

## Essential signs and tests in TBI & concussion management.

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CHIROPRACTIC & FAMILY WELLNESS PC

## Three Seminars:

1. Concussion case study
2. Concussion rehab
3. Balance disorders review and diagnoses

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## Subarachnoid Haemorrhage

- Non specific headaches (sometimes premonitory)
- Frank Headache that is similar to a migraine **with differences:**  
simultaneous onset vertigo & vomiting vs in migraine they are with the auras or later as headache unfolds.
- Photophobia, neck stiffness, nausea, vomiting, bilateral extensor plantar responses.
- Cardiac Arrhythmias / Glycosuria (we don't know why)

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CT and Follow up CT: people have weak arteries, aneurysms, slow leaks etc.

## Increased Intracranial Pressure

- Raised CSF protein or altered blood products cause impaired CSF circulation. (Post Subarachnoid Haemorrhage)
- Cerebral Edema post head injury

- A Delayed complication of serious head injury and subarachnoid haemorrhage, 10 days to several weeks after acute injury, relatively rapid generalized deterioration in alertness, altered behaviour, development of new bilateral physical signs. (CT)

- Signs of intracranial pressure and brain herniation

- Rising blood pressure (Cushing's triad)

- Slow pulse

- Slowing / periodic respiration

(internal bleeding - systemic - falling blood pressure, rapid but thready pulse, rapid respiration)

- Headache (Diff DX supine vs standing),  
nausea, vomiting

British actress Natasha Richardson d  
after a skiing accident in Canada

TI • 1041 • 9 11:19 CET • by NickiBey • 628 Views • 5 Comments



- “Lucid Interval” :

- Skull fracture of severe head injury, with or with loss of consciousness need to be observed and possibly admitted. If there is loss of consciousness, they HAVE to be admitted.

- “Lucid interval” is a period of time when the patient after being unconscious comes around and is apparently normal. Then start to demonstrate inappropriate and/or belligerent behaviour (alcohol) then slip into coma and die.

- Tentorial Herniation:
  - Pupillary Dilation on same side of lesion
  - Hemiparesis (contralateral or false localizing?)
  - Acute loss of consciousness
  - A late finding on an ophthalmologic exam in a patient with increased ICP is papilledema, which presents with a blurring of the optic disc margin and decreased venous pulsations.

These symptoms are due to compression or displacement of ascending arousal pathways, the oculomotor nerve (CN III), and the corticospinal tract. (Uncal herniation)

- Cerebellar Tonsillar Herniation
    - Cerebellar tonsils move down through the foramen magnum causing compression of the medulla and upper C spine
    - May Cause cardiac and respiratory dysfunction
    - May cause focal lower cranial nerve dysfunction
    - Down beat nystagmus (Chiari Malformation)
-

## Blood testing Results

In most cases, although the neurological dysfunction resolves in a short period, the underlying physical injury to the brain does not (2). In up to 15% of individuals with mild TBI the immediate neurological dysfunction also does not resolve, or resolves only to recur within weeks and manifest as persistent cognitive dysfunction (3), the post-concussion syndrome (4).

<https://www.frontiersin.org/journals/neurology/articles/10.3389/fneur.2023.1155479/full>



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## NEUROTRAUMA ASSESSMENT TEST

Test	Result
<b>GFAP Glial Injury Marker</b> (Values < 12.5 pg/mL are considered Negative)	<b>Negative</b> < 12.5 pg/mL

Glial Fibrillary Acidic Protein (GFAP) is an astroglial cytoskeletal protein that is exclusive to the central nervous system (CNS). This protein forms networks that provide support and strength to the glial cells. The glial cells nourish and support nerve cells within the brain and spinal cord. If nerve cells are injured, glial cells respond by activating and generating more cells in a process called gliosis; during gliosis, the glial cells rapidly produce more GFAP. Thus, this protein is released after CNS injury and high levels are associated with glial and neuronal cellular damage. GFAP is a sensitive blood marker for traumatic brain injury (TBI), including mild TBI (mTBI). It is also used to aid decisions about whether CT scans of the brain should be performed after TBI.

