



# Traumatic Brain Injury; Assessment of Persistent Balance Disorders


David Domoracki PhD CCC/A  
Cleveland VAMC




**In a 1997 study, 67 subjects with TBI of mixed severity (mostly severe) at 5 years post injury complained that , after headaches, dizziness was second most frequently reported physical symptom.**

**Hillier SL, Sharpe, MH, Metzger, J, “Outcomes 5 years post-traumatic brain injury” Brain Inj. 1997:11(9); 661-75**








President's Commission on Care for  
America's Returning Wounded (2007)  
estimated that up to 20% of returning  
OIF/OEF veterans may be found to have  
suffered mild to moderate TBI  
(approximately 300,000 of the 1.5 million  
who have served).







## The proposed mechanisms for dizziness and imbalance following TBI (blast related injury) include

- dislodged otoconia in vestibular system (BPPV)  
(Maskell et.al, 2006)
  - fistula in the vestibular system
  - post traumatic endolymphatic hydrops
  - damage to otolith organs (Walker, 2008 personal communication)
  - vestibular hair cell damage (Guskiewicz, 2003)
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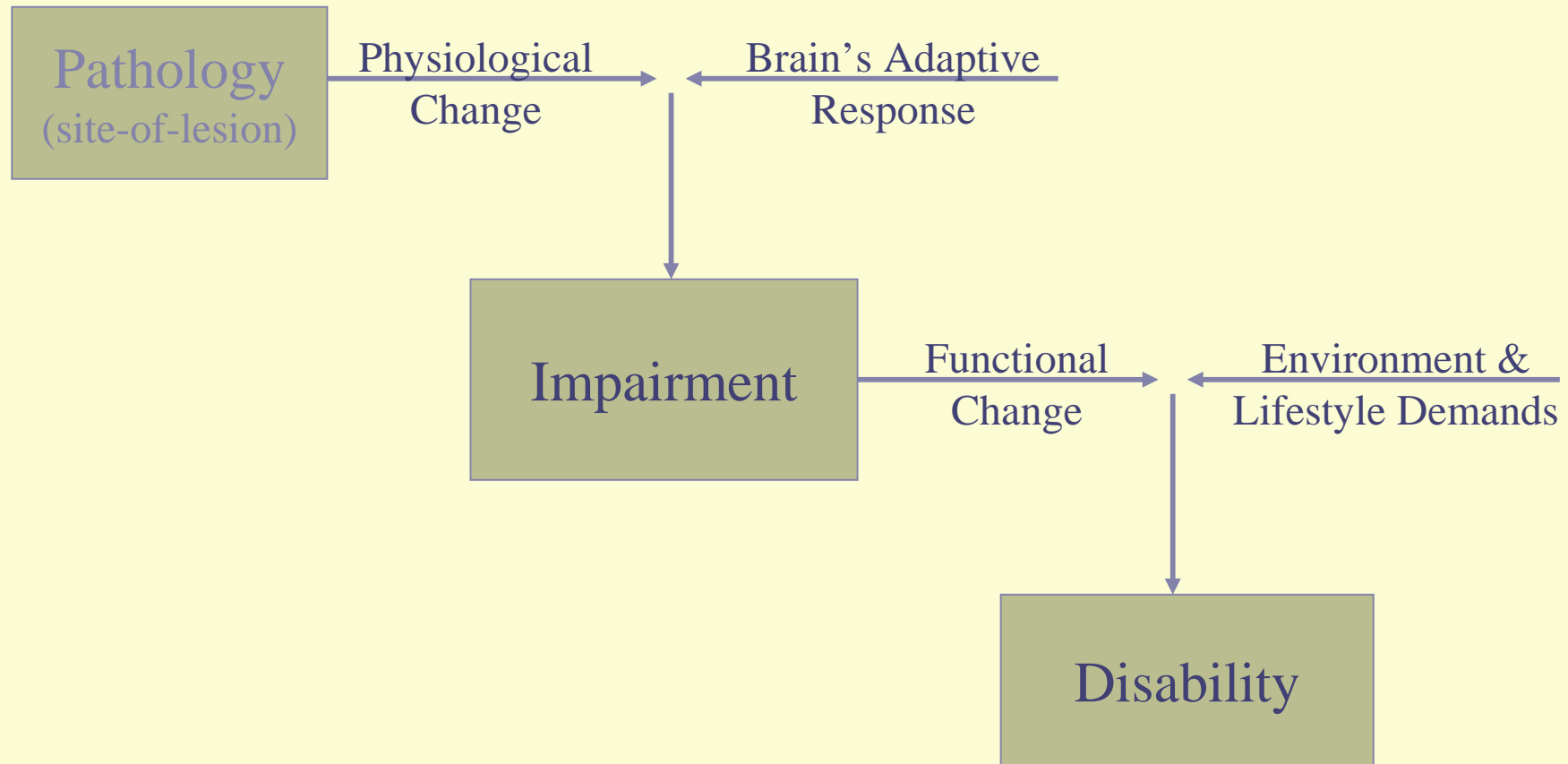
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- “tethering” of the vestibular nerve in internal auditory meatus (Basford et. Al., 2003)
  - migraine associated vertigo (Maskell,et.al, 2005)
  - general labyrinthine (semicircular canal) injury (Sylvia et.al, 2001)
  - cerebellar damage (Black et.al, 2000)
  - motor programming weakness (Black et.al, 2000)
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The injuries that cannot be immediately medically treated tend to cause impairments in the vestibulo-ocular reflex (VOR) and the vestibulo-spinal reflex (VSR). These veterans complain of “spatial disorientation” (Hoffer et.al, 2004)




