Dizziness After Concussion

Canadian Concussion Centre Webinar Series
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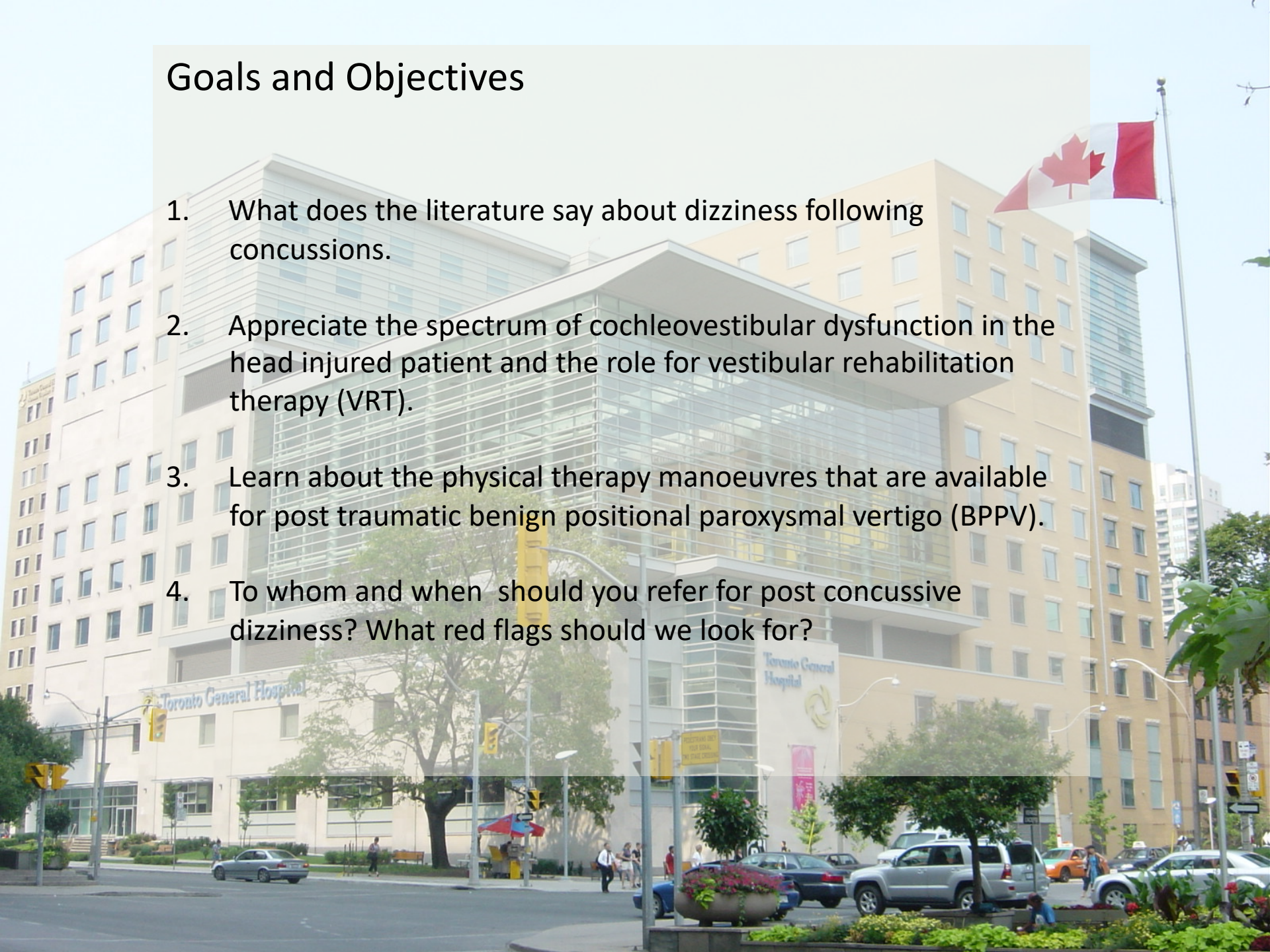
Goals and Objectives

1. What does the literature say about dizziness following concussions.

2. Appreciate the spectrum of cochleovestibular dysfunction in the head injured patient and the role for vestibular rehabilitation therapy (VRT).

3. Learn about the physical therapy manoeuvres that are available for post traumatic benign positional paroxysmal vertigo (BPPV).

4. To whom and when should you refer for post concussive dizziness? What red flags should we look for?



Mild/Minor Head Injury

Defined as:

- Closed head injury with or without LOC <30 min.
- A Glasgow Coma Scale of 13-15 at presentation.
- Resolution of post traumatic amnesia in 24 hrs.
- Normal intracranial imaging (CT/MRI).

Dizziness-post head injury/concussion

- Fact # 1

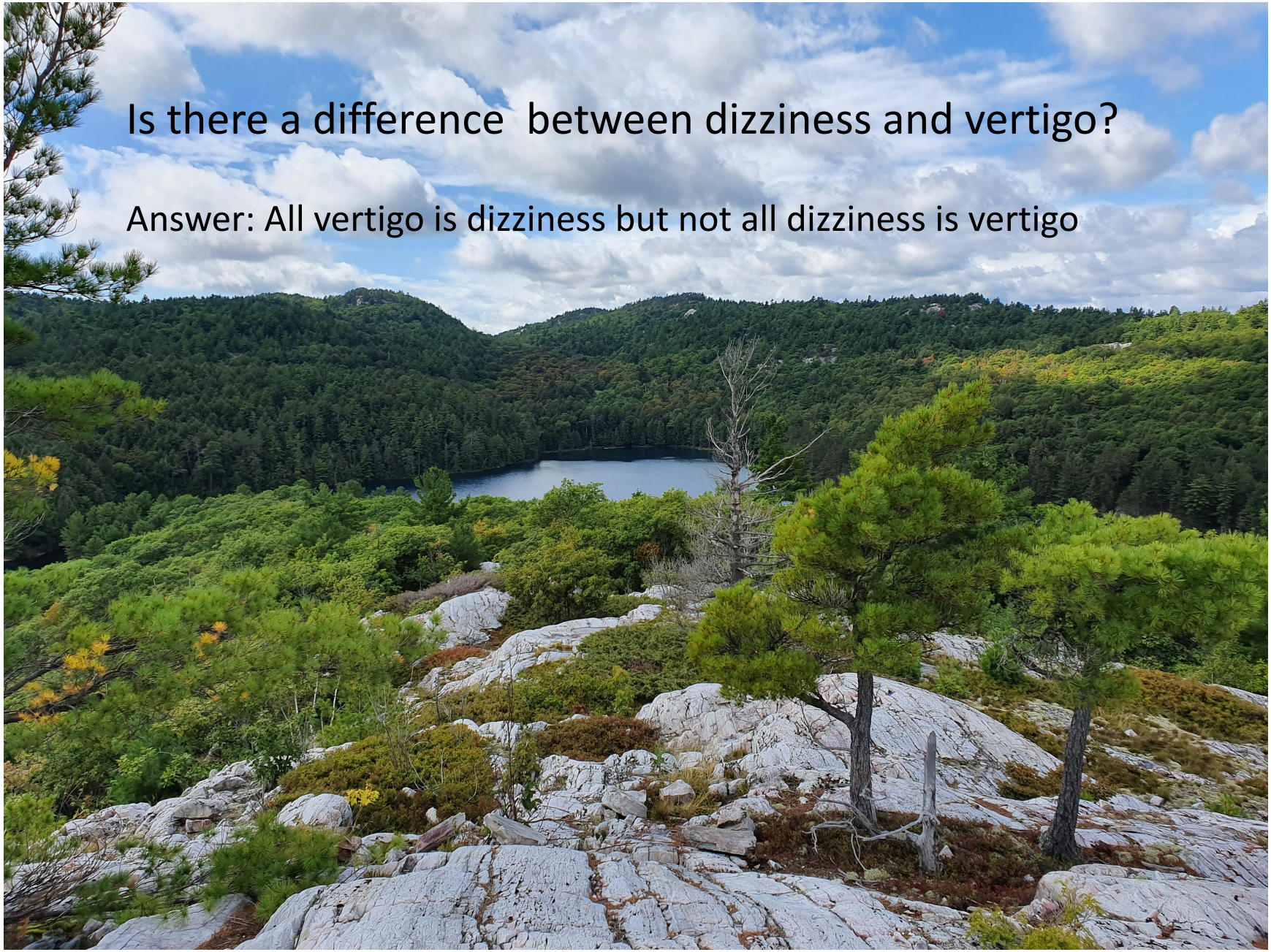
  Headaches, **neurocognitive/neuropsychological complaints** (ie memory loss/troubles concentrating/hypersensitivity to lights and noise/anxiety etc) and **dizziness** are the 3 most common symptoms post head injury.

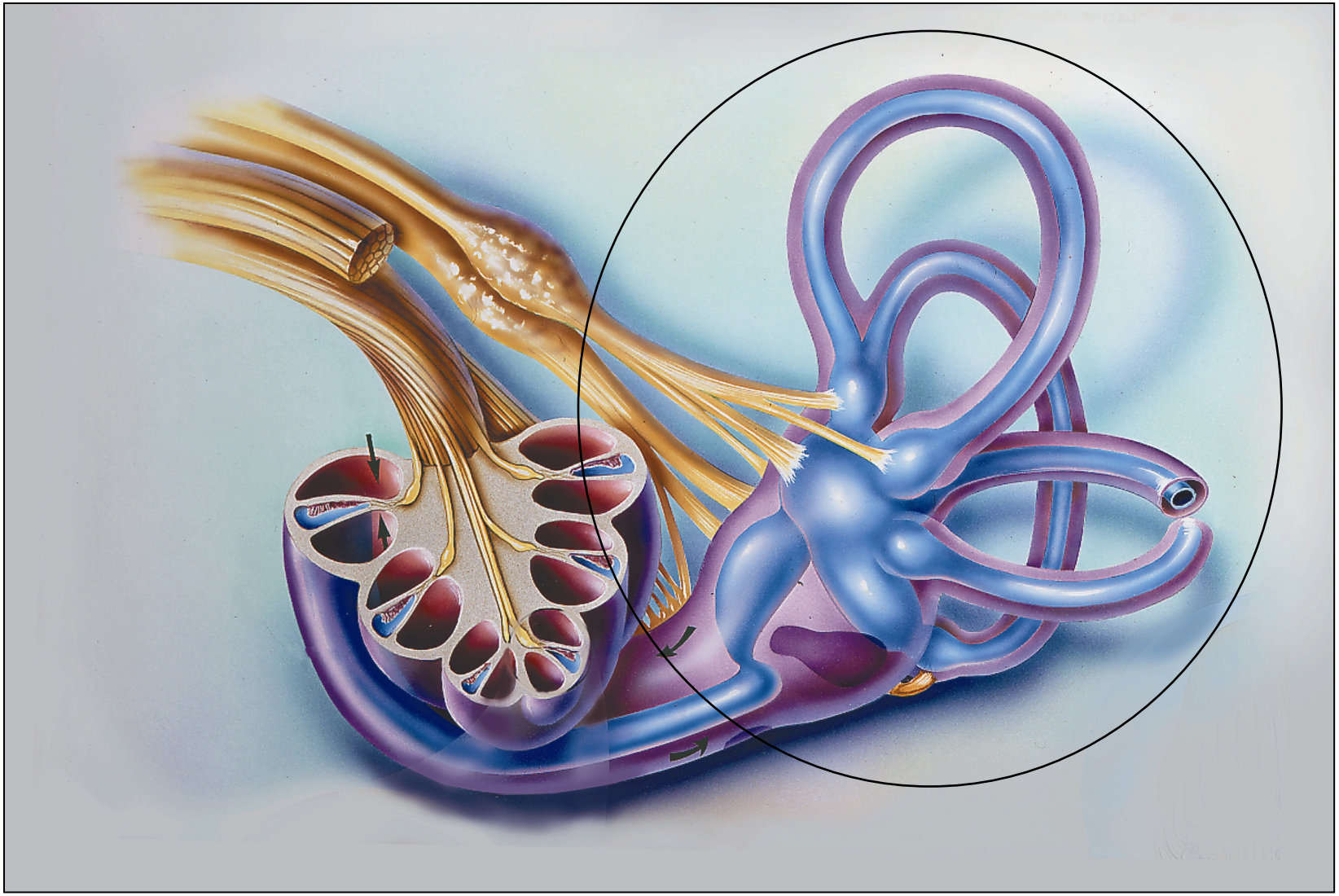
- Fact # 2

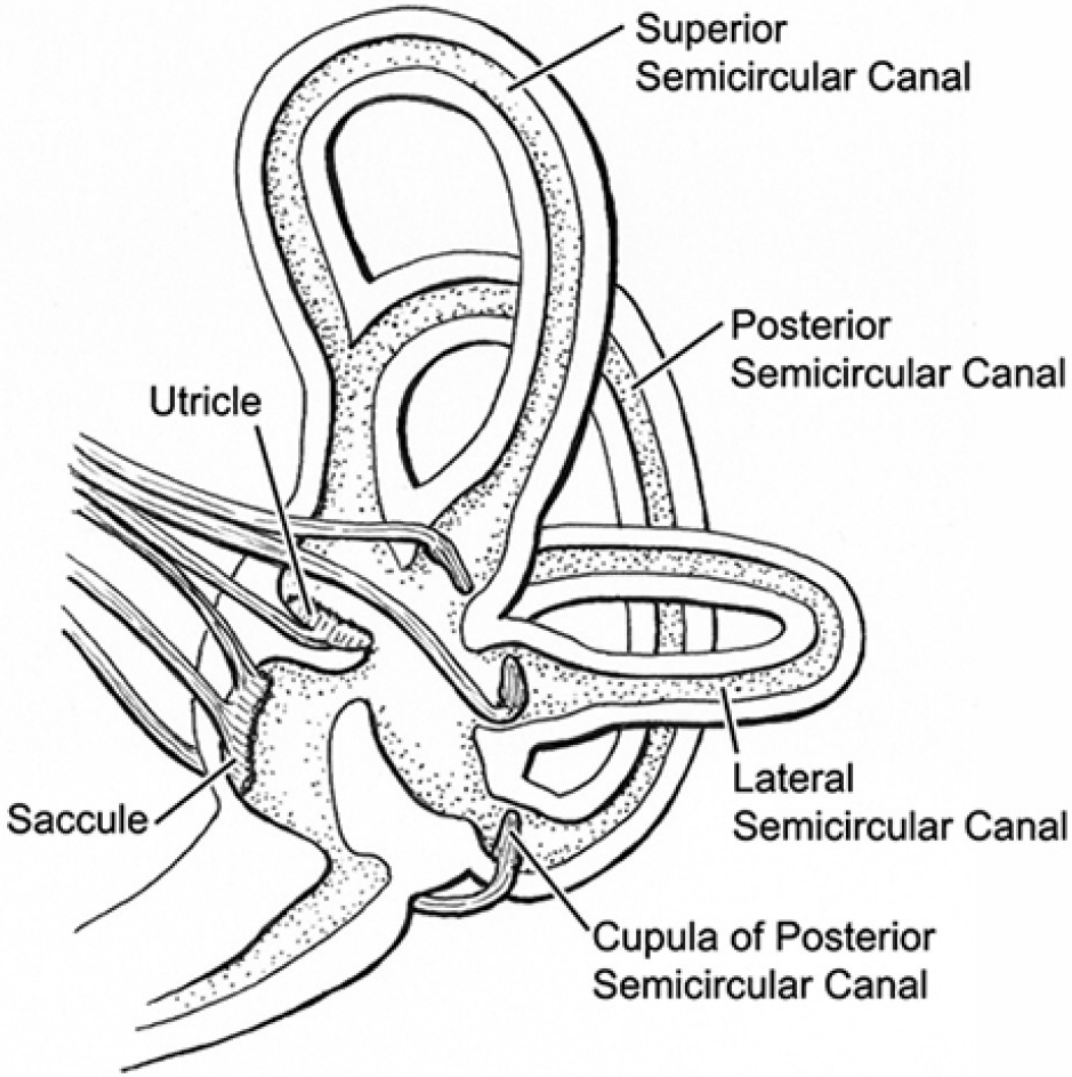
  Organic inner ear disorders are relatively rare overall. Most causes for dizziness are unknown or 2^{o} to medically unexplained or non-organic (anxiety/psychogenic) factors.

- Fact # 3

  Benign positional paroxysmal vertigo (BPPV) represents the most common recognized inner ear disorder identified following head injury.