Test	Result
<b>UCH-L1 Neuronal Injury Marker</b> (Values > 17.2 pg/mL are considered positive)	<b>Positive</b> 64.58 pg/mL

Ubiquitin C-terminal hydrolase-L1 (UCH-L1) is a cytoplasmic protein enzyme found in nerve cells throughout the brain. UCH-L1 breaks down damaged and unneeded proteins in nerve cells. Injured nerve cells release UCH-L1 into the blood. Hence, elevated UCH-L1 is a post-TBI marker of injury. It is also used to aid decisions about whether CT scans of the brain should be performed after TBI.

Test	Result
<b>S100B Injury Marker</b> (Values > 1.1 pg/mL are considered Positive)	<b>Positive</b> 6.54 pg/mL

Test	Result
<b>NFs Injury Marker</b> (Values > 10.51 pg/mL are considered Positive)	<b>Positive</b> 246.69 pg/mL

Neurofilaments (NFs) are proteins that help construct the cytoskeleton of neurons. They are highly specific to neuronal cells, provide structural support and scaffolding for metabolism and signaling, and contribute to neuroaxonal caliber and strength. They additionally allow the transport of important biological materials along the axons and neuronal processes that enable cell survival and facilitate information transfer. Information that allows us to move, respond to stimuli, and think among other things. NFs are made up of three

Test	Result
<b>APOE</b>	E3/E3

**APOE ε3/ε3 Patient Diplotype and TBI Diagnostic Line:**  
**APOE ε3/ε3 Genotype : Associated with better outcomes after injury and increased improvement in neuropsychological performance at 6 months postinjury than APOE ε4 variant carriers**

Test	Result
MTHFR-2 (667)	G/G
MTHFR-1 (1298)	T/T

MTHFR 677 G/G (Homozygous, "Wild Type" Reference Allele), 1298 T/T (Homozygous, "Wild Type" Reference Allele), and TBI

Diagnostic Line:

MTHFR Normal Metabolizer: The risk for homocysteinemia due to MTHFR enzymatic activity is lowest for this patient, with better recovery post-TBI than patients with Poor MTHFR enzyme activity (677 A/A and 1298 G/G Homozygotes)

Homocysteine levels are significantly inversely related with Montreal Cognitive Assessment (MoCA) scores. For mTBI,

## Affect, posture and face observation

1. Mood
2. Blink
3. Tremor
4. Paresis
5. Eye alignment
6. Head position

Patient presents with:

Mary presents with acute sudden dizziness. She was at her work and suddenly things started to move. She almost fell and had to sit down. She never had this before. Feels like throwing up. She is dizzy and has been dizzy since it started yesterday at work.

Questions? Discussion?

- General physical exam
  - Head exam
  - Lacerations, bruising, swelling
  - The Nose
  - Nasal Discharge (Watery, bloody, CSF leak)
  - The Ears
  - Watery discharge, blood, torn drum, mastoid bruising
  - The Face
  - Active movements, paresis, asymmetry
- (Temporal Bone fractures)



- General physical exam

### The Affect / Speech / Blinks

- Happy, Depressed, Anxious, Confused. Aggressive, from family members any changes in personality
- Make up, dress, appropriate socially, clean, eye contact, eyes looking around the room, smile, joke.
- Blink rate, slowness in movement, delay in action or response
- Hyperkinetic, fidgety, tremors, twitches, tics, stutter
- Posture and position of neck, extremities, feet etc

Positive and Negative Affect Schedule (PANAS-SF)

	Indicate the extent you have felt this way over the past week.	Very slightly or not at all	A little	Moderately	Quite a bit	Extremely
PANAS 1	Interested	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 2	Distressed	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 3	Excited	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 4	Upset	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 5	Strong	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 6	Guilt	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 7	Scared	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 8	Hostile	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 9	Enthusiastic	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 10	Proud	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 11	Irritable	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 12	Alert	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5
PANAS 13	Ashamed	<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3	<input type="checkbox"/> 4	<input type="checkbox"/> 5

- General physical exam
- Memory (alert and oriented x3)
  - Long term
  - Short term
  - **Visual, visual spatial**, auditory, numbers
- Memory of accident: Amnesia
  - Pre-traumatic Amnesia (The event & period before) indicate temporal and/or frontal lobe injury.
  - Post-Traumatic Amnesia: correlation with severity of injury. The period prior to the patient establishing full orientation and continual memory.

- Post-Traumatic Amnesia is hard to identify and measure because the patient might seem fine then they go home and weeks later upon follow up, they do not recall nor able to identify the ER doctors, procedures nor time in the ER.