# What Is An Impairment?





## Pathologies do not equal impairments!

Patients with the similar pathologies may present with significant differences in impairments and functional limitations. Because of these differences, patients with similar pathologies may not respond the same to a given treatment.





# Sensory Weighting is Task-Dependent in Normal Individuals

## WEIGHTING

Stable Surface

- 70% SOM
- 20% VEST
- 10% VIS

## RE-WEIGHTING


Unstable Surface

- 60% VEST
- 30% VIS
- 10% SOM

Peterka, R. and P. Loughlin (2004). "Dynamic regulation of sensorimotor integration in human postural control." J Neurophysiol 91:000-000; adopted from Horak 2003




# Protocol for managing Polytrauma Clinic TBI veterans with Persistent Balance Problems

- PCP referral to Polytrauma Clinic Coordinator. 1<sup>st</sup> evaluation done by PCP.
  - Coordinator or neurologist perform 2nd evaluation with nationally standardized VA self assessment tool. Also, clinical examination performed for impairment
  - Referral to audiology for hearing test and balance lab exams.
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## Audiology exam protocol;

- Comprehensive hearing test with fistula testing.
  - Dizziness Handicap Scale
  - Clinical exams
  - Case history
  - ENG/VNG with head shake testing.
  - VEMP then ABR if VEMP abnormal and caloric weakness
  - Dynamic Visual Acuity test (DVA) if c/o visual instability with motion.
  - Posturography exam with motor control and adaptation testing.
  - Motorized rotary chair exam with step velocity testing and off axis exam if appropriate
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## After the audiology exam;


- Discussion with neurologist
  - Referral to Physical Therapy Balance Team if the posturography composite score is abnormal and the DHI shows a handicap.
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# The Neurobehavioral Symptom Inventory


22 items rating post-concussive symptoms on a scale of 0 (no symptom) to 4 (very severe symptom). This is utilized after a positive screen to identify common problems in a structured interview. It has been validated for mTBI (Cicerone: J. Head Tr Rehab. 1995(10)3; 1-17).

The items relevant to balance control include;

1. Dizziness
  2. Loss of Balance
  3. Poor Coordination, clumsy
  4. Headaches
  5. Nausea
  6. Vision Problems
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# mTBI Data Summary