Is there a difference between dizziness and vertigo?
Answer: All vertigo is dizziness but not all dizziness is vertigo




Superior
Semicircular Canal
Posterior
Semicircular Canal
Utricle
Lateral
Semicircular Canal
Saccule
Cupula of Posterior
Semicircular Canal

Facts about the Peripheral Vestibular System

Each inner ear contains 3 semicircular canals and 2 otolithic organs

- SCC's (superior, posterior and lateral) - angular acceleration perception
- Otolithic organs (utricle and saccule)-linear acceleration perception

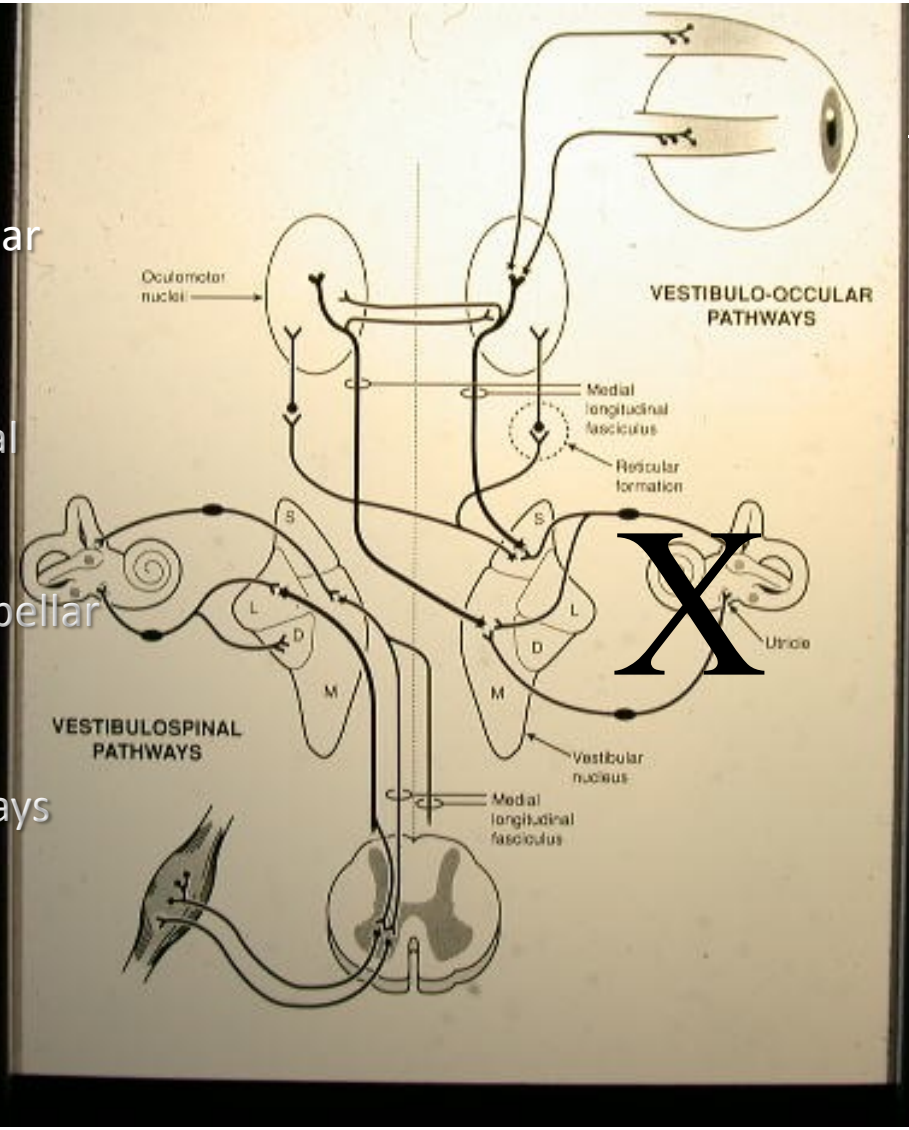
Vestibular nerve is an afferent connection between the inner ear and the brainstem

- Superior vestibular nerve-superior, horizontal SCC's and utricle
- Inferior vestibular nerve-posterior SCC and saccule
- **80% of the electrical traffic along the vestibular nerve comes from the otolithic organs; 20% from the semicircular canals**

The reality is that we know very little about the role of the otolithic organs even to this day

Vestibular Pathways

4 Pathways	Cardinal Signs
Vestibulo-ocular Reflex (VOR)	Nystagmus
Vestibulospinal Tracts (VST)	Falling to Side
Vestibulocerebellar Tracts (VCT)	Ataxia, Past Pointing
Emetic Pathways	Vomiting, Nausea



Head Thrust Testing of the Vestibulo-ocular Reflex (VOR)

scientific reports

OPEN

Post-traumatic peripheral vestibular disorders (excluding positional vertigo) in workers following head injury

Priyanka Misale, Fatemeh Hassannia✉, Sasan Dabiri, Tom Brandstaetter & John Rutka

Benign paroxysmal positional vertigo has typically been reported to be the most common cause of post-traumatic dizziness. There is however paucity in the literature about other peripheral vestibular disorders post-head injury. This article provides an overview of other causes of non-positional dizziness post-head trauma from our large institutional experience. The UHN WSIB Neurotology database (n = 4291) between 1998 and 2018 was retrospectively studied for those head-injured workers presenting with non-positional peripheral vestibular disorders. All subjects had a detailed neurotological history and examination and vestibular testing including video nystagmography, video head impulse testing (or a magnetic scleral search coil study), vestibular-evoked myogenic potentials, and audiometry. Imaging studies included routine brain and high-resolution temporal bone CT scans and/or brain MRI. Based on a database of 4291 head-injured workers with dizziness, 244 were diagnosed with non-positional peripheral vertigo. Recurrent vestibulopathy (RV) was the most common cause of non-positional post-traumatic vertigo. The incidence of Meniere's disease in the post-traumatic setting did not appear greater than found in the general population. The clinical spectrum pertaining to recurrent vestibulopathy, Meniere's disease, delayed endolymphatic hydrops, drop attacks, superior semicircular canal dehiscence syndrome, and uncompensated peripheral vestibular loss are discussed.

Severity of injury

a. Severity of injury (from clinical/imaging evidence)

1	Minor head injury	3472	80.91%
2	Closed head injury	297	6.92%
3	Closed head injury +skull fracture	429	9.99%
4	Open/compound skull fracture	23	0.53%
5	Minor head injury + CSF leak only	2	0.04%
2+5	Closed head injury + CSF leak	1	0.02%
3+5	Closed head injury + skull fracture + CSF leak	24	0.55%
4+5	Open skull fracture + CSF leak	6	0.14%
	Unknown	37	0.86
	Total	4291	100%

Diagnostic Groups in Data Base of Head Injured Workers (N=4,291)

Peripheral Vestibular Disorder	1152 (26.80%)
b. Peripheral Vestibular	244 (5.6%)
Cognitive Vestibular Disorder (Medically unexplained dizziness, Non-organic dizziness, Psychogenic dizziness, Chronic subjective dizziness, PPPD, MdDS, Visual-vestibular syndrome etc)	
–	
Unknown	
Total	4291 (100%)

Peripheral vestibular diagnosis

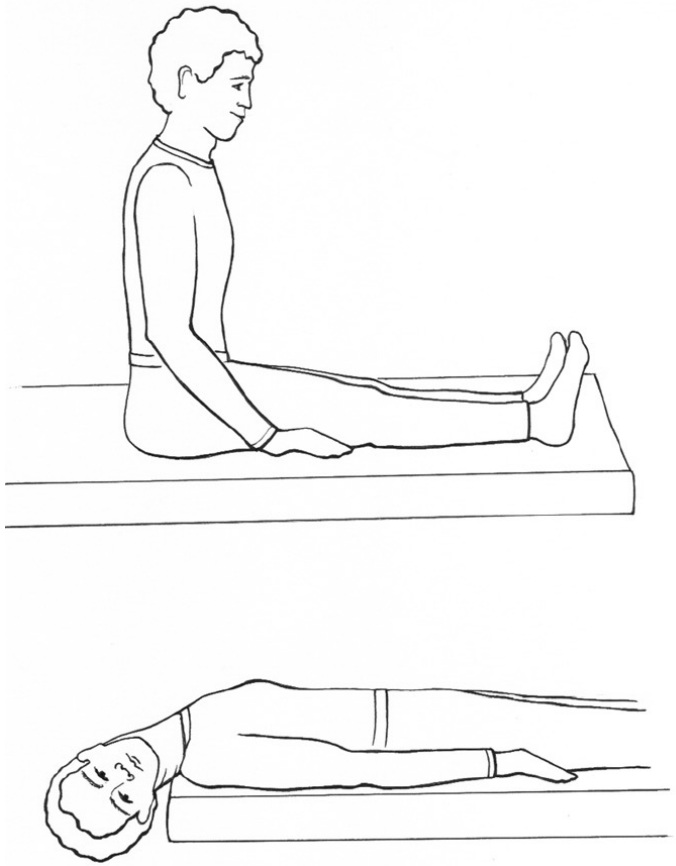
b. Peripheral vestibular diagnosis, N=244, 5.68% of data base

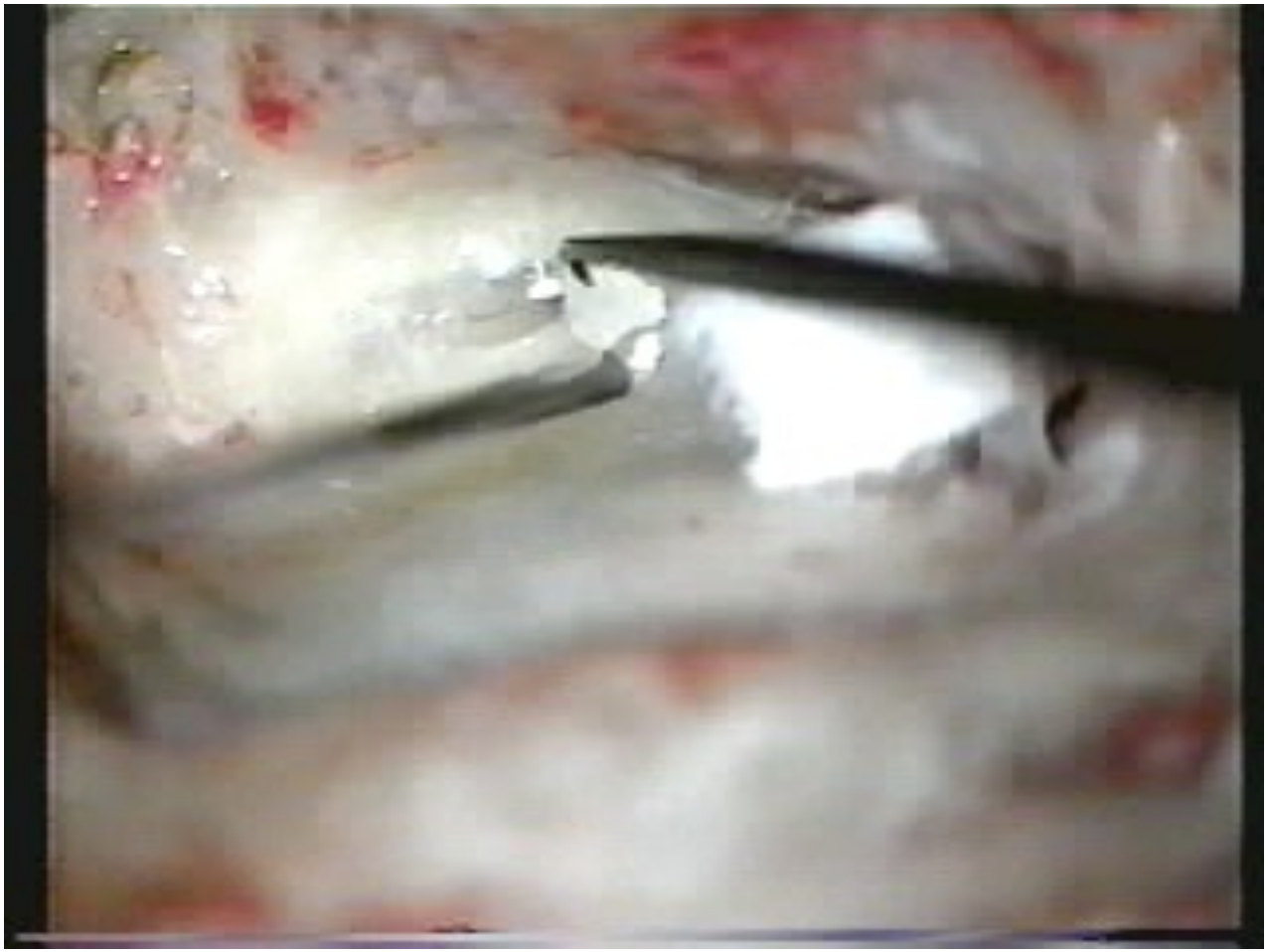
Diagnosis	N	%
Recurrent Vestibulopathy (RV)	49	1.14%
RV-Otolith based	29	0.67%
Uncompensated fixed vestibular loss	63	1.46%
Meniere's	11	0.25%
Delayed Endolymphatic Hydrops	10	0.23%
Drop Attacks	9	0.20%
SSCD	3	0.06%
Other/Unknown	69	1.6%
Total	244	5.68%

Common Inner Ear Disorders in Trauma

Disorder	Duration of Vertigo	Hearing Loss	Tinnitus
Positional Vertigo* a. Historical b. BPPV c. "Other" Positional Vertigo	Seconds Variable	+/-	+/-
Recurrent Vestibulopathy	Minutes -> Hours	-	-
Uncompensated "fixed" vestibular loss	Seconds	+/-	+/-
Undiagnosed peripheral	Variable	+/-	+/-

Fig. 4 Right Hallpike's Manoeuver

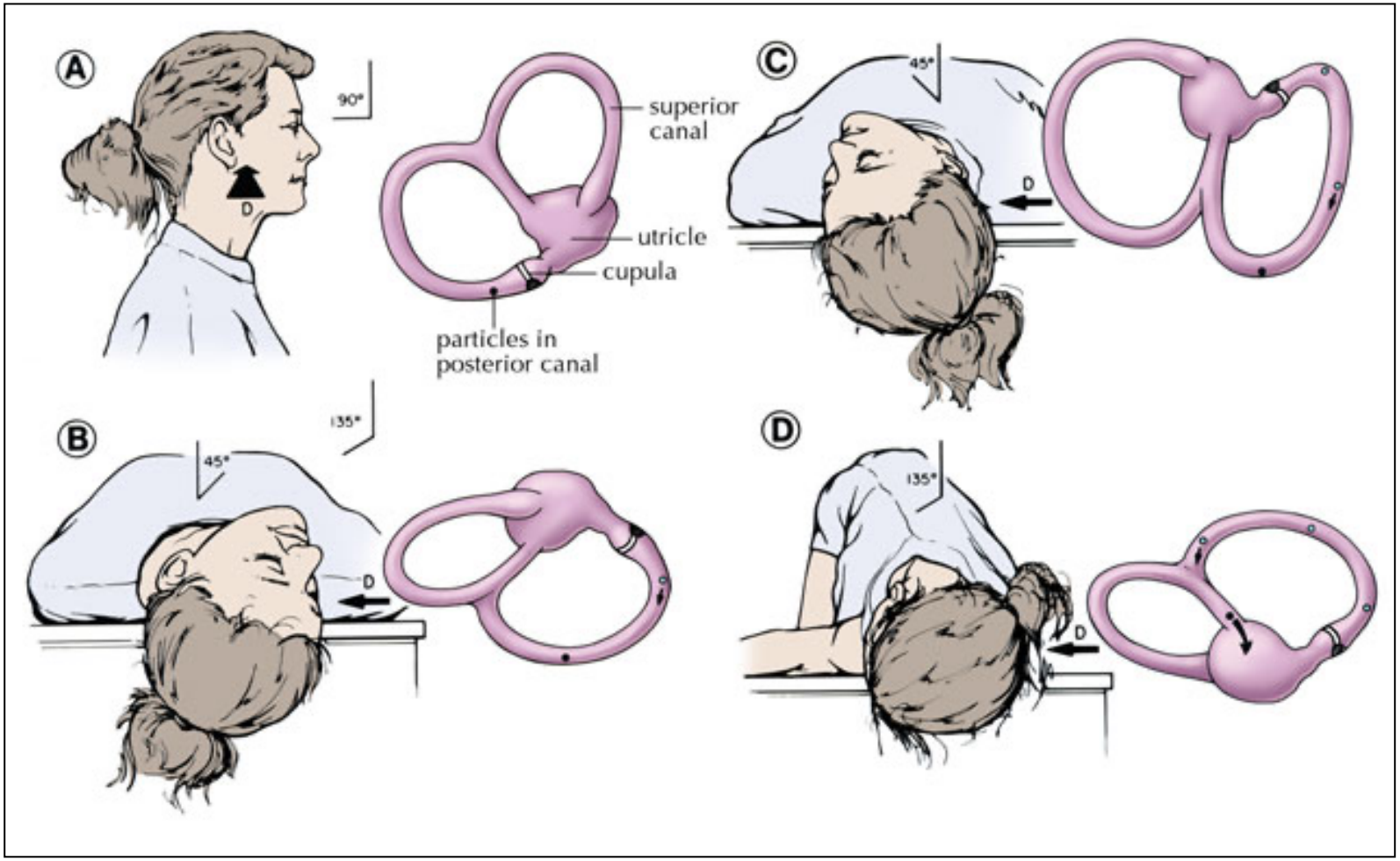




Canalolithiasis

Courtesy of Dr Lorne Parnes

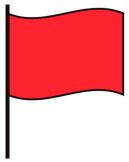
Particle Repositioning Procedure (PRP)/ Epley Manoeuvre



Particle Repositioning Procedure

Courtesy of Dr Lorne Parnes

The Red Flags For Dizziness:

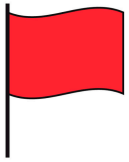


Who Should I Refer? Where should I refer?

