

INCIDENCE OF SUSPECTED  
OTOLITHIC ABNORMALITIES IN MILD  
TRAUMATIC BRAIN INJURED  
VETERANS  
OBSERVATIONS FROM A LARGE VA POLYTRAUMA  
NETWORK SITE

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# TBI as an Increasing Concern

- 11,703 cases of moderate or severe TBI among OIF/OEF service members
- Burden of mild TBI (mTBI) is likely to be far greater, up to 20% of the 1.5 million OIF/OEF veterans
- Also a concern in the civilian population as 1.4 million Americans suffer TBI each year
- Proposed that peripheral vestibular injury, particularly otolith organs, plays an important role in the pathogenesis of persistent disequilibrium after TBI

# Vestibular Deficits in TBI

- Benign paroxysmal positional vertigo (BPPV)
  - Displaced otoconia
- Migraine-associated vertigo
  - Respond well to migraine pharmacotherapy
- Spatial disorientation
  - Possible permanent damage to the sense organs of the vestibular labyrinth in the inner ear
  - Resulting in impaired vestibulo-spinal (VSR) and vestibulo-ocular (VOR) reflexes

# mTBI Physiological Mechanisms

- Repairable mechanical abnormalities
  - Fistulas
  - BPPV
- Extended vestibular rehabilitation
  - Labyrinthine injury
  - 8<sup>th</sup> nerve shearing
- Otolithic dysfunction
  - Persistent dizziness with normal results except for tests of postural control