5 min or less	Very Mild injury
5 to 60 min	Mild injury
1 to 24 hours	Moderate injury
1 to 7 days	Severe injury
7 to 30 days	Very Severe injury
30 or more days	Extremely Severe injury

## When to Call an Ambulance

1. Prolonged unconsciousness.
  2. Worsening symptoms.
  3. 3x vomiting or 1x projectile vomiting (ICP)
  4. CSF (blood and CSF) from ears and or nose.
  5. Paralysis, Paresis, Peripheralization.(neck assessment)
  6. Asymmetric, Blown or fixed pupil(s).
- 

- General physical exam  
The Limbs / Neck / Spinal Cord  
(Paralysis, Paresis, Peripheralization)  
Muscle testing, sensory testing, vibration testing...

Sensory extinction, position sense,

Tone, reflexes (UMNL, LMNL, Hoffmann sign)

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## Affect, posture and face observation

1. Mood:
2. Blink: 12/ per min
3. Tremor
4. Paresis: forehead, eye lids, lower face
5. Eye alignment: esotropis, exotropia, hypertropia, hypotropia. Cover, Cover uncover tests.
6. Head position
7. Pupils

Patient presents with:

Mark presents with a history of dizziness for the last 9 years. He is 26, runner.

Questions, Discussion?

- General physical exam  
The Eyes (pupils, movements, blood, vision, acuity)

Fixation System:  
Can the eye stay on stationary target, moving target, after finding the target, attentional network.

OculoMotor:  
VOR, Pursuits, Saccades, Optokinetic Nystagmus, Vergence.

Brain Processing:  
Peripheral vs central vision, amount of information, speed of processing.

**Smooth Pursuit Eye Movements as a Biomarker for Mild Concussion within 7-Days of Injury.**

Melissa Hunfalvay, Nicholas P. Murray, Revathy Mani & Frederick Robert Carrick

PMID: [34894915](#)

DOI: [10.1080/02699052.2021.2012825](#)

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Concussion. 2020 Jan 14;5(1):CNC69. doi: [10.2217/cnc-2019-0013](#)

**Vertical smooth pursuit as a diagnostic marker of traumatic brain injury**

Melissa Hunfalvay<sup>1</sup>, Claire-Marie Roberts<sup>2\*</sup>, Nicholas P Murray<sup>3</sup>, Ankur Tyagi<sup>4</sup>, Kyle W Barclay<sup>5</sup>, Takumi Bolte<sup>6</sup>, Hannah Kelly<sup>7</sup>, Frederick R Carrick<sup>8,9,10,11</sup>

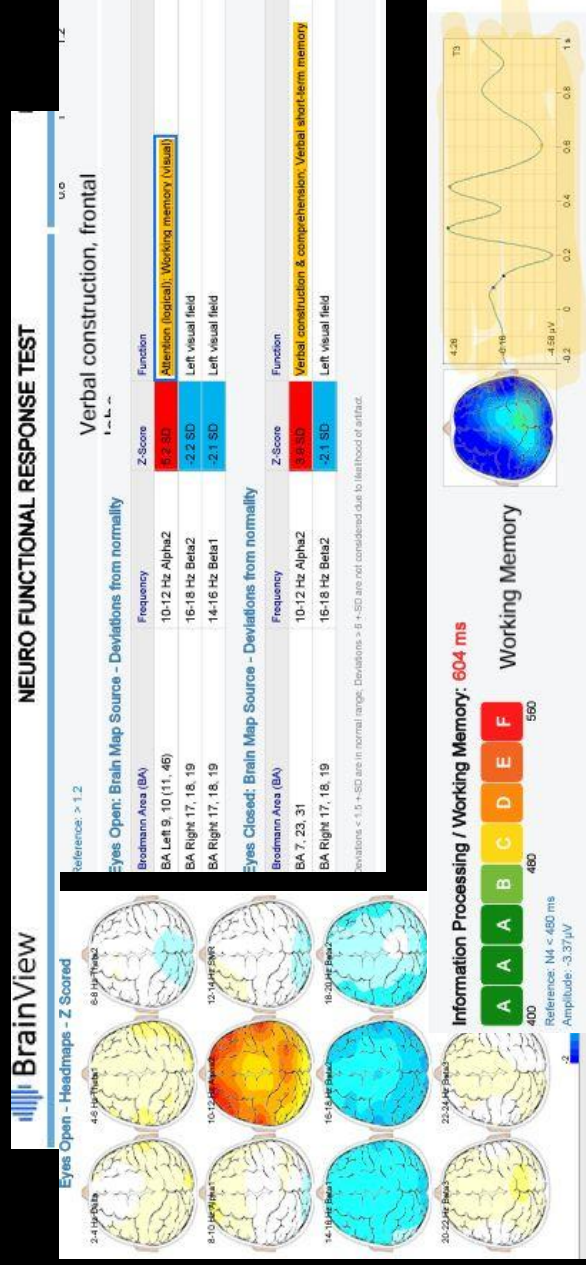
PMID: [32266081](#)