For a Medical Assessment

- Those with persistent symptoms of dizziness/imbalance that does not improve or resolve over a 3-6 month timeframe.
- Those with complaints of episodic vertigo/dizziness (non-positional) lasting minutes to hours or unprovoked drops (drop attacks).
- Those with complaints of hearing loss/tinnitus/anosmia (smell dysfunction)

The Red Flags For Dizziness:



For Vestibular Rehabilitation (Physiotherapy) Therapy (VRT)

- Those with history highly suggestive for positional vertigo.
- Dizziness aggravated by head movement
  (ie failure to compensate for an underlying vestibular loss).
- Dizziness with motion relative to self
  (visual-vestibular mismatch/supermarket syndrome/motion sickness)

Caveat: VRT is unlikely to provide any benefit to an individual with a significant underlying mood disorder until this is treated appropriately.

Diagnoses not without some controversy post concussion (in my opinion)

- Cervicogenic vertigo
- Vestibular Migraine (migraine associated vertigo)
- Syndromes of Cognitive Vestibular Dysfunction

  General-psychogenic dizziness, medically unexplained dizziness, chronic subjective dizziness, non-organic dizziness

  Specific-chronic phobic dizziness, persistent postural perceptual dizziness, mal d'embarquement, visual-vestibular syndromes, post-traumatic vision syndrome)

Medically Unexplained Dizziness

All seem to share many similar features and while the epiphenomenon may have been an acute vestibular event the generator is likely from higher cognitive vestibular centers within the cortical brain.

- There seems to be significant functional (non-organic) interplay.
- VRT deemed unlikely to provide significant benefit usually.
- Treatment with sedatives (ie clonazepam)/antidepressant therapy (SSRI/SNRI's) often recommended.
- Role for cognitive behavioral therapy (CBT).
- The interplay of litigation/compensation claims/workplace issues will adversely affect any treatment provided (ie MVA/medicolegal suits/workplace harassment/toxic work environment) etc) further serves to "stir the pot".

Some Interesting Factoids/Questions

- What is the most physically dangerous job in Ontario?

  The answer might surprise you but in my opinion it is Tire Mechanics (for large trucks) from explosive injuries.

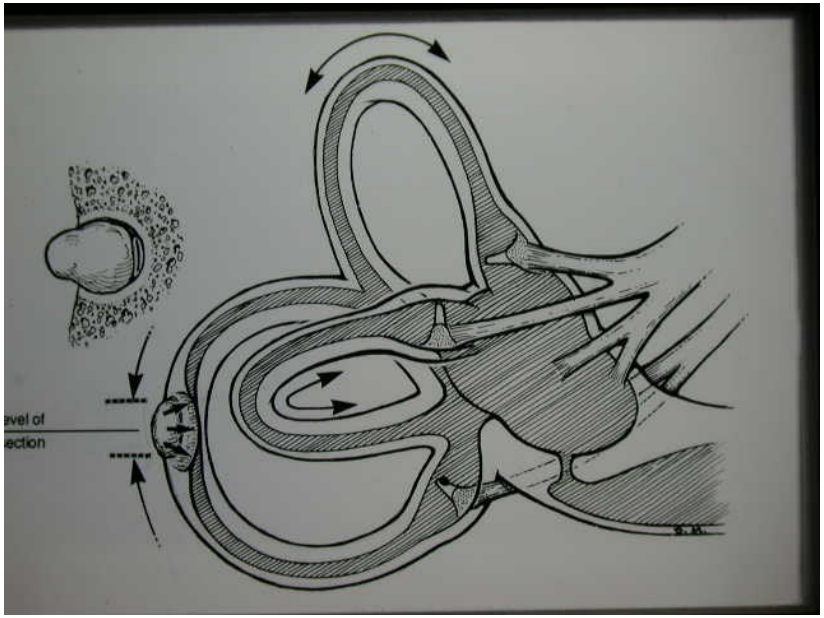
- What cranial nerve is injured the most often in head injury?

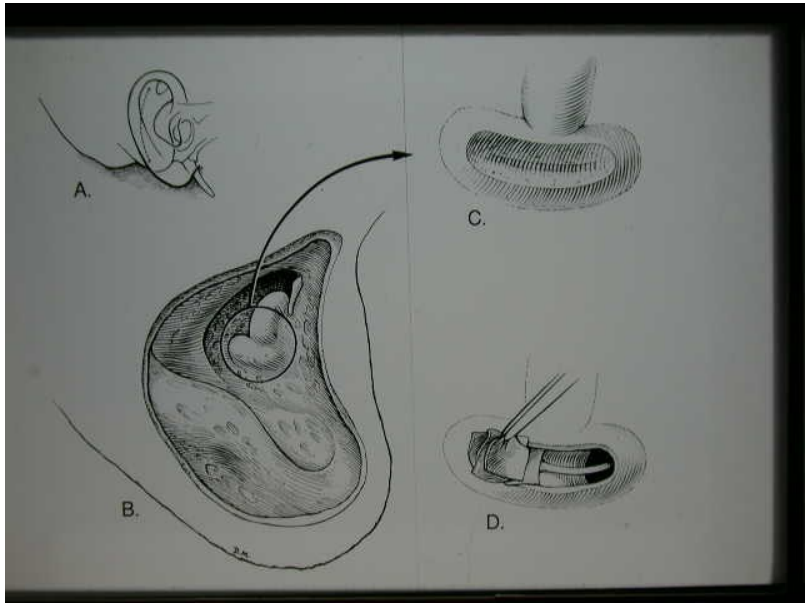
  Answer: The olfactory nerve.

- Does olfactory dysfunction indicate a worse prognosis for a return to work (RTW)?

  Comment: Further study is required to look at WSIB long term data to see if these individuals had greater psychological/cognitive issues.

Surgical Treatment of BPV





Posterior semicircular canal occlusion Sx

Dizziness Post Injury

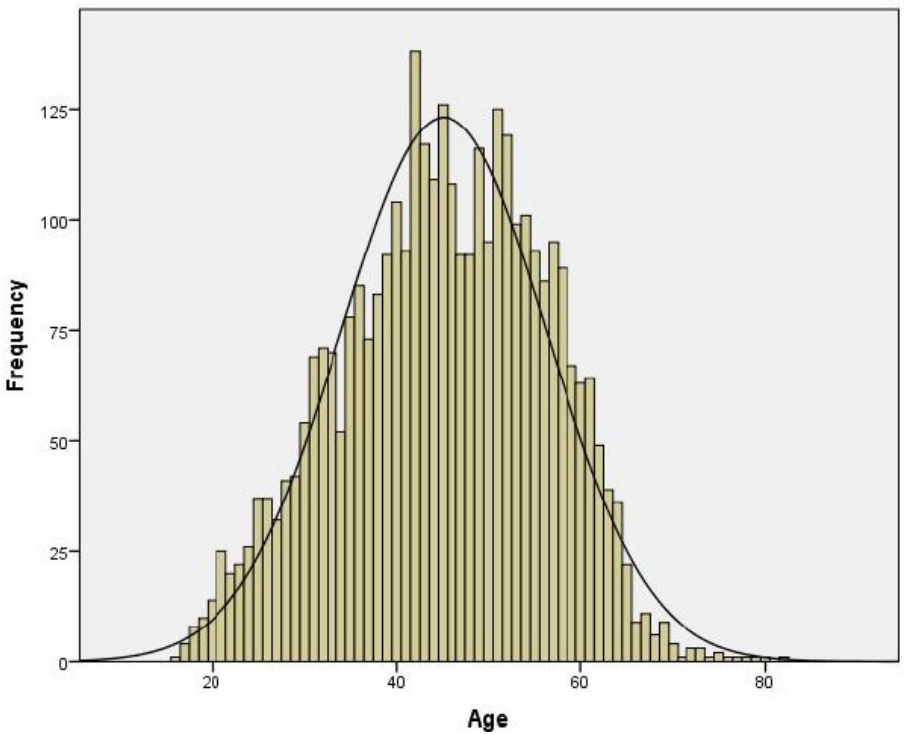
What does big data demonstrate?

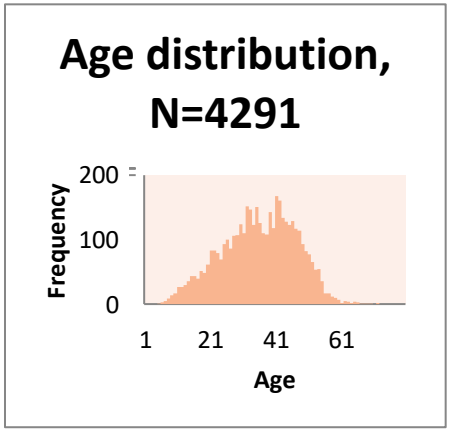
WSIB Neurotology Data Base (1988-2018)

N=4,291 pts

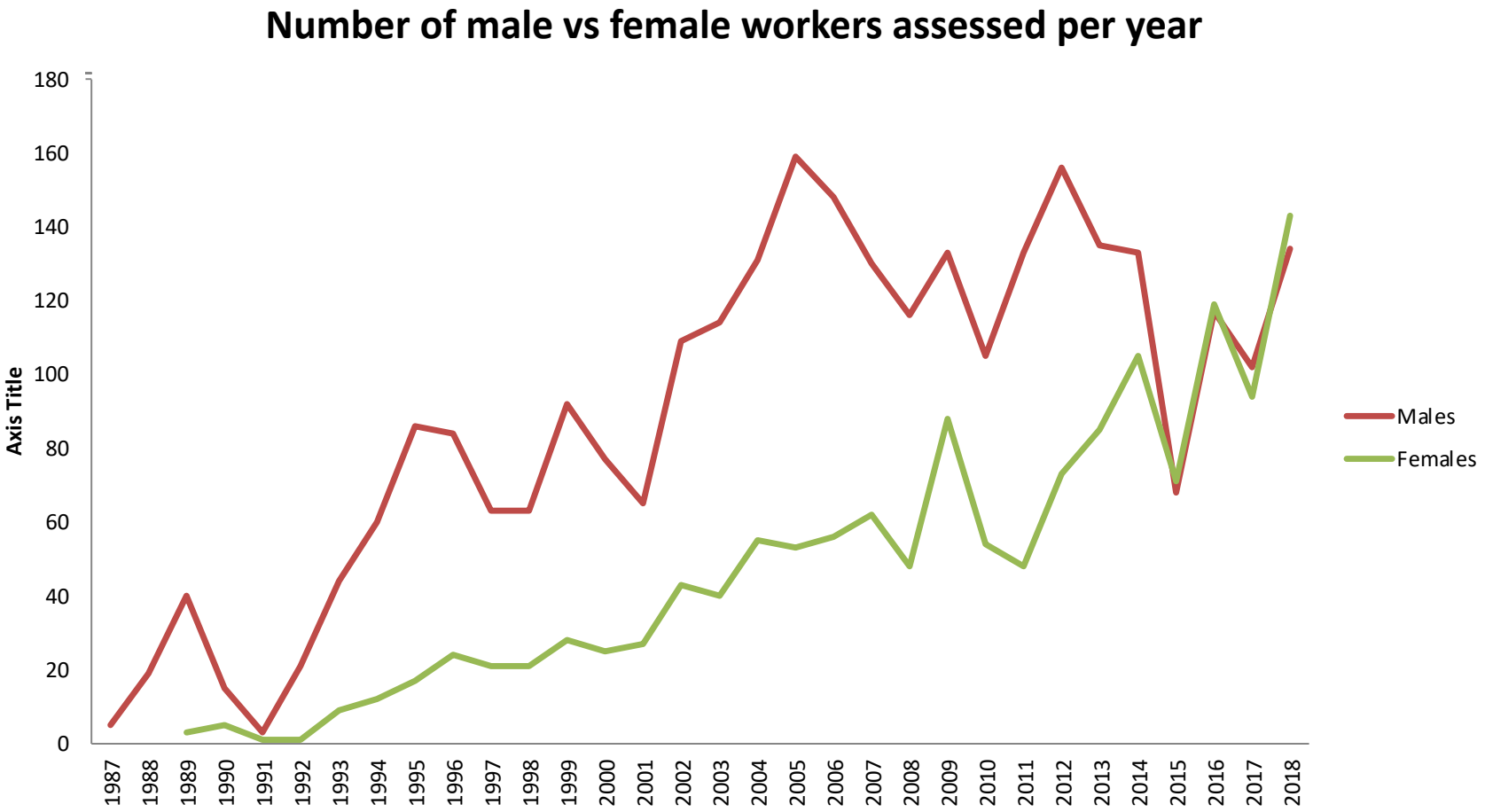
M:F= 2860 (66%):1,431 (34%)