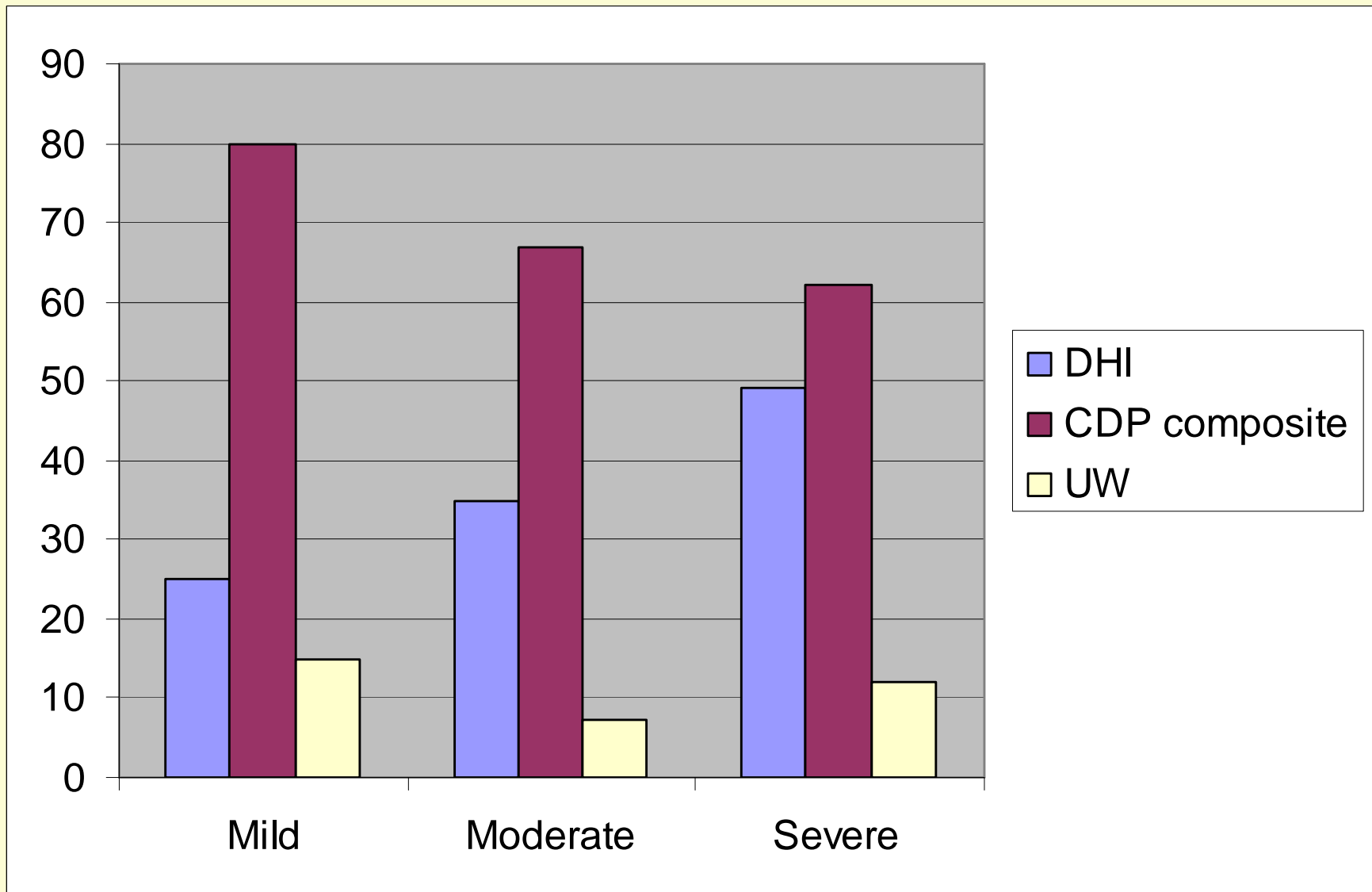
- 20 OEF/OIF veterans between 1 yr and 5 yr post blast exposure/blunt head trauma
  - No penetrating wounds
  - No control over comorbidities except for requiring vet to be ambulatory and able to stand for ½ hr.
  - Referred with c/o persistent balance problems since event
  - Their NBI ratings for balance related elements (dizziness, coordination, balance) were summed and the veterans were divided into “mild, moderate and severe” mTBI balance classifications.
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## mTBI Data Summary


- A comparison was made of the Dizziness Handicap Inventory (Jacobson and Newman, 1990), the composite score of the posturography exam, and unilateral weaknesses among the three groups.