Fixation and Smooth pursuits  
The ability to hold gaze on a target and follow it  
when moving slowly.

(attentional network)

Ball throwing, star throwing, follow fingers, Marsden  
Ball.

## Brain View QEEG Functional Testing





<https://www.brainview.com/>

Tel: +1 800 433 4609

#### Physician Summary - Key Findings:

Normal response time to visual and cognitive stimulus

Delayed information processing latency under go-nogo condition.

Normal/rever of theta frequencies central brain activity.

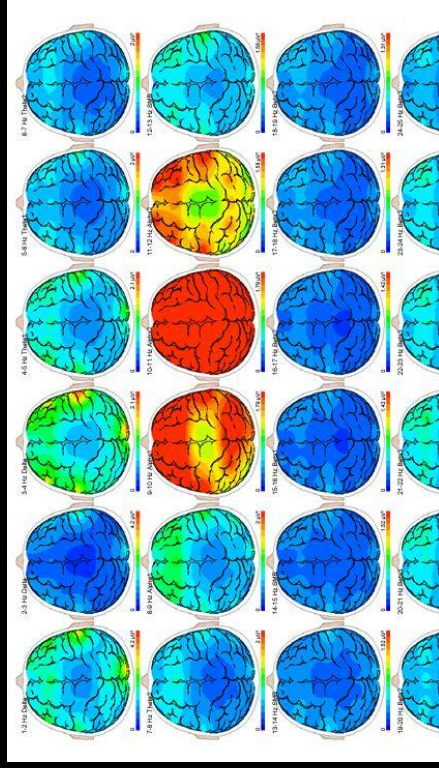
Increased power of alpha frequencies brain activity.

Normal level of beta frequencies central brain activity;

Normal peak alpha frequencies have been correlated with good information processing capacity and semantic memory.

Alpha Interhemispheric asymmetry is in normal level.

go no go



## Saccades

These are fast eye movements to position retina on object of attention

Latency, Speed, Accuracy  
Heart Charts

## Vergence

Convergence and divergence insufficiency

(Brock beads, Hart chart, eye curls)

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# Saccades and Vergence practice

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## Brain Processing:

Peripheral vs central vision, amount of information, speed of processing.

Uno Cards, Fitlight, flash cards...

<https://www.fitlighttraining.com/>

- General physical exam

- VOR
- Balance

Balance is a combination of visual, vestibular, and proprioceptive inputs. It is a job of integration of multiple sensory inputs. Problems could be caused from the sensory organ, peripheral nerve, connections centrally, relay / integration centers and cortex.

- Peripheral neuropathy
- Discussed Meniere's
- Vestibular Neuritis
- BPPV
- Orthostatic
- Stroke
- Post fossa tumors
- Vest Migraines

- General physical exam
- Vertigo = sense of spinning or tilting (movement)
- Light headed / presyncope = Cardio
- Dysequilibrium / imbalance = not sure footed
- Non specific = psychogenic, functional, psychiatric, conversion disorder.

- General physical exam
- Consider onset time
- Consider duration
- Hearing involvement (low frequency-meniere's)
- Provocation (standing, exertion, supine-turning, coughing, loud noise)
- Consider light headedness, vertigo or dizziness
- Consider duration

- General physical exam
  - Systemic disease
  - Meds and side effects
  - Other issues - referral (fistula/dehiscence, cancer, antibody issues, paraneoplastic - lung, breast, melanoma, colon- GI posterior fossa-, genetics, toxins - alcohol, MS)
- 

## Vestibular Schwannoma (Acoustic Neuroma)

- Most common cerebellopontine angle tumor
- Subacute to chronic sensorineural hearing loss and/or tinnitus.
  - Dizziness / vertigo are less common
  - Can pinch the internal auditory canal and pinch CN 7 (diff DX)
- • MRI with contrast. Mostly unilateral and **if bilateral then that is a hallmark of**

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- • MRI with contrast. Mostly unilateral and if bilateral then that is a hallmark of neurofibromatosis type 2.