Figure 5: Age Distribution: UHN WSIB Neurotology Data Base 1988-2014

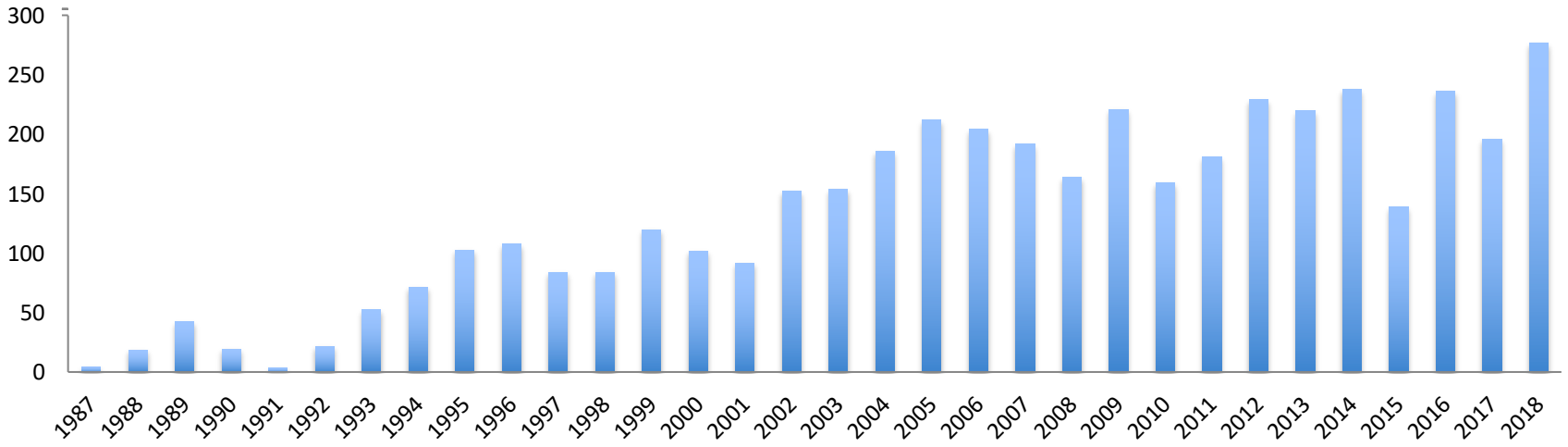




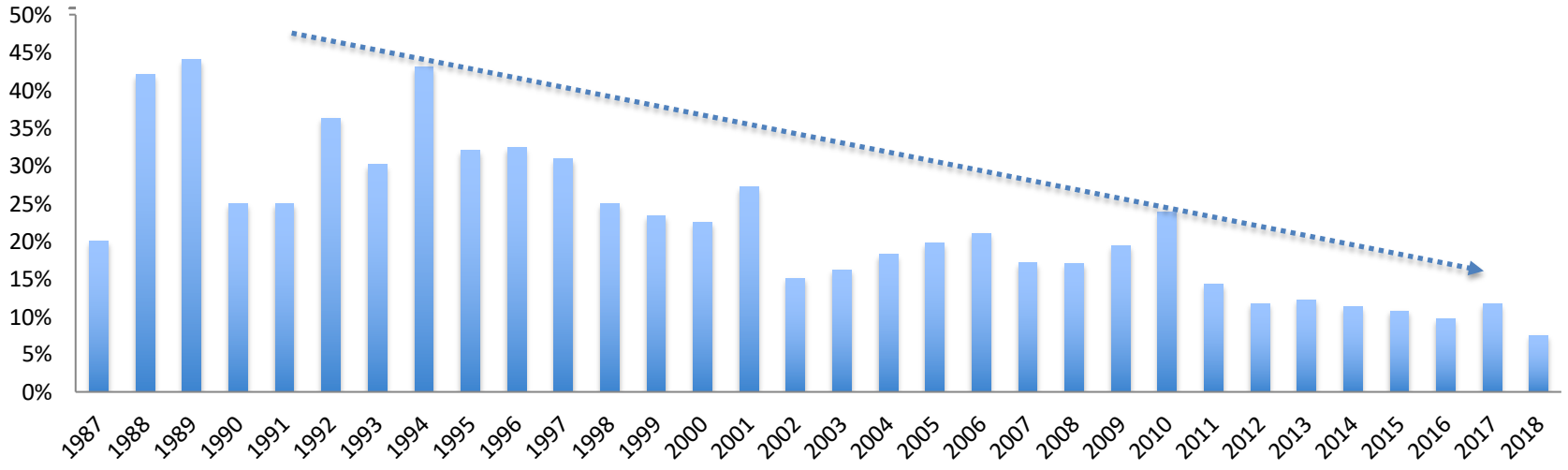
Work Injuries M:F



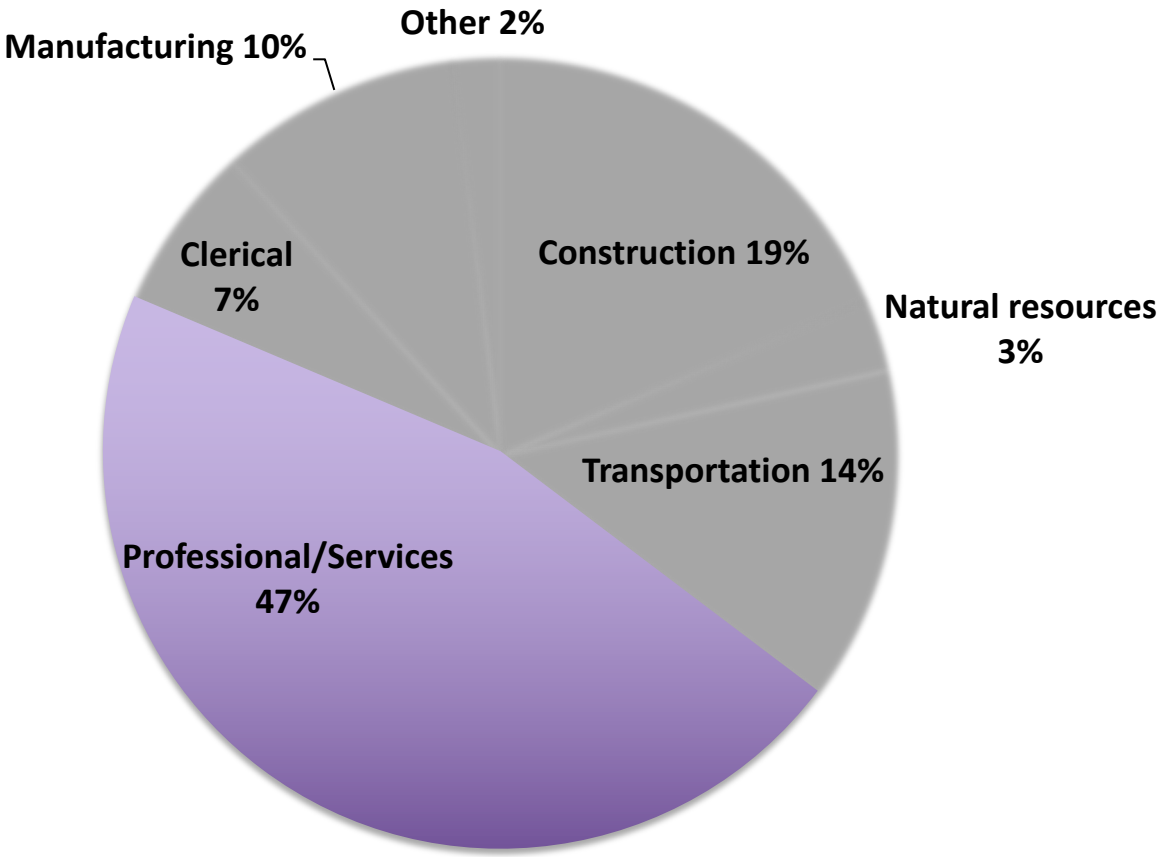
Patients assessed per year



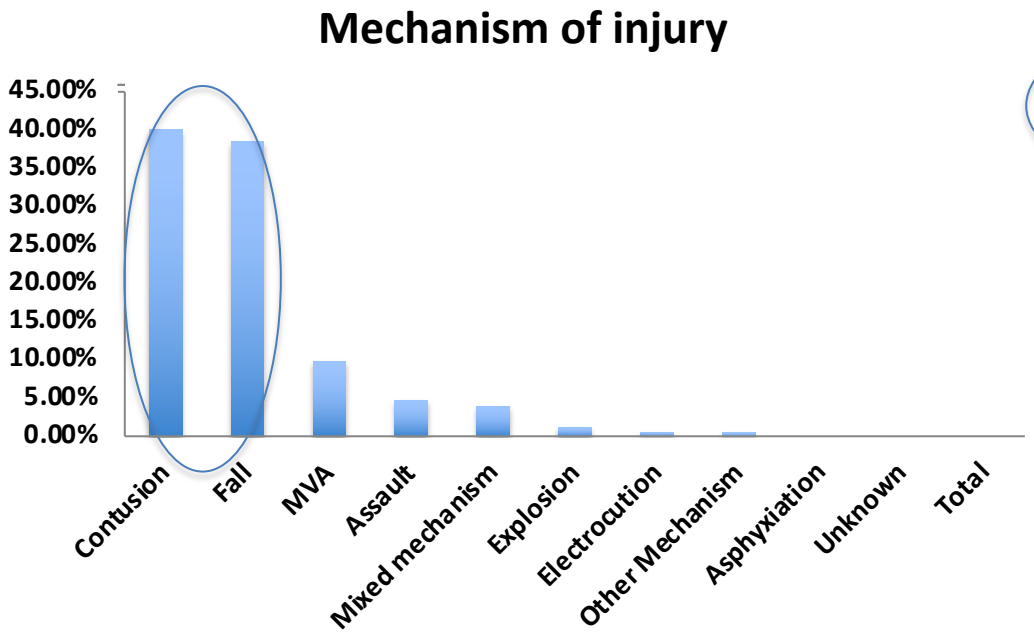
More severe head injuries (%) over the years by referral



Injury by Professions

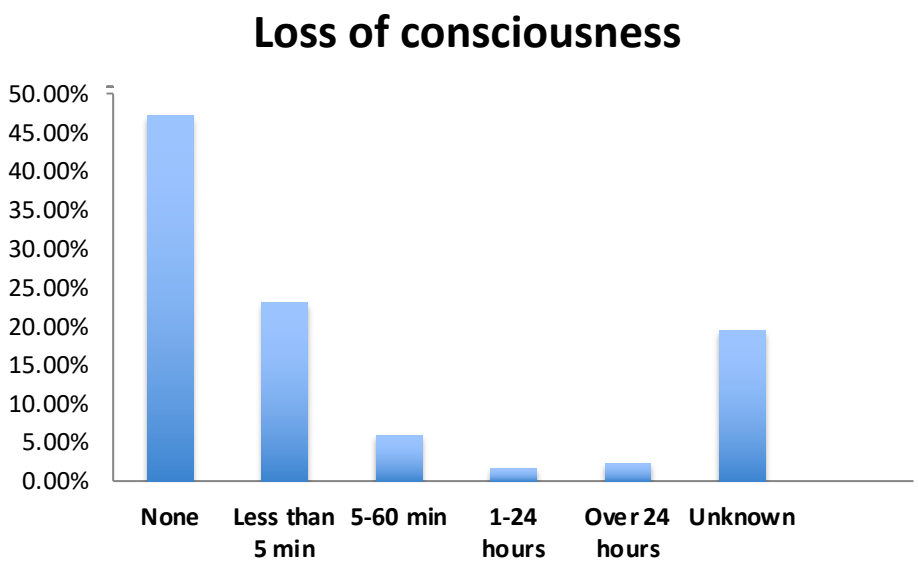


Mechanism of injury



Contusion	1718	40.03%
Fall	1654	38.50%
MVA	423	9.85%
Assault	295	4.77%
Mixed mechanism	172	4.00%
Explosion	55	1.28%
Electrocution	29	0.67%
Other Mechanism	25	0.58%
Asphyxiation	5	0.11%
Unknown	5	0.11%
Total	4291	100.00%

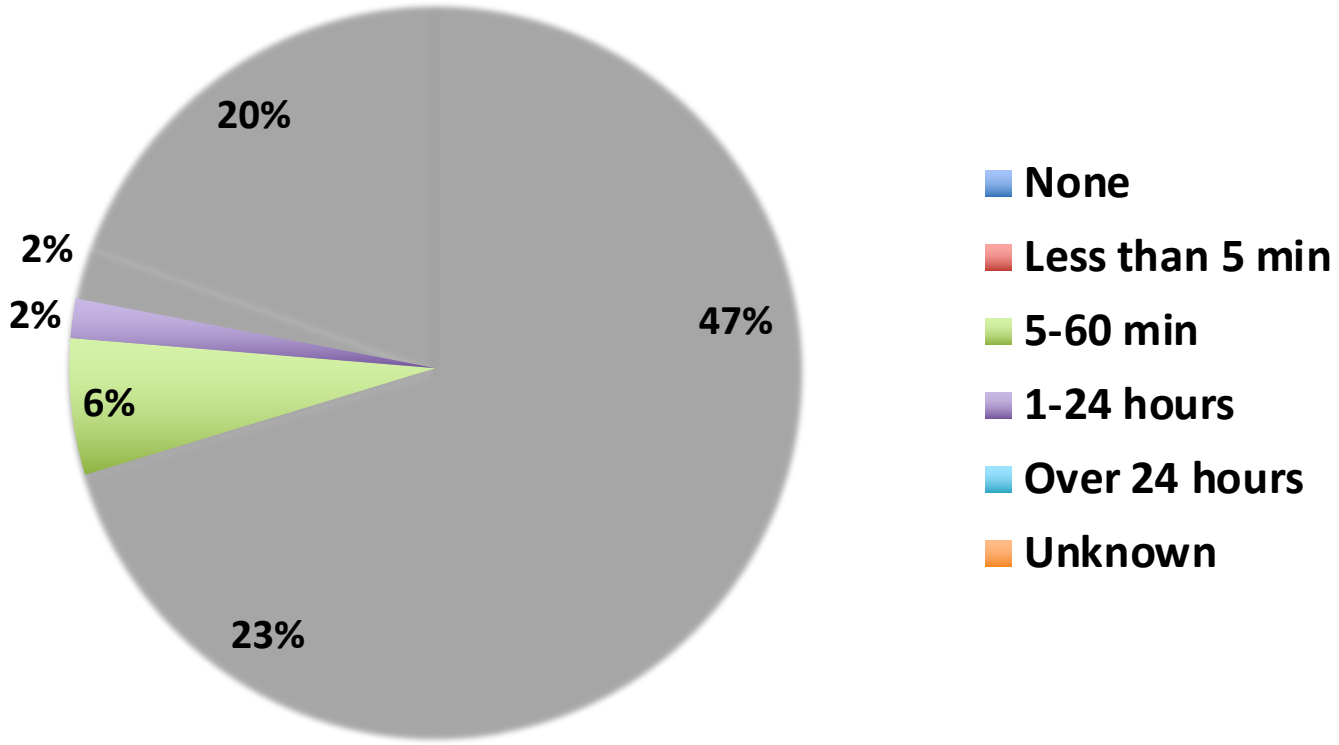
Loss of Consciousness (LOC)



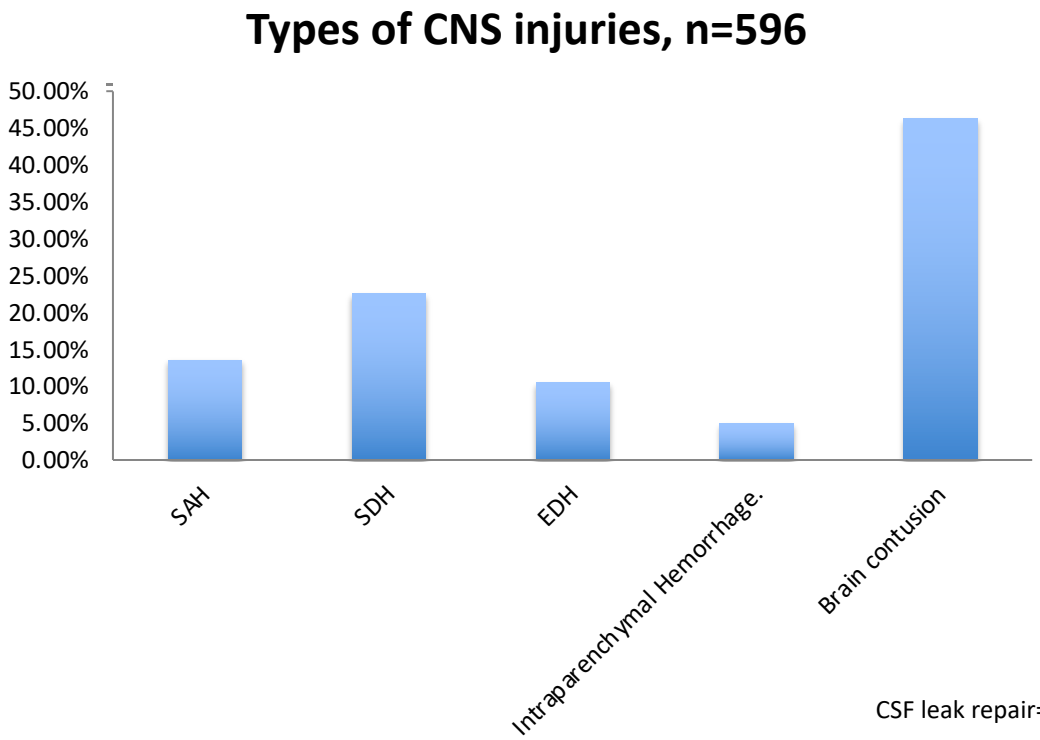
b. Duration of loss of consciousness

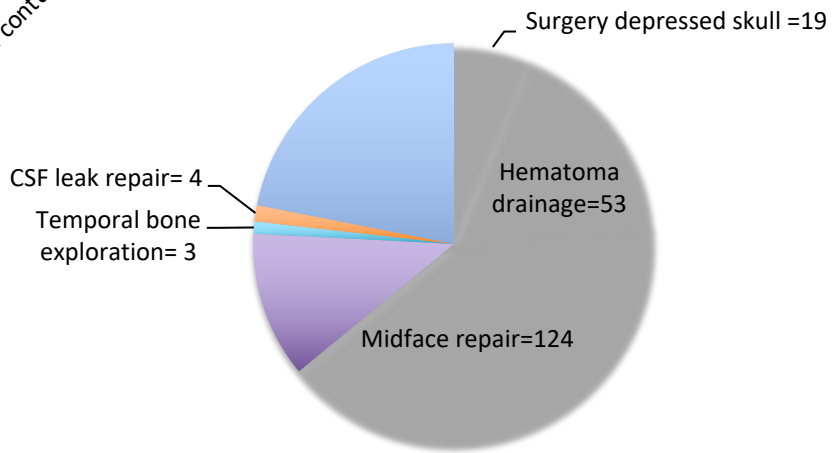
Time	Frequency	Percent
None	2025	47.19%
Less than 5 min	991	23.09%
5-60 min	258	6.01%
1-24 hours	75	1.74%
Over 24 hours	105	2.44%
Unknown	837	19.50%
Total	4291	100.00%

Graph: LOC and its duration (n=4,291)