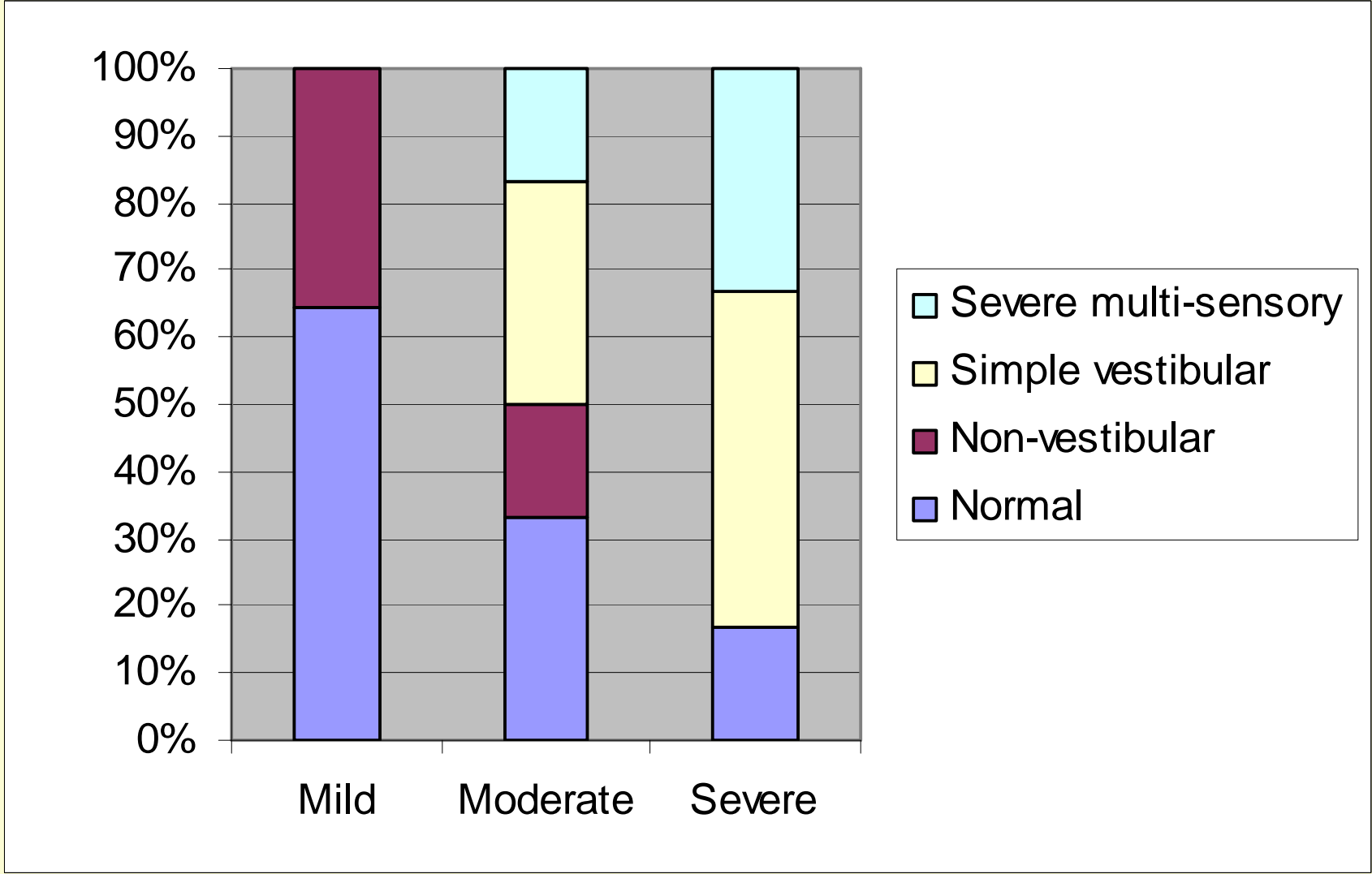







# mTBI Data Summary

- The sensory organization test results from the posturography exams were clustered into “normal, non-vestibular, simple vestibular, and multisensory” categories.
  - For each of the “mild, moderate, severe” NBI self report categories, it was determined what percentage of those individuals had each type of SOT result.
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# Activity encounter

- Diagnostic codes for TBI. Include both
    - 780.4 dizziness and giddiness
    - V15.51 if skull fracture, or
    - V15.59 if no skull fracture
  - Procedure codes
    - 92700 Dix-Hallpike
    - 92585 Auditory Evoked Potential (for VEMP)
    - 92543 Caloric Vestibular Testing with recordings (4 times)
    - 92548 Computerized Dynamic Posturography
    - 92544 Optokinetic Nystagmus Test with recording
    - 92545 Oscillating Tracking Test with recording
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## Procedures continued

- 92542 Positional Nystagmus Test with recording<sup>9</sup>
  - 2546 Sinusoidal Vertical Axis Rotation
  - 92541 Spontaneous Nystagmus Test with recording
  - 92547 Vertical Channel
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No show rate for 2<sup>nd</sup> level TBI Evaluation was 90% 2 yrs ago. This year it is 38%. This only pertains to polytrauma clinic/ 2<sup>nd</sup> level eval, not polytrauma clinic/other clinic activities. Suspected that around 45% no show for other clinics. Almost all are mild TBI cases. (Personal communication with Traci Piero, Polytrauma Clinic coordinator, 2008).