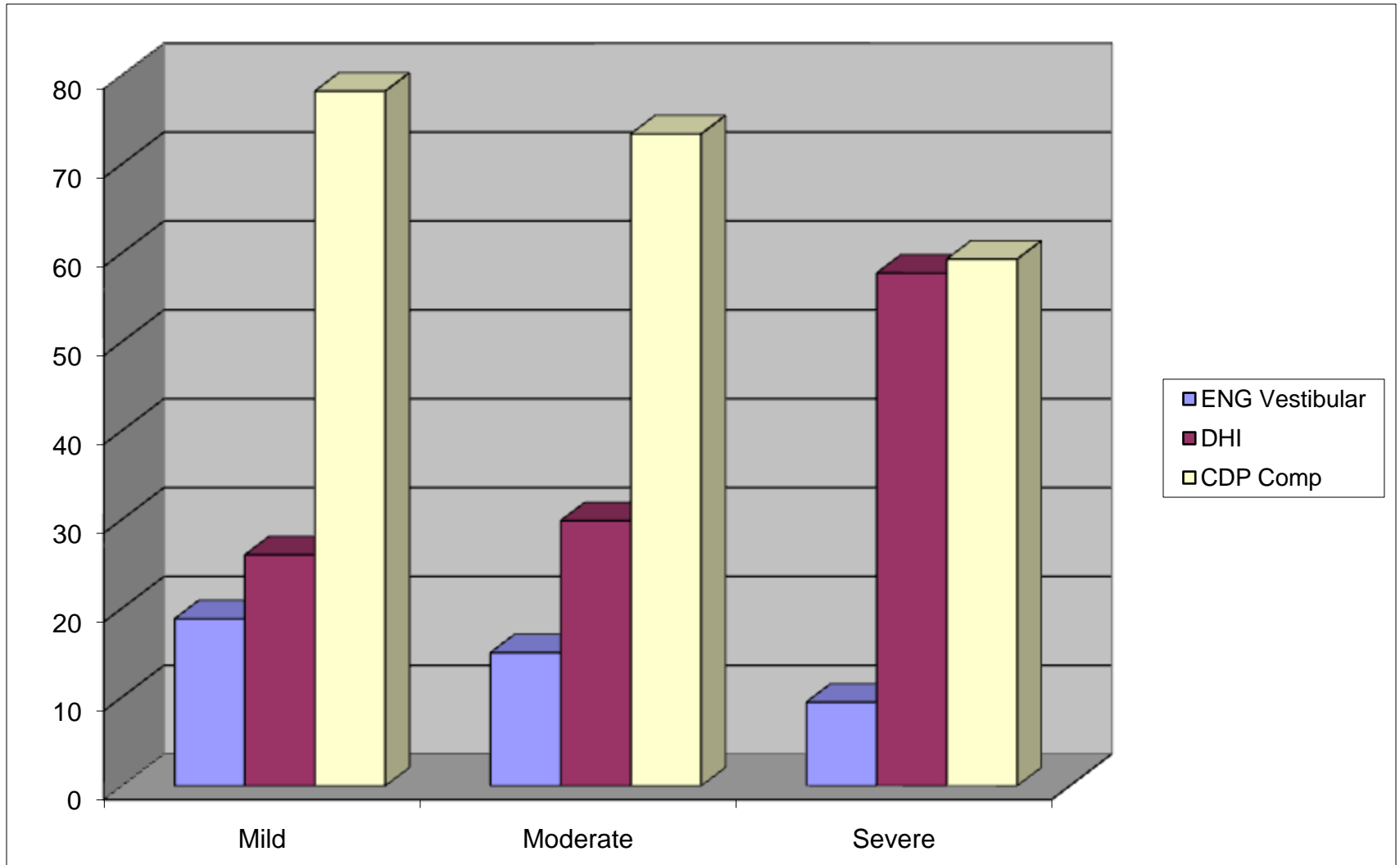
# Otolithic Dysfunction Diagnosis

- Normal site of lesion laboratory tests
  - ENG and rotary chair exams
- Coupled with poor performance on vestibular subtests of postural control exams
- Tests sensitive to otolith disorders
  - Vestibularly evoked myogenic potentials (VEMPs)
  - SVV exams
  - Not site specific or have limited normative data

# Implied Disorders

- Disorder with the saccule or utricle can be implied from:
  - Set of symptoms
  - Postural instabilities
  - Essentially normal laboratory exams
- Incidence of vestibular defects available but incidence of implied otolithic dysfunction has not been reported

A comparison of a disability measure (DHI), an impairment measure (CDP Composite), and a pathology assessment (Unilateral Vestibular Weakness) on three populations of mTBI veterans (N=25)



# Methodology

- Data recorded from:
  - Laboratory tests
  - Postural control tests
  - Self assessment handicap tools
  - Standardized questionnaires
  - Sensory organization tests (SOTs)
- Collected from all OIF/OEF veterans for a one year period with mTBI

# Current Observations Matrix

	<b>DHI <math>\geq</math> 40</b>	<b>DHI <math>&lt;</math> 40</b>
<b>Unilateral or Bilateral Weakness</b>	3	6
<b>Abnormal SOT 5,6</b>	6	4
<b>Abnormal VEMP</b>	1	4
<b>Abnormal VEMP and SOT 5,6</b>	5	2
<b>WNL</b>	5	15

# Methodology

- Matrix developed to tally the incidence of:
  - Low/High Dizziness Handicap Scale
  - Positive/Negative vestibular results
- 2 by 2 matrix produces the cell which displays the count of those veterans who show:
  - Normal ENG results
  - Normal VEMPs
  - Weaknesses on subtest 5 (or 5 & 6)

# Are VORs Impaired in TBI Veterans with Disequilibrium?

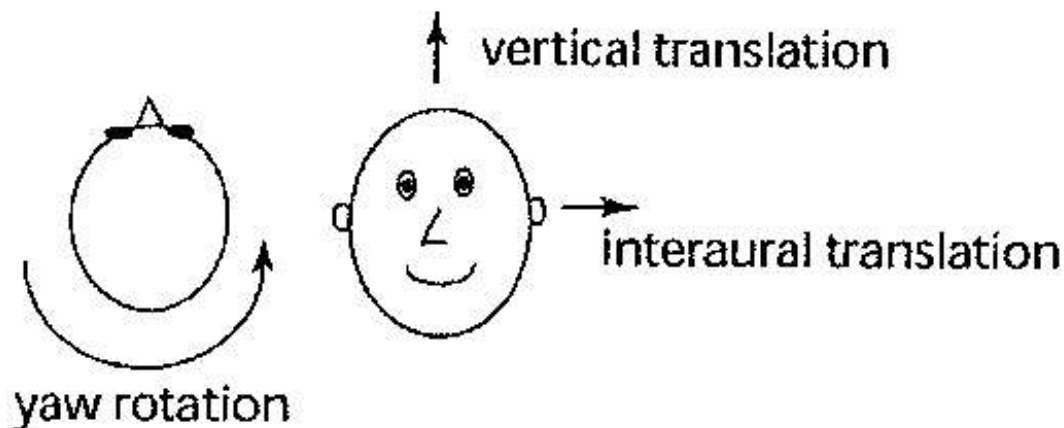
- Hypothesis: altered otolith reflexes underlie impaired balance and gait after TBI
- Alternate hypothesis: imbalance after TBI results from damage to vestibular pathways within the brain
- Major focus is to measure reflexes systematically in veterans with TBI, with and without persistent dizziness

# Moog Six Degree-of-Freedom Motion Platform

- Equipped with magnetic field search coil system to measure interaural and vertical TVORs and the yaw RVOR
- VORs hold the eyes steady when the head rotates (RVOR) and translates (TVOR)

# VOR Measures

- Normalized gaze velocity (NGV) measured during:
  - Yaw rotation: tests horizontal semicircular canals
  - Interaural translation: tests utricles
  - Vertical translation: tests saccules



# In Summary

- Results will provide important new information regarding the possible mechanisms of imbalance after TBI
- Lead to more precise measures of TBI-related injury that could potentially be used for diagnosis, prognosis, developing new treatments and making decisions regarding returning to work or combat duty