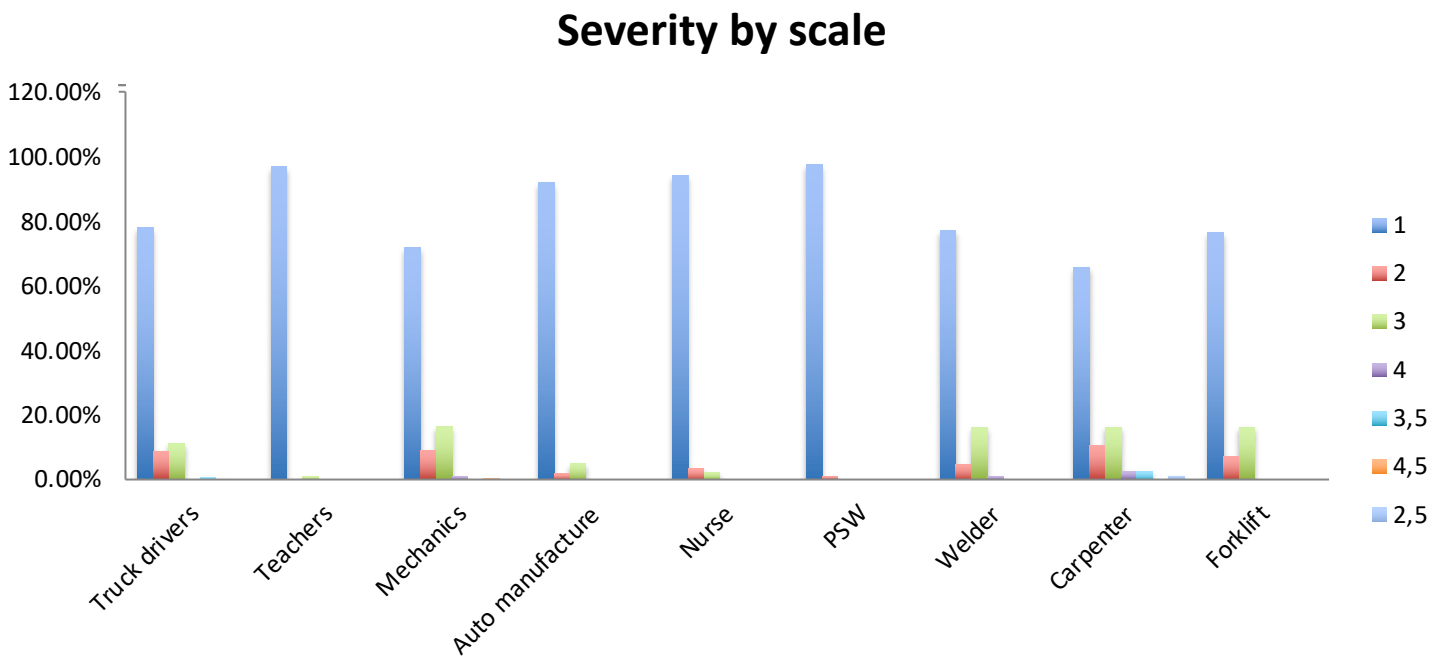


Significant CNS Injury





Head Injury Severity by Profession



KEY

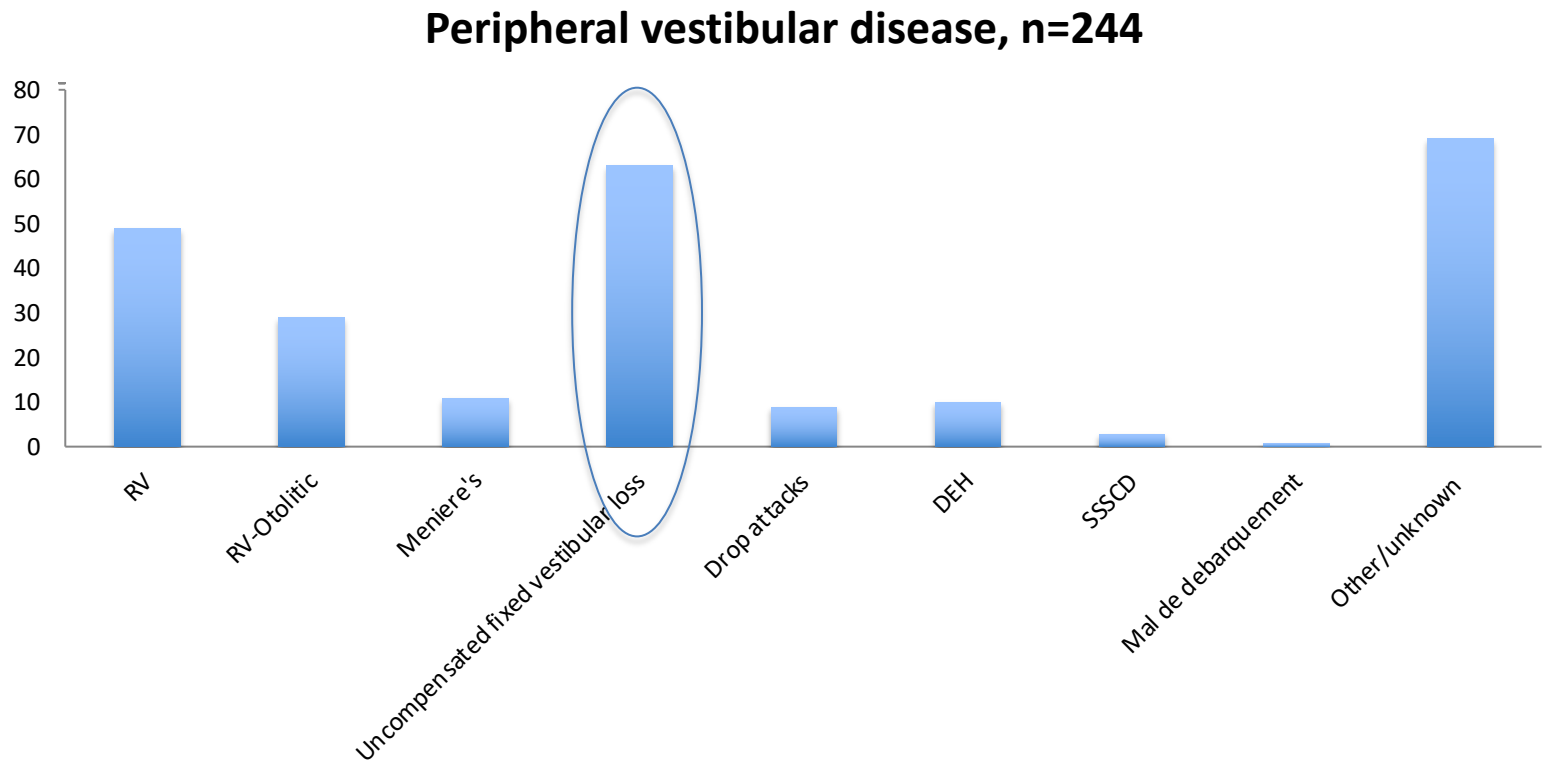
1-Minor head injury
2-Closed head injury
3-Closed head injury and skull #
4-Open/compound skull #
3,5-Closed head injury, skull # and CSF leak
4,5-Open/compound skull # and CSF leak
2,5-Closed head injury and CSF leak

Dizziness Diagnoses

a. Diagnosis		N	%
BPPV			
	Typical BPPV	137	3.19%
	Atypical BPPV	57	1.32%
	Hx for BPPV	714	16.63%
			21.14%
Cochlear +/- vestibular loss*		1349	31%
Peripheral vestibular disorders		244	5.68%
Central vestibular disorders		28	0.65%
Psychogenic (Non-organic)		1166	27.17%
Unknown		804	18.73%
No diagnosis		256	5.96%

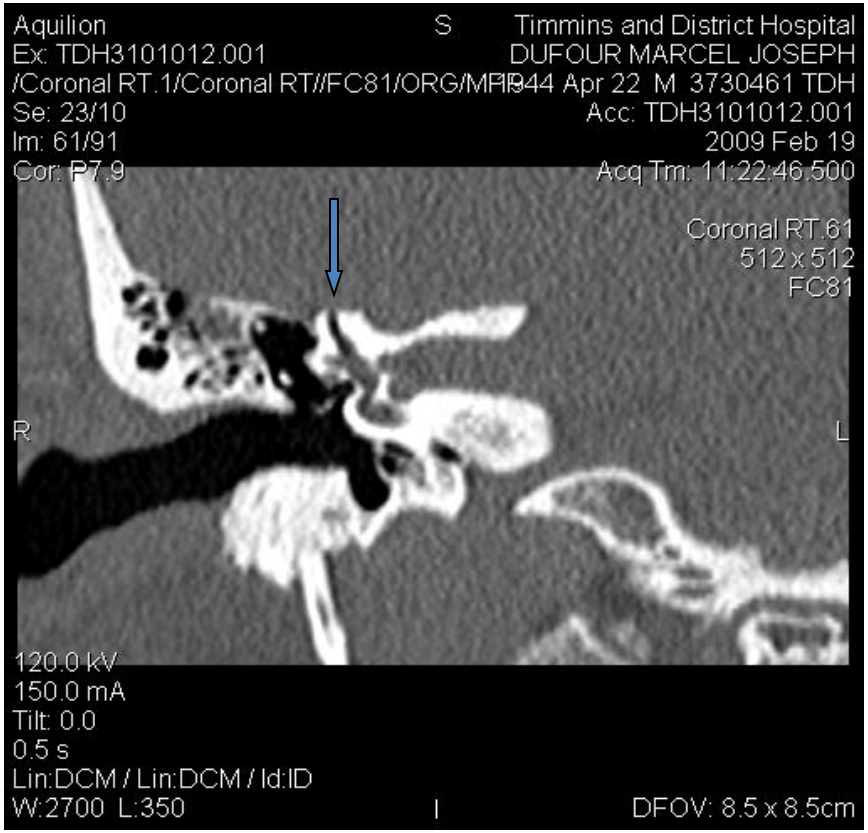
** A key question remains to be determined is whether these findings were significant for inner ear loss from the trauma or could they have been pre-existent/technically related?*

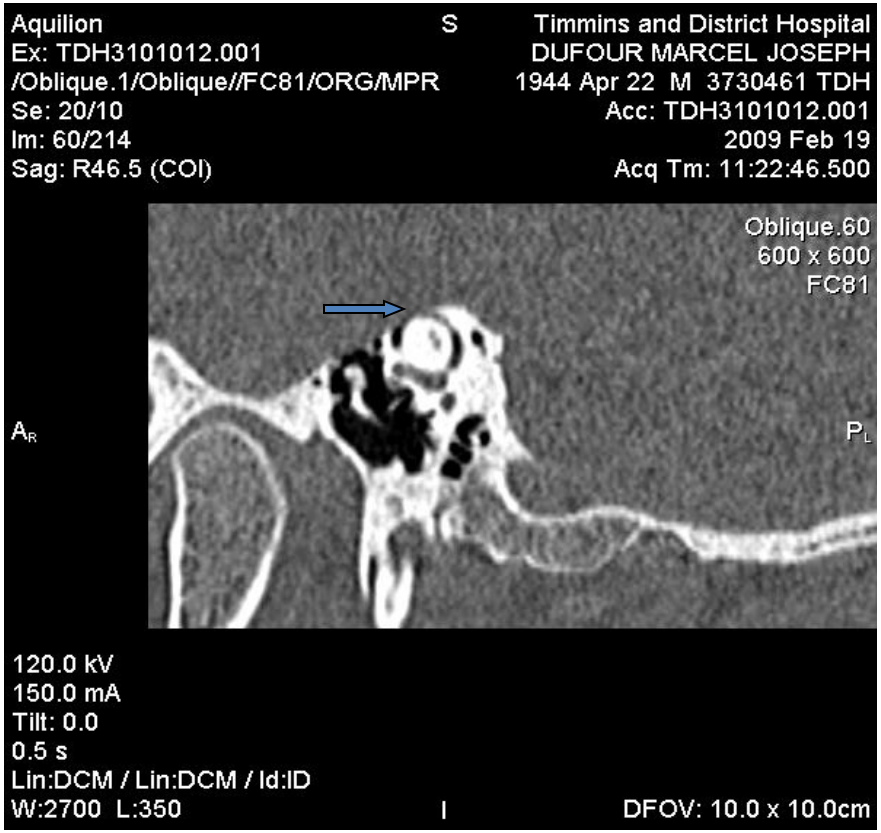
Peripheral Vestibular Disease Post Head Injury (Excluding BPPV)

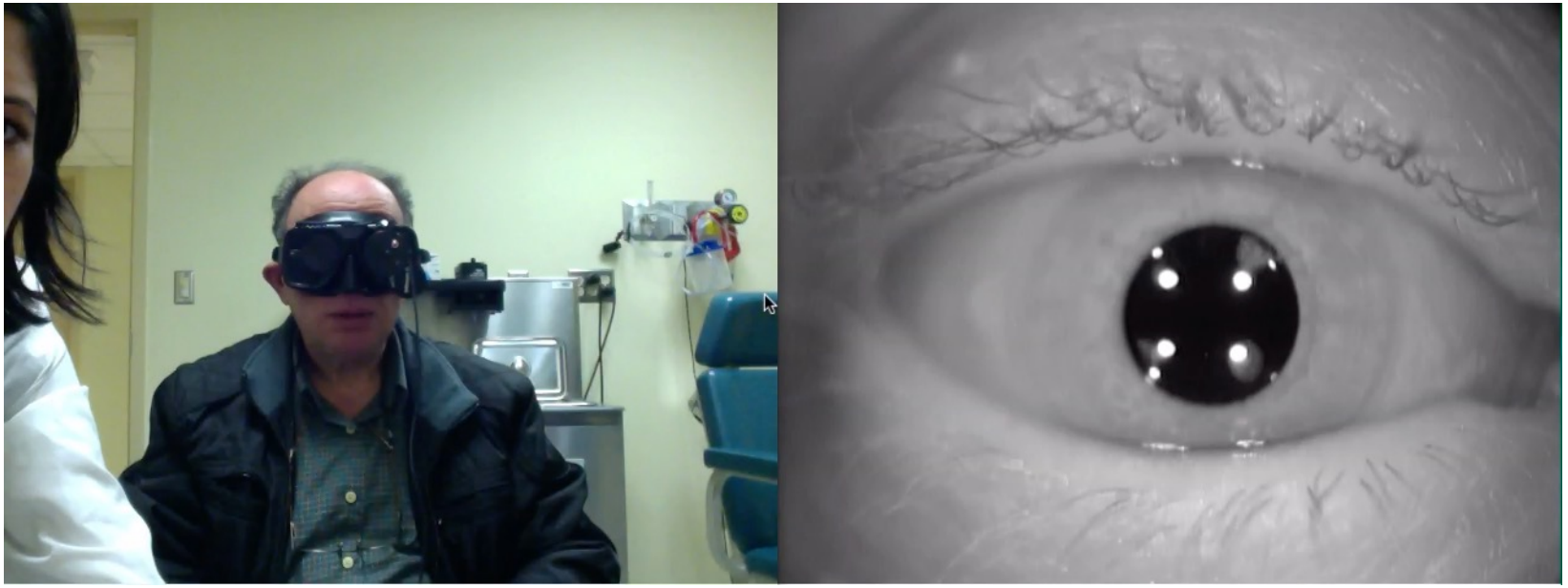


Could receive benefit from vestibular rehabilitation therapy

Superior Semicircular Dehiscent Syndrome







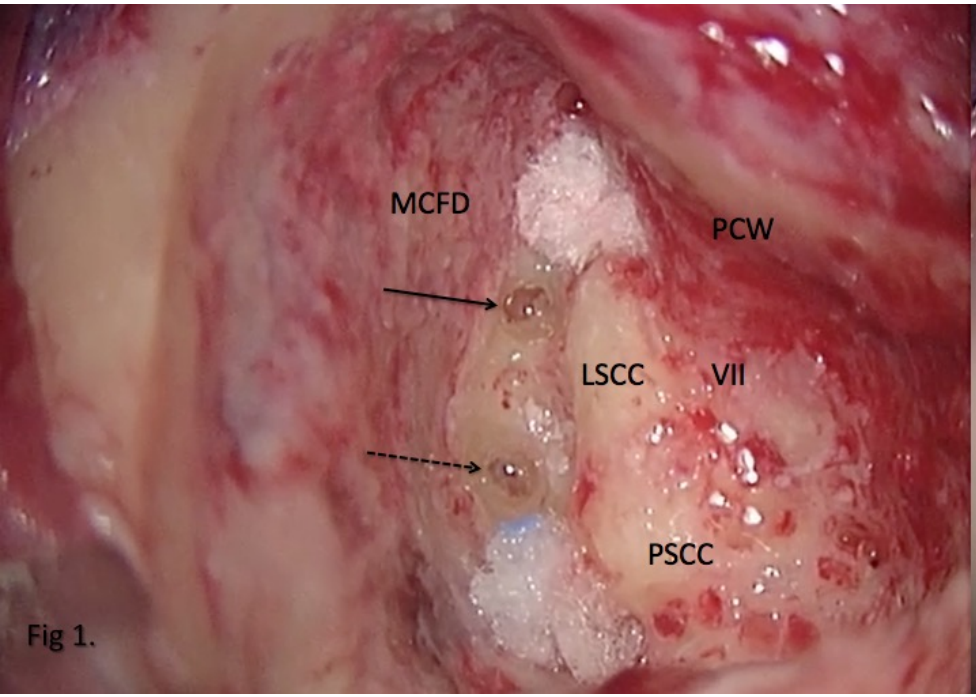


Fig 1.

