

# TBI-RELATED VISION LOSS PERSPECTIVES FROM ADULTS

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# Disclaimer & Outline

- I have nothing to declare
  
- Outline
  - ▣ Background
  - ▣ Magnitude
  - ▣ Classification of severity
  - ▣ Visual sequelae of TBI
  - ▣ Treatment
  - ▣ Children and TBI
  - ▣ Implications & Summary



# Is Brain Injury-related Vision Loss New?

- It's been around a long time, but...
  - ▣ CVI/TBI, without proper medical attention, often fatal
    - Medical advances
  - ▣ Visual symptoms often over-shadowed by other symptoms (cognitive, emotional, paralysis, amputations, etc.)
    - Visual symptoms aren't "visible" to the observer
  - ▣ Injured may be unaware of the vision loss
  - ▣ Until recently there was a lack of adequate medical/visual tests
    - First Magnetic Resonance Imaging (MRI) performed in 1977
    - Essentially lack of understanding "too often we can name it, but we don't know how to accurately diagnose or treat it"
  - ▣ Comprehensive medical records needed to assess the extent of problem (i.e., is this case unique or part of a pattern?)
    - Electronic medical records first conceived in 1960s

# TBI: War, Accidents, Sports, and Gender

- Wars in Afghanistan and Iraq first raised public awareness
- Accidents: Falls, being hit by something, vehicle crashes are leading causes ([https://www.cdc.gov/traumaticbraininjury/get\\_the\\_facts.html](https://www.cdc.gov/traumaticbraininjury/get_the_facts.html))
  - ▣ 2.8 million ER visits, ~50k deaths, most prevalent in children (0 to 4 yrs) and older adults (over 75 yrs)
- Boston University – autopsies conducted on over 202 fatalities related to Chronic Traumatic Encephalopathy (CTE)
  - ▣ Many but not all were professional football players – includes high school athletes – CTE appears to result from repetitive concussions
- Its been observed that there are no non-contact sports
- Girls soccer players have higher rate of concussion than boy football players (Michael S. Schallmo, et al, 2017 Annual Meeting, American Academy of Orthopedic Surgeons)

# Traumatic Brain Injury (TBI)

## Classifications

- Concussion is most