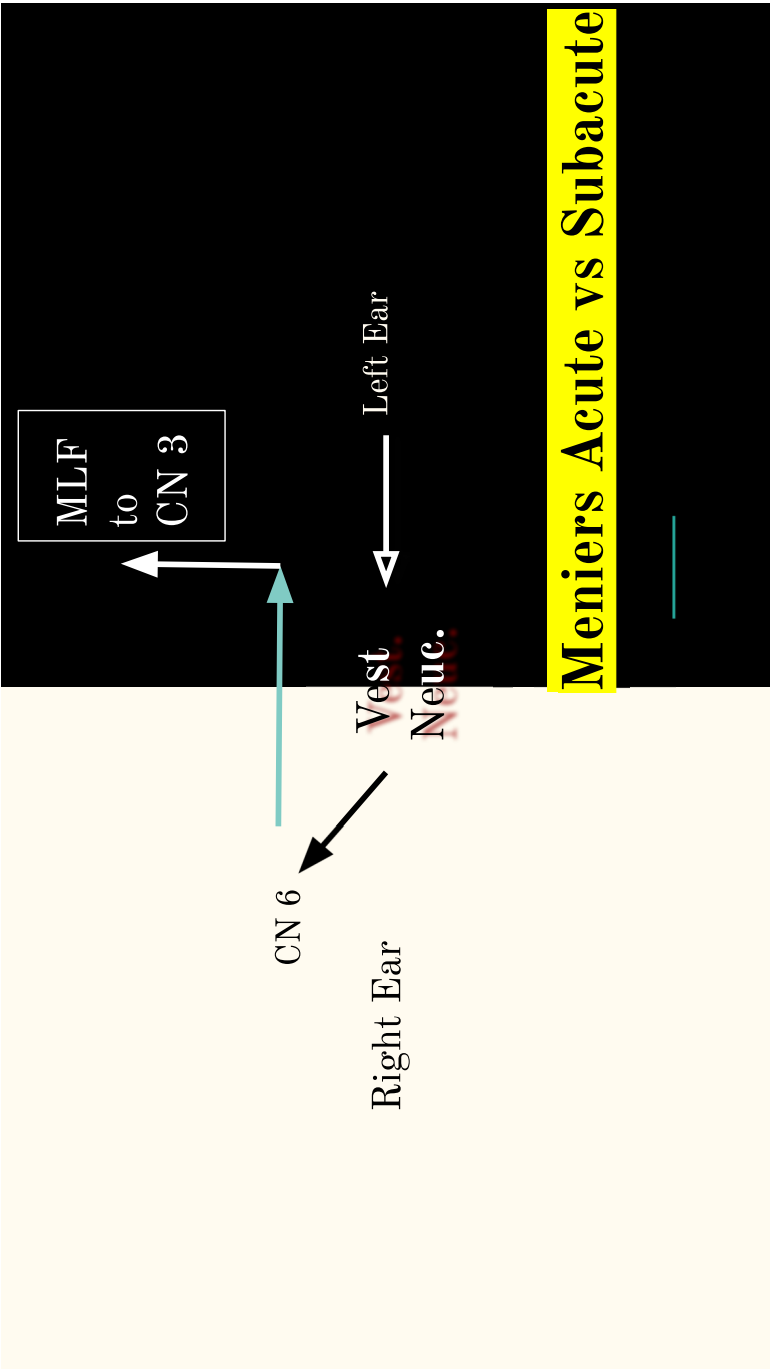
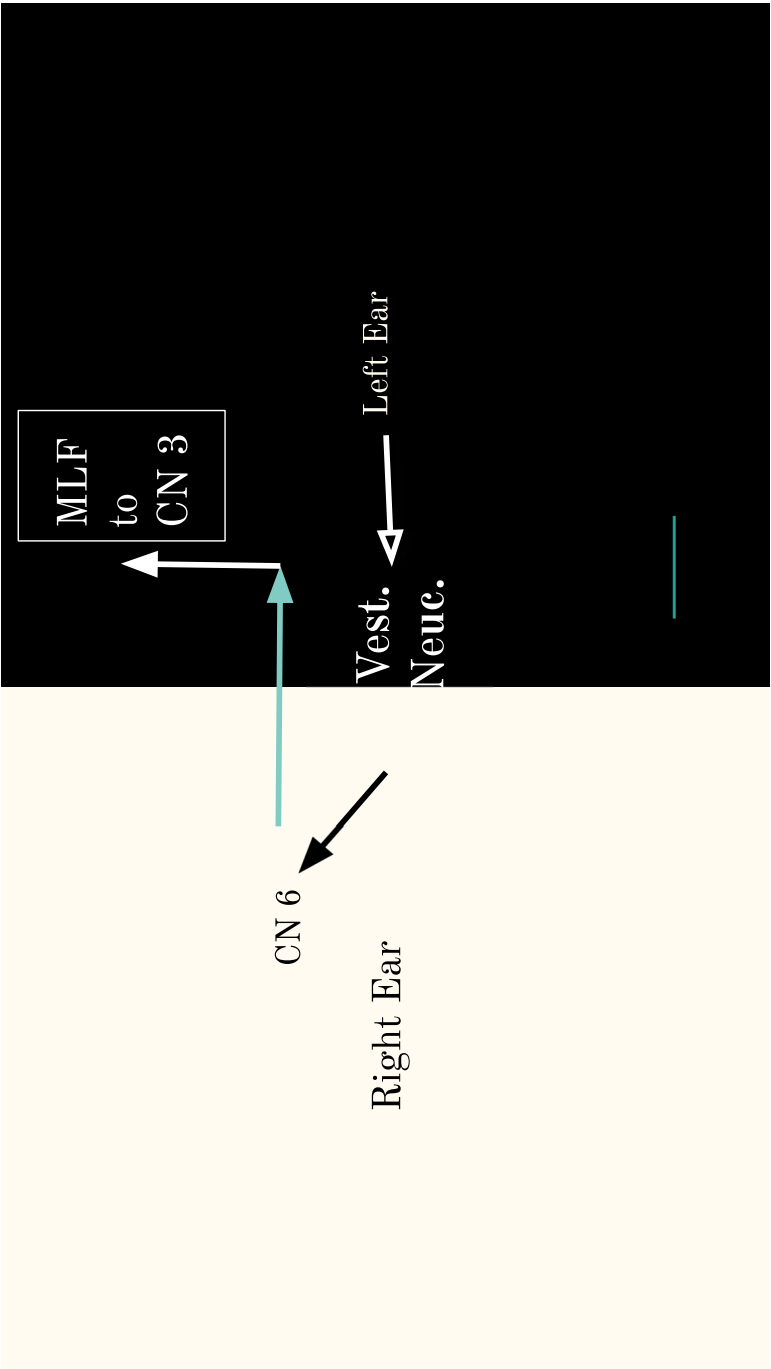
Remember:  
Tonic output