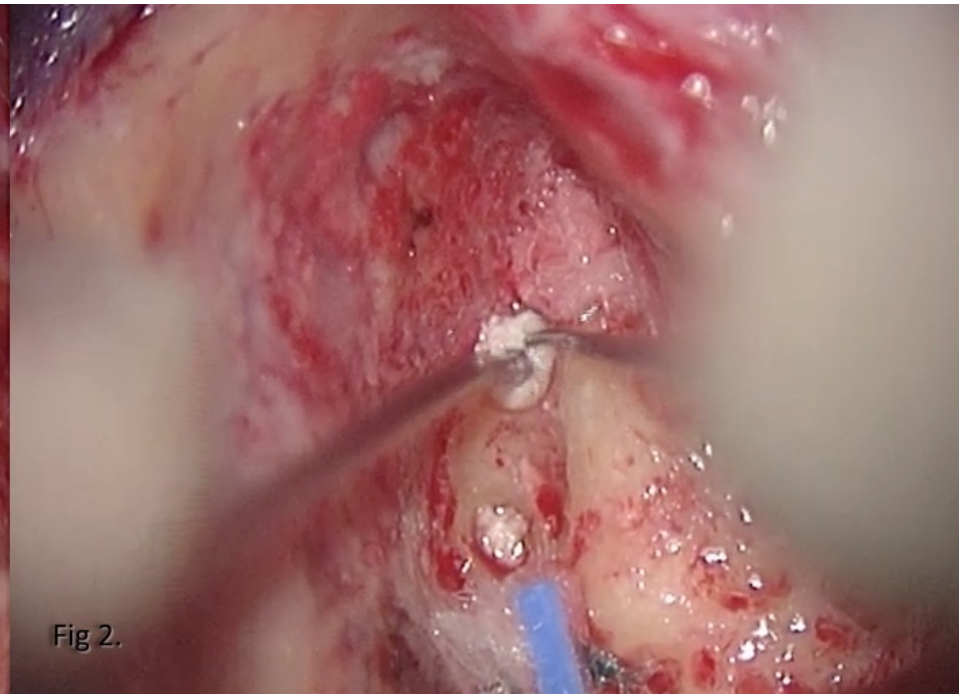
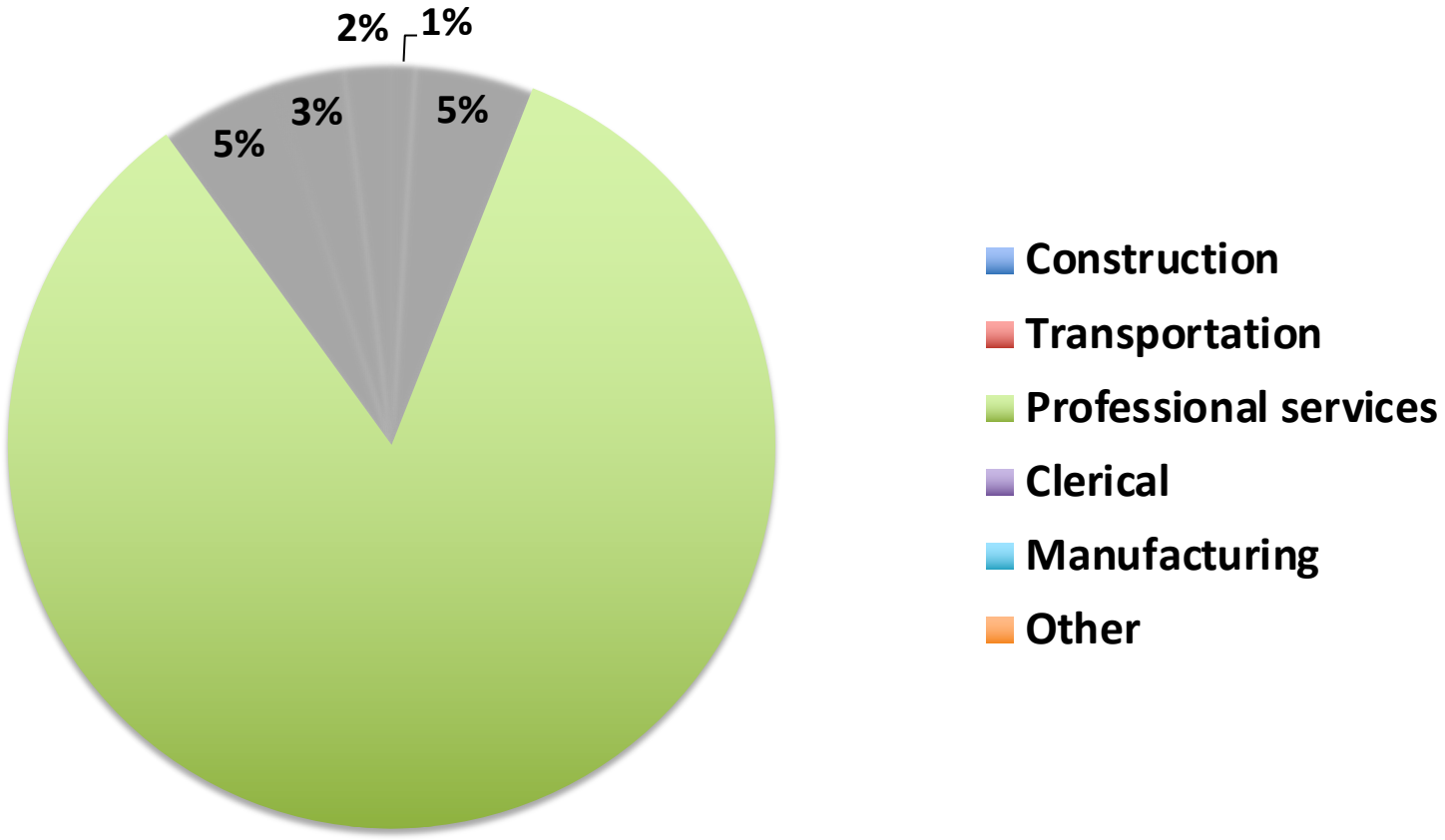


Fig 2.

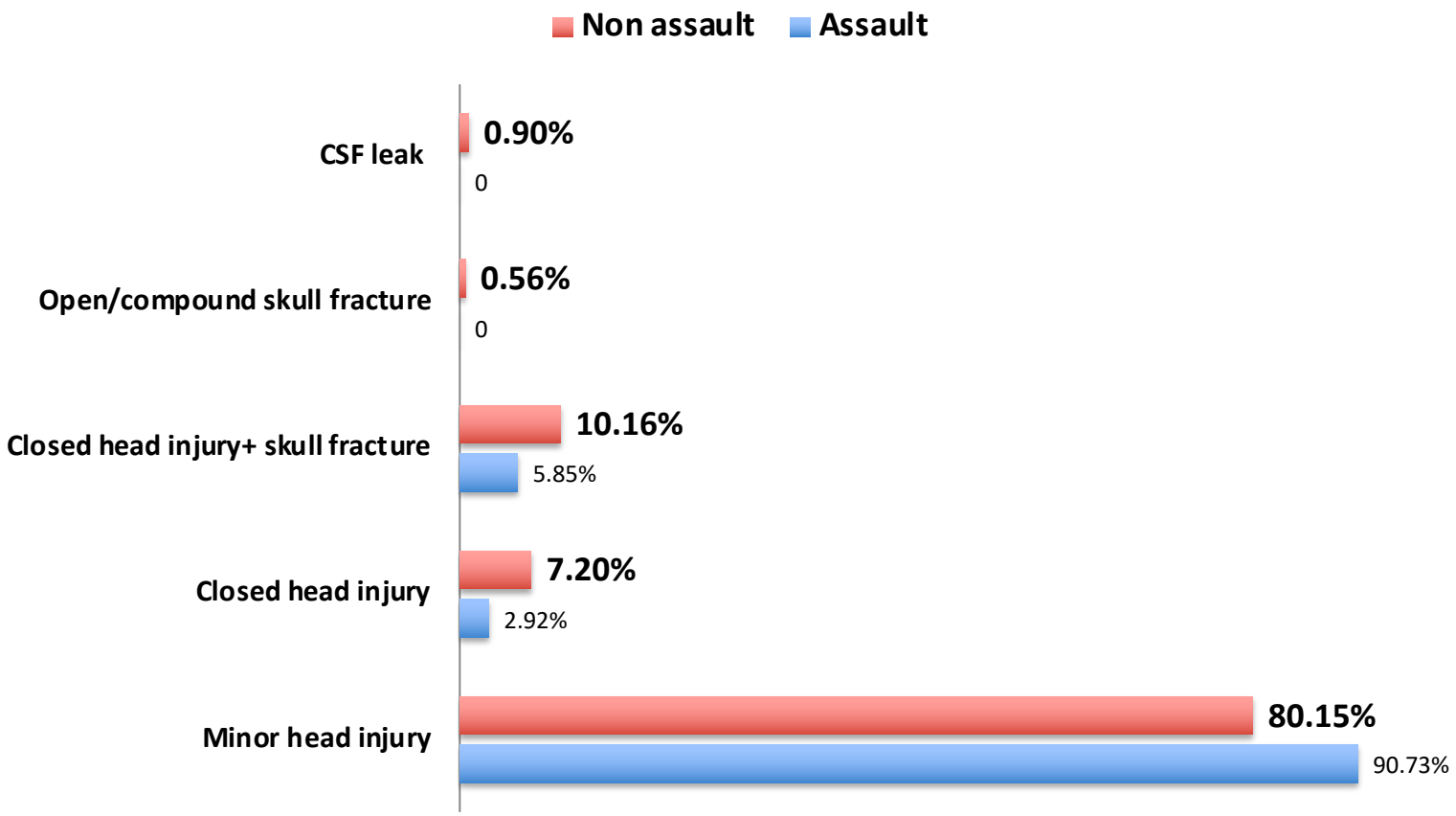
Professions involved in an assault (n=205/4291)



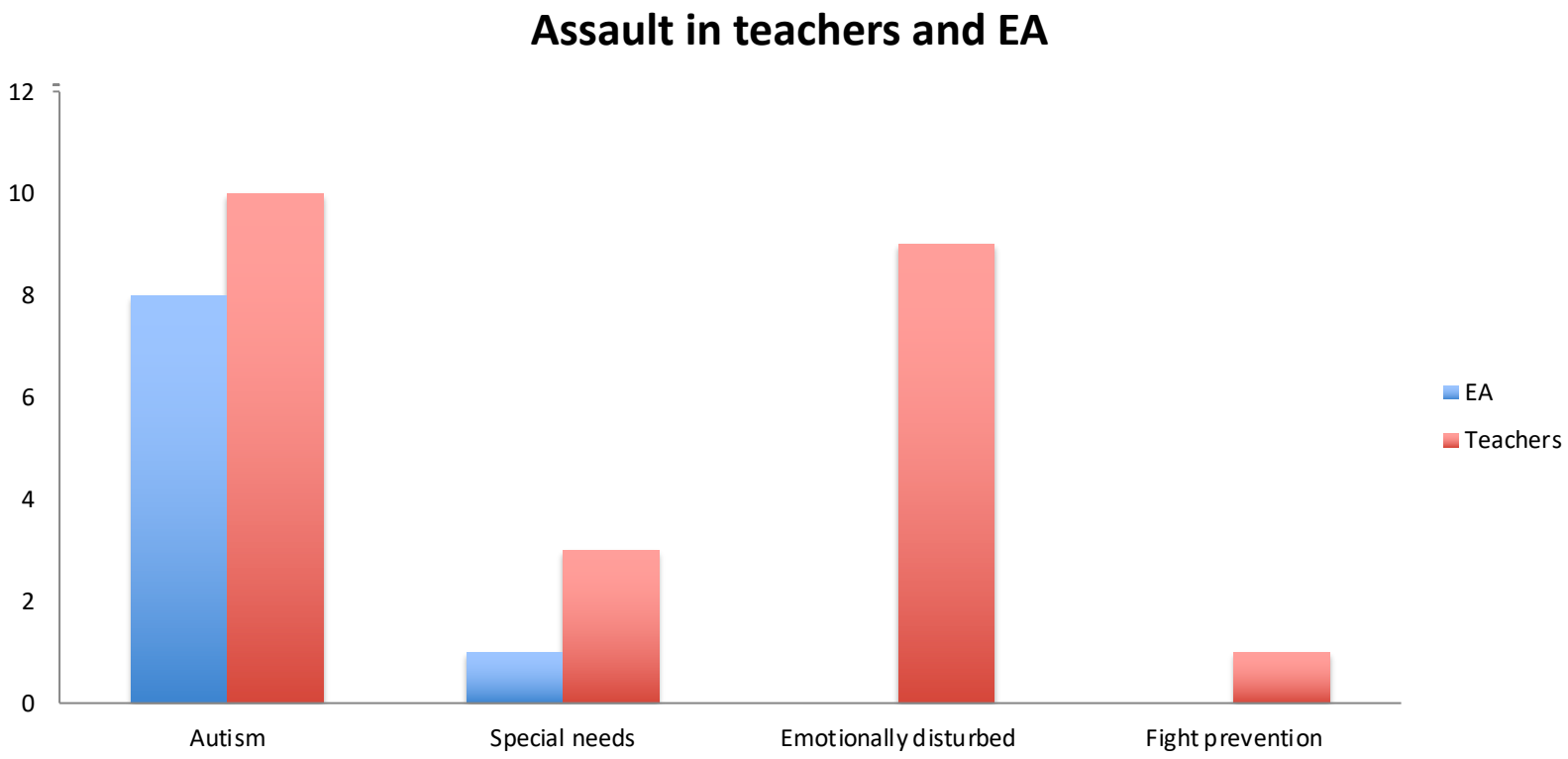
Professions most at risk for assault (up to 2018)

Profession	Non-assault	Assault
Teacher	196(4.79%)	24(11.70%)
Nurse	52(1.27%)	24(11.70%)
PSW	58(1.41%)	23(11.21%)
Police officer	26(0.63%)	10(4.87%)
Security guard	17(0.41%)	10(4.87%)
Educational assistant	25(0.61%)	9(4.39%)
Social worker	16(0.39%)	8(3.90%)
Prison guard	2(0.04%)	7(3.41%)
Food service	161(3.94%)	7(3.41%)
Manager	82(20.09%)	5(2.43%)
Sales	74(1.81%)	3(1.46%)

