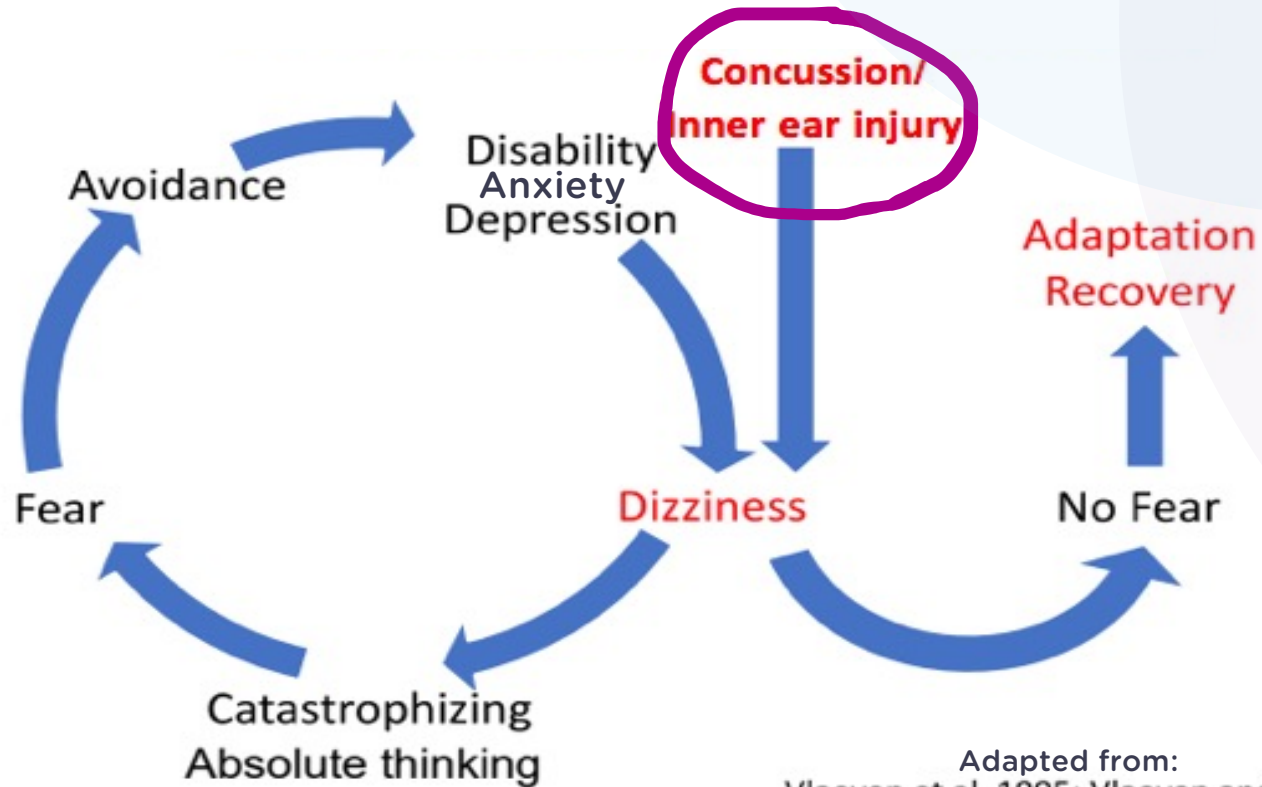
**Vestibular rehabilitation for unilateral peripheral vestibular
dysfunction (Review)**

(Hall et al., 2016; McDonnell & Hillier, 2015)

Barriers to recovery

WHY PATIENTS DON'T GET BETTER DESPITE OUR BEST
EFFORTS

Fear Avoidance Model



Adapted from:
Vlaeyen et al, 1995; Vlaeyen and Linton, 2000

Patient
A



+

Catastrophization

=

Symptoms

Patient
B



+

Catastro
phization

=

Symptoms

Source: Dr David Pothier

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, MChB, MSc, FRCS(ORL-HNS), DOHNS; Parita Shah, BSc; Lena Quilty, PhD; Miracle Ozoude, HBSc; Wanda A. Dillon, RN; John A. Rutka, MD, FRCS; 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 RESULTS 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 ($r = 0.6; P < .001$).

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.

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What to do if you have dizziness

- Consider ENT consultation
- Consider assessment with a vestibular rehabilitation physiotherapist

Take Home messages

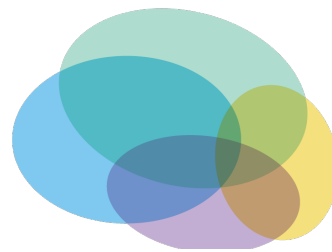
Dizziness is a common symptom after concussions and is often accompanied by balance impairments and visual symptoms

Initial presentation of dizziness is an important clinical finding and should be evaluated further with vestibular and balance testing

Benign Paroxysmal Positional Vertigo is the most common inner ear disorder and responds well to treatment

If patients are not improving, recognize and address the anxiety/catastrophization- could be beneficial as it will delay recover

Speak to your doctor if you have dizziness or feel free to contact us for a short phone consultation to see if Vestibular Physiotherapy is right for your symptoms.



THANK YOU!

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