Right Ear

Vest  
Neuc.

Left Ear

—



## Vest. Hypo Function



Hallpike  
Supine head rolling  
Head Impulse Test

Times 1 Viewing  
Times 2 Viewing  
Times 0 Viewing







#### How Many Types of Concussions Are There?

- Somatic (headache/ dizziness)
- Cognitive (feeling like in a fog, slow reaction times)
- Emotional symptoms (anxiousness/depression)
- Physical (loss of consciousness)
- Balance impairments (gait unsteadiness)
- Visual System (light sensitivity/trouble focusing)




For use by Health Care Professionals Only

Developed by: The Concussion in Sport Group (CISG)

Supported by:      

**SCAT6™**

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622  Echemendia RJ, et al. *Br J Sports Med* June 2023; Vol 57 No 11

Editorial

Sport Concussion Assessment Tool 6 - SCAT6™

**SCAT6™** Sport Concussion Assessment Tool  
For Adolescents (13 years +) & Adults

Athlete Name:  ID Number:

# COMPASS 31: A Refined and Abbreviated Composite Autonomic Symptom Score

- Vestibular Rehabilitation
  - Cervical Proprioceptive and Vestibular Integration
  - Vision Therapy
  - Cognitive function
  - Autonomic Rehabilitation
- 

# Motion Guidance Options

<https://www.motionguidance.com/>

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