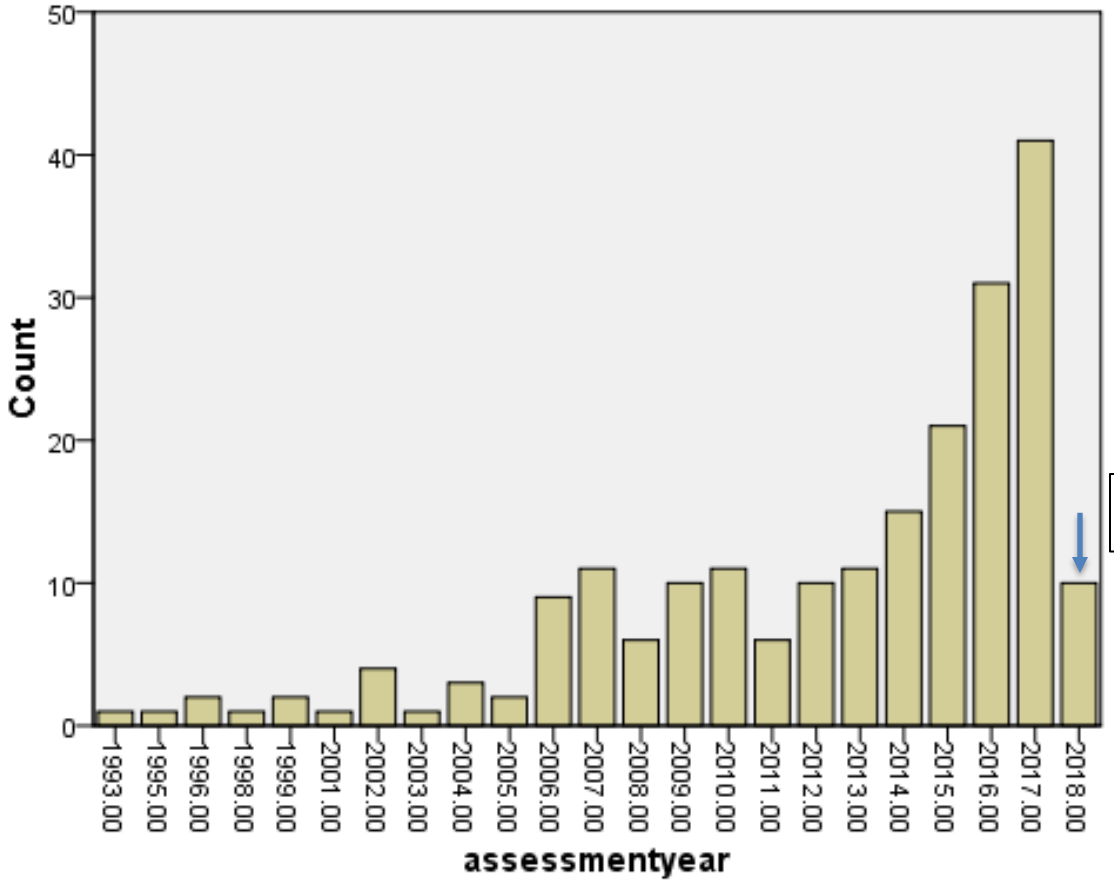
Severity of injury



Who Assaults Teachers and EA's

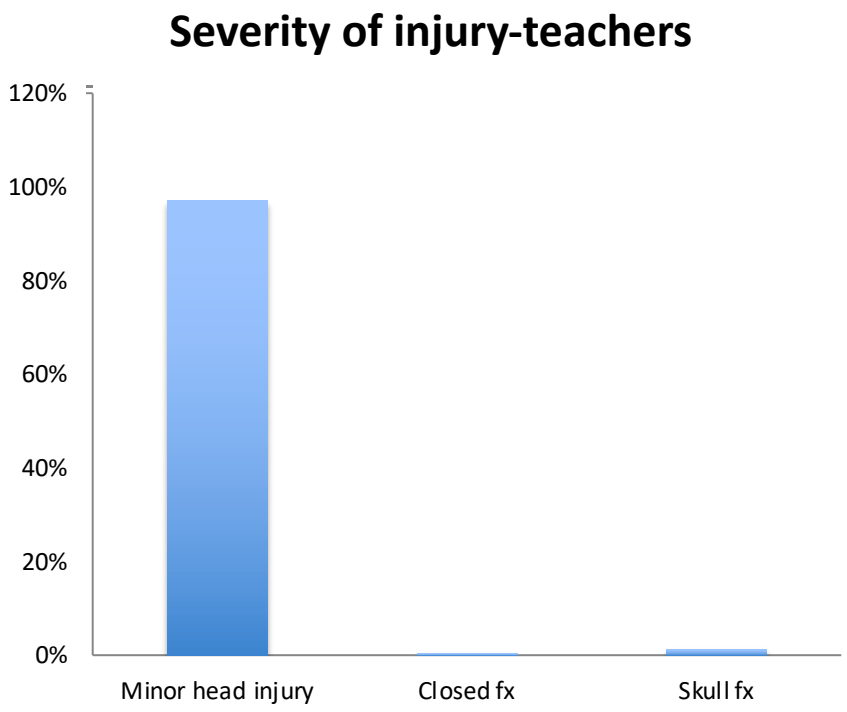


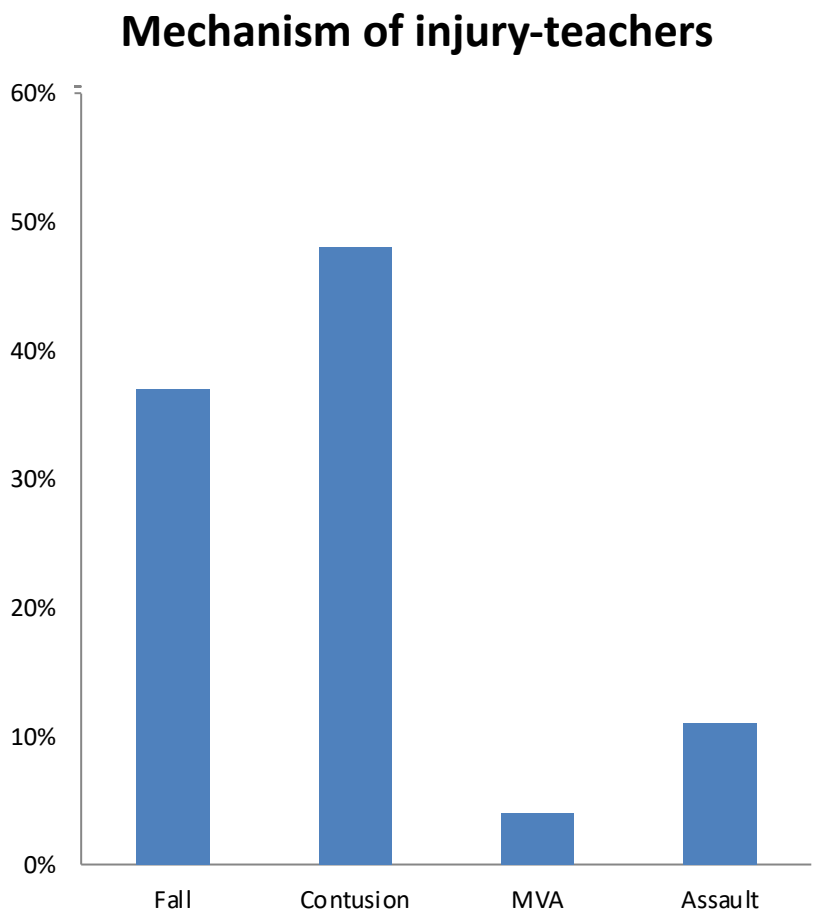
Head Injuries in Teachers



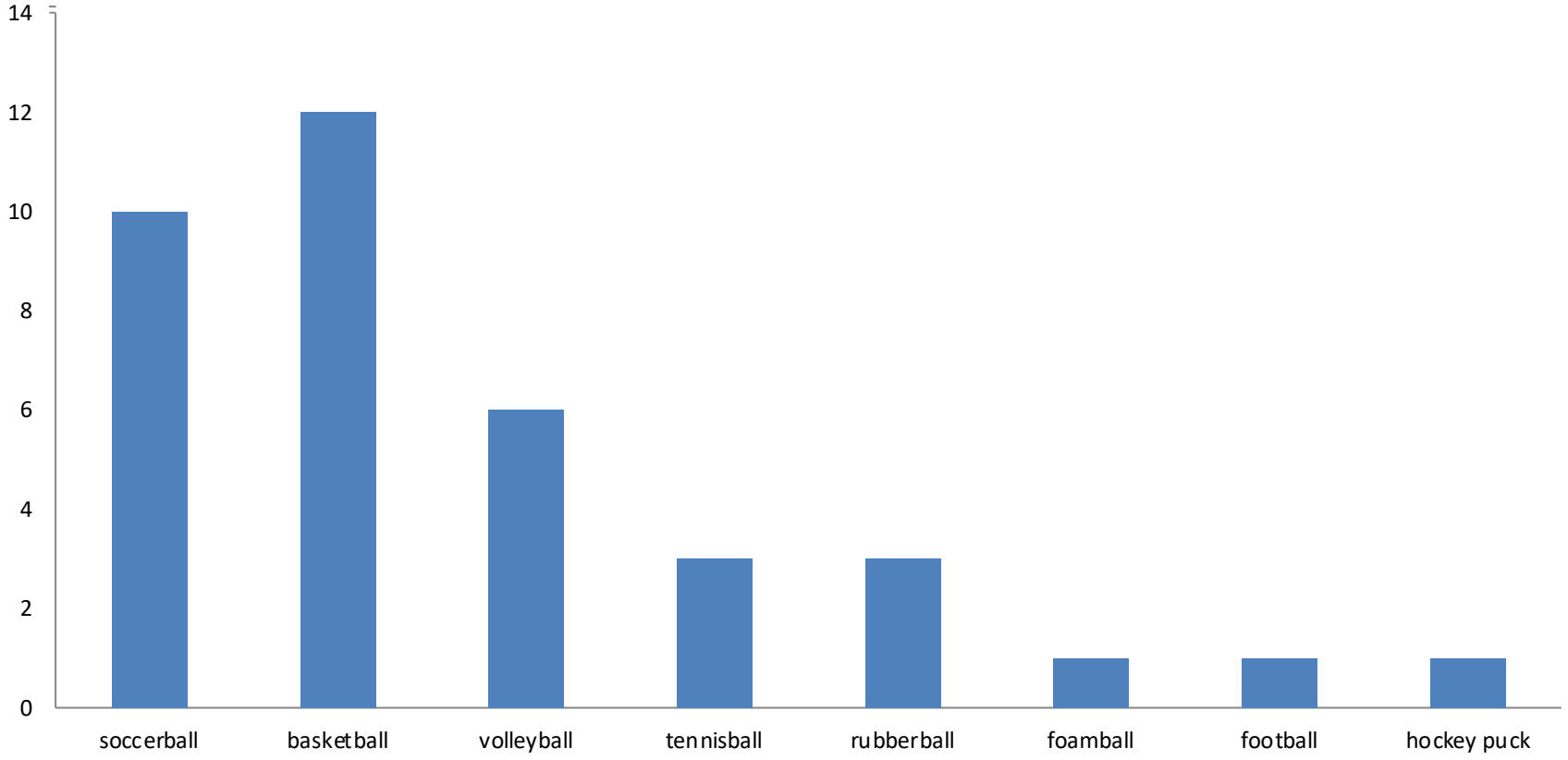
Not a full year

Severity/Mechanism of Injury





Frequency of ball type injuries to teachers



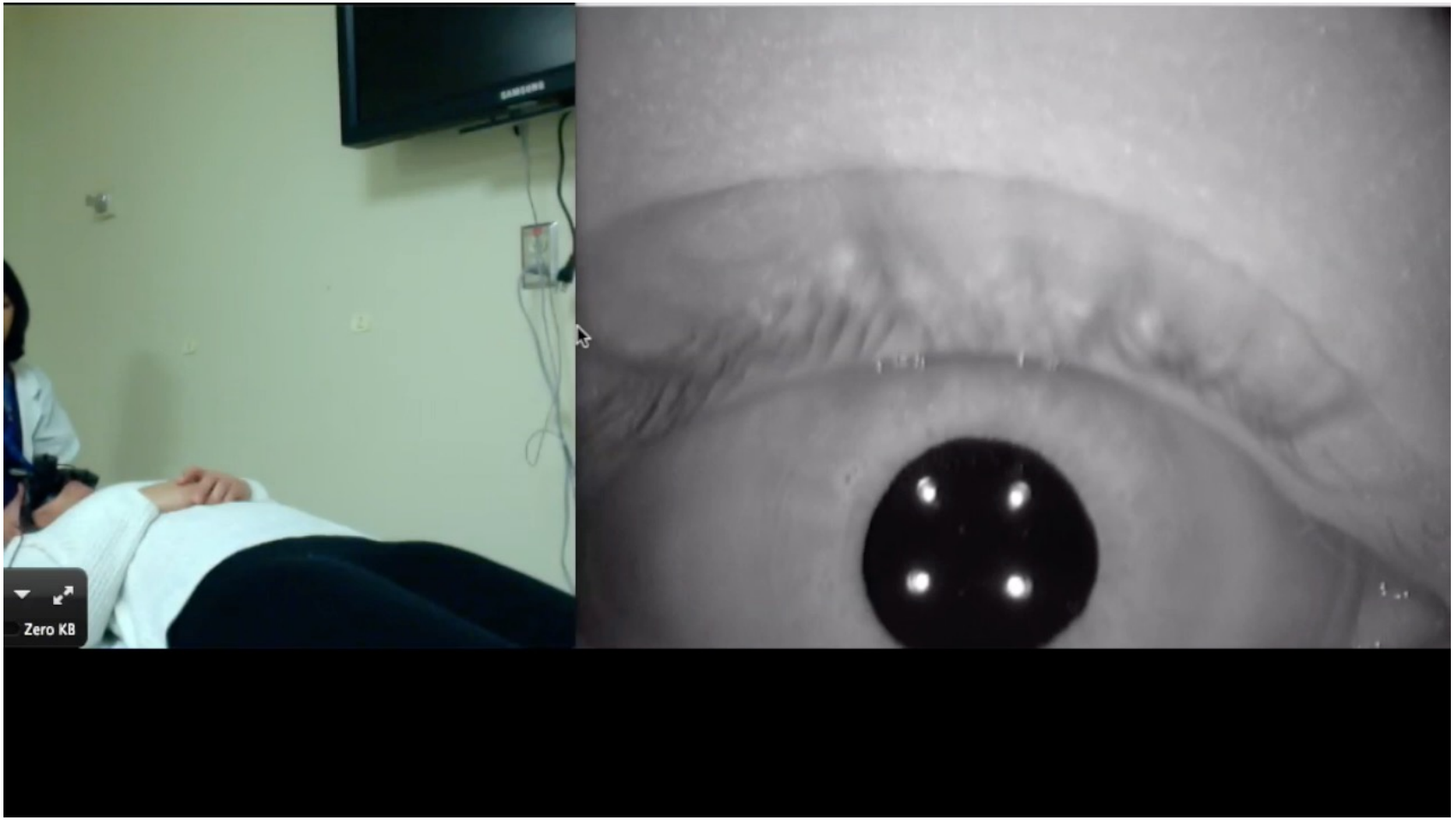
I would be pleased to answer any questions that you might have regarding this presentation, the UHN Center for Advanced Hearing and Balance Testing and the Hertz Multidisciplinary Neurotology Clinic at UHN.

If time does not permit please contact me with your question(s) at:

john.rutka@uhn.ca

I will try my best to respond in a timely fashion.

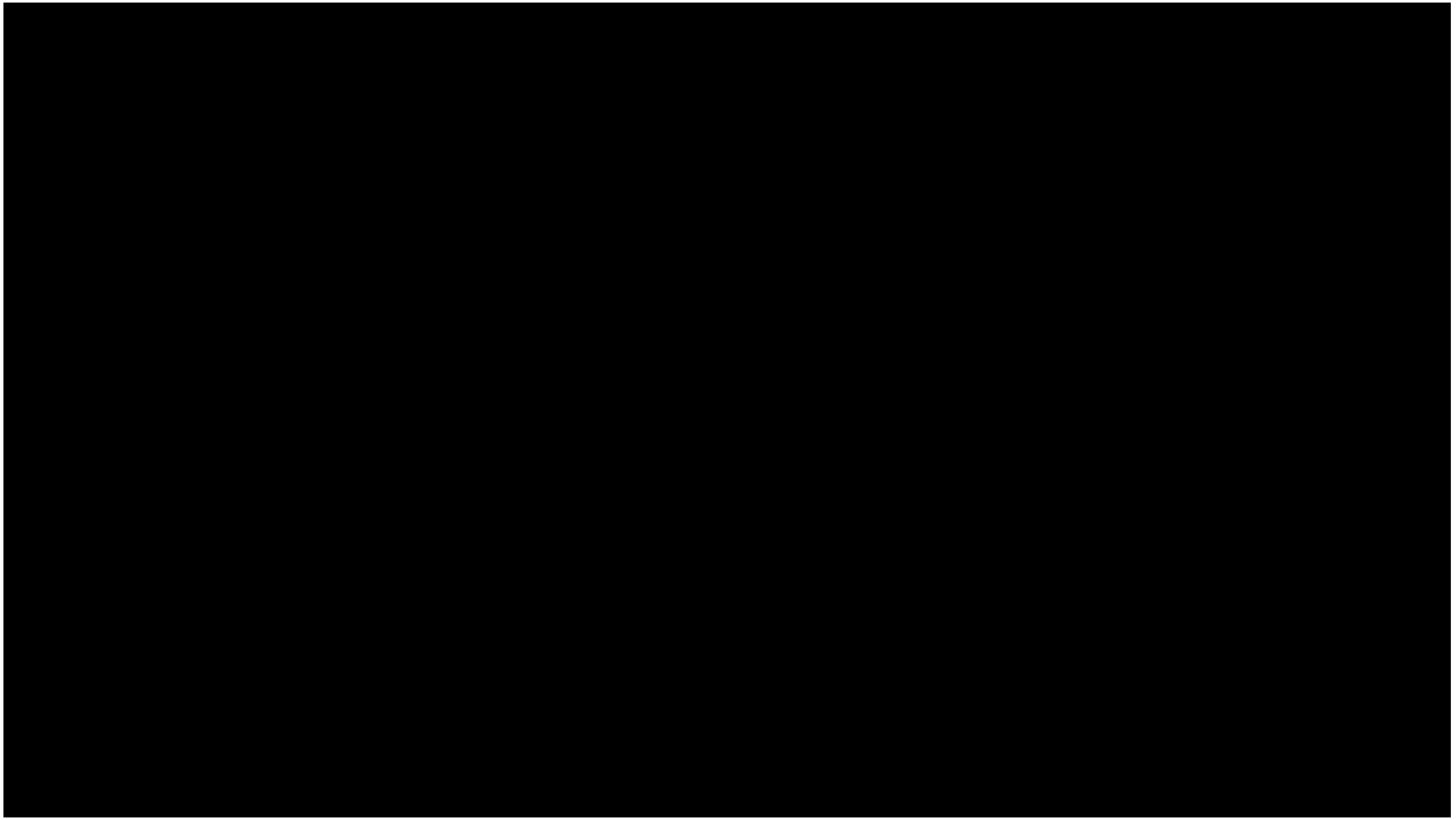
EXTRA Slides



Light Cupula Syndrome

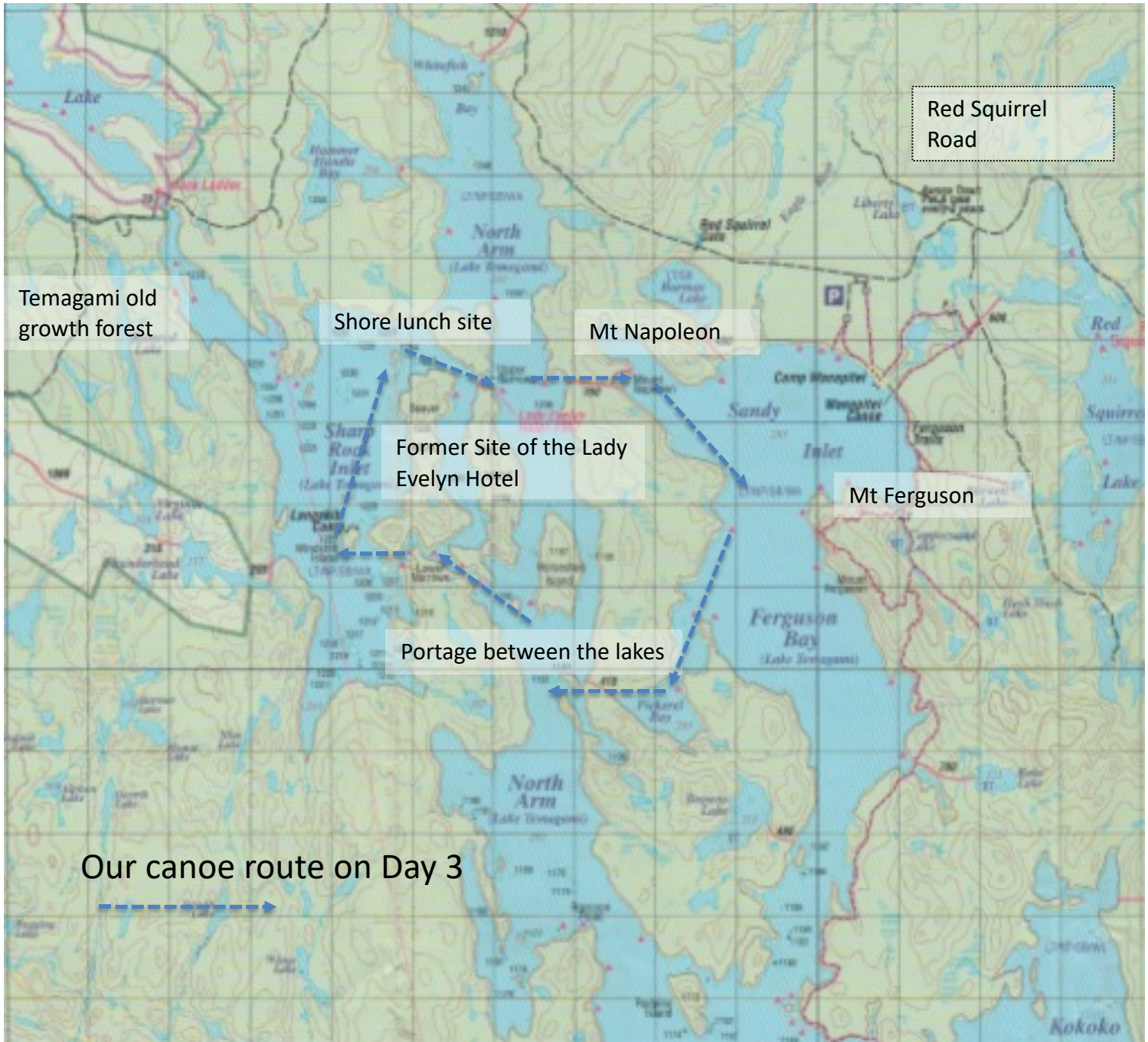
Positional Nystagmus in Cerebellar Ataxia with Bilateral Vestibulopathy (CABV)

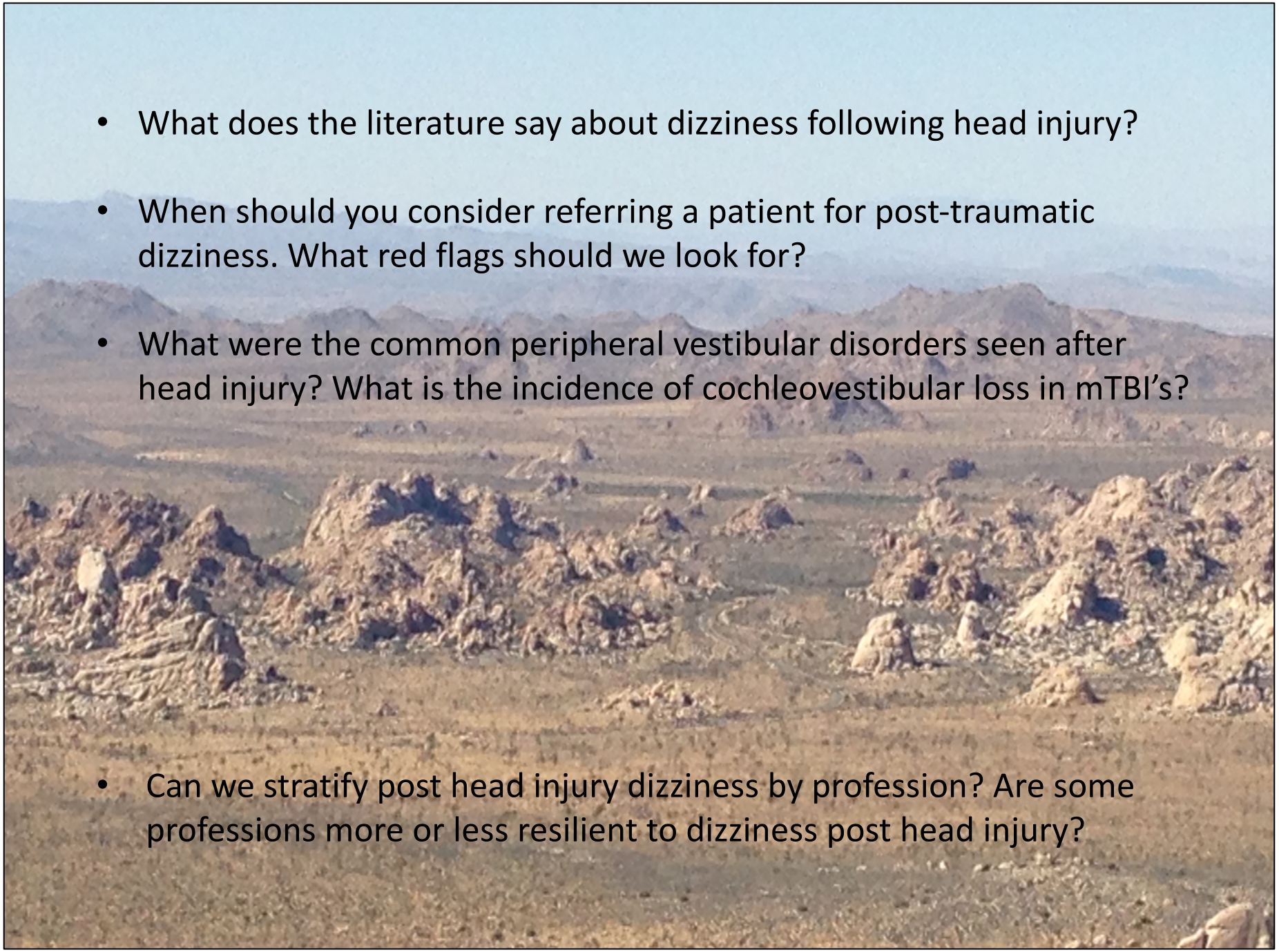
Positioning Nystagmus in Cerebellar Stroke



Central Positional Nystagmus from 4th Ventricular Cyst

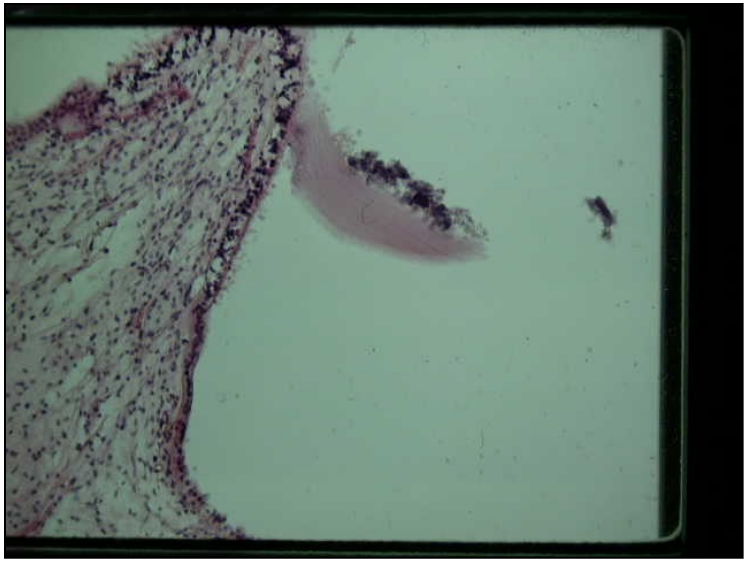
Posterior Canal Occlusion for Intractable BPPV


Red Squirrel Road
Temagami old growth forest
Shore lunch site
Mt Napoleon
Former Site of the Lady Evelyn Hotel
Mt Ferguson
Portage between the lakes
Our canoe route on Day 3
North Arm
Sharp Rock Inlet
Sandy Inlet
Ferguson Bay
Red Squirrel Lake
Camp Wanapitei
Kokoko



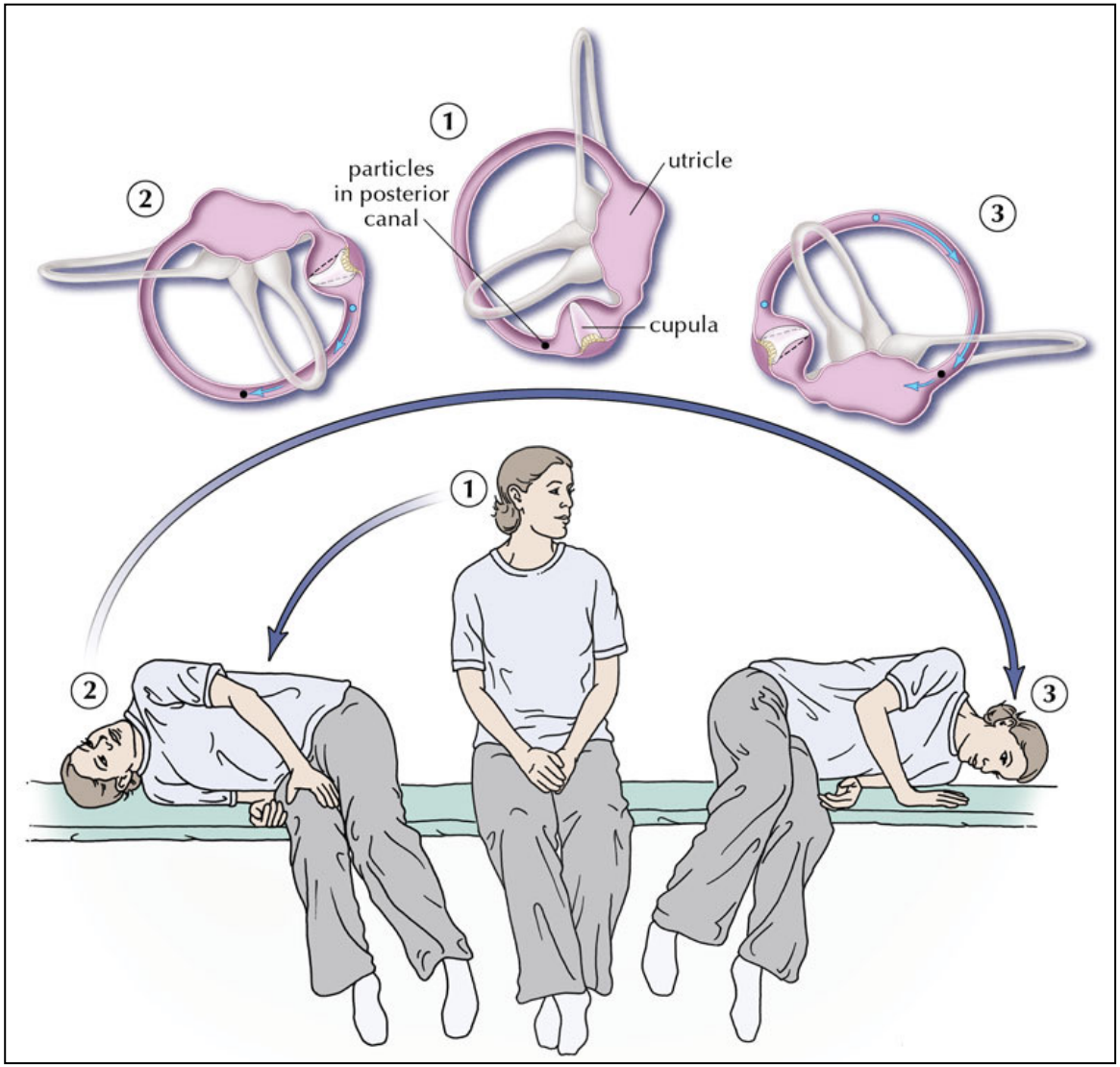
- What does the literature say about dizziness following head injury?
- When should you consider referring a patient for post-traumatic dizziness. What red flags should we look for?
- What were the common peripheral vestibular disorders seen after head injury? What is the incidence of cochleovestibular loss in mTBI's?
- Can we stratify post head injury dizziness by profession? Are some professions more or less resilient to dizziness post head injury?

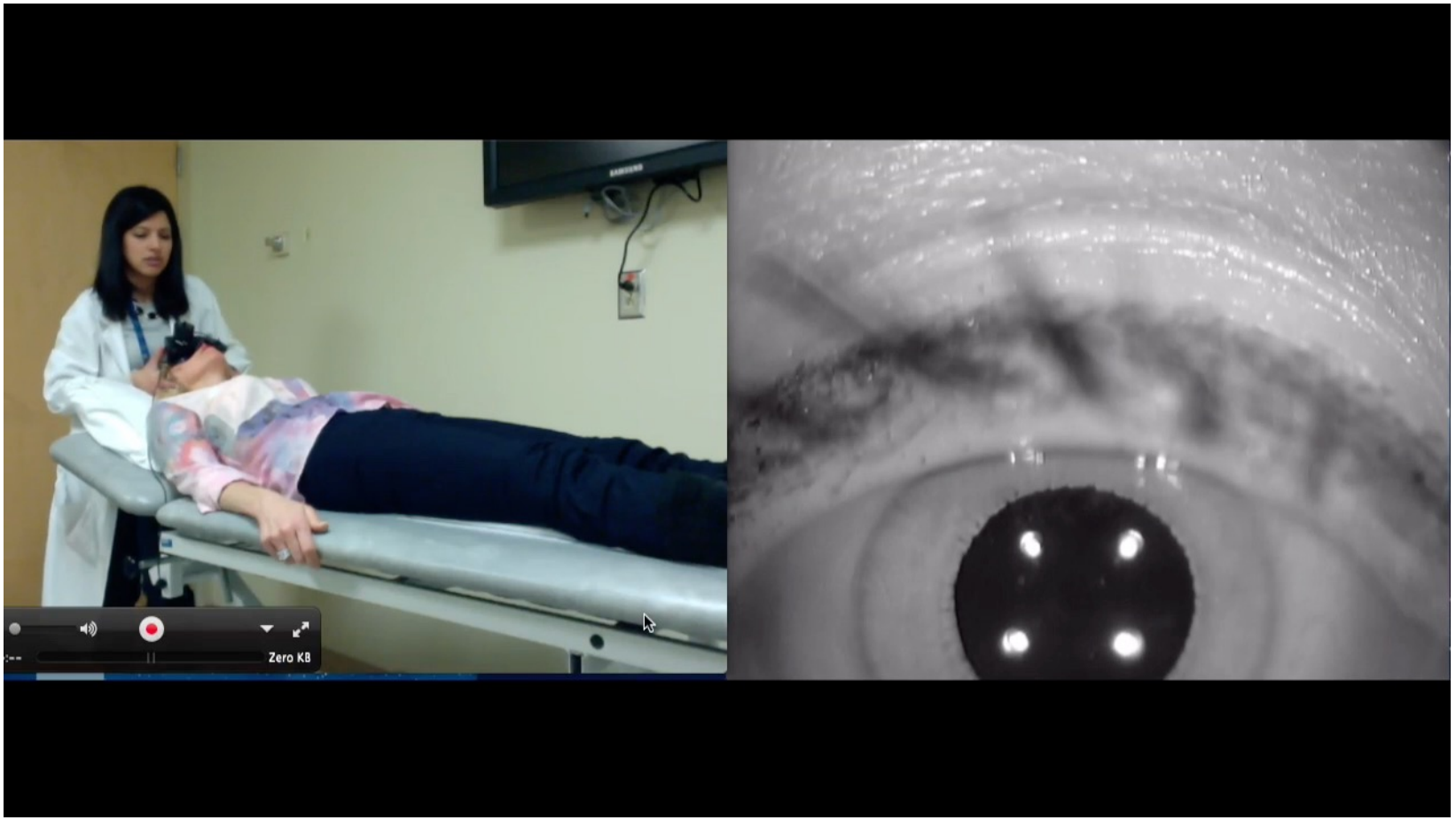
Pathology of BPV



Cupulolithiasis vs Canalolithiasis

Semont's Manoeuvre





Lateral Canal Canalolithiasis

Vestibular Rehabilitation Therapy

Promote compensation for a stable peripheral vestibular loss
(acute/chronic)and treatment for benign positional vertigo

- Adaptation
- Habituation
- Visual stabilization
- Stabilize and if possible improve physiology of a central and/or a peripheral vestibular loss (the holy grail of vestibular rehabilitation)

“Never underestimate the effects of a compassionate and empathetic therapist in the care of a patient with a vestibular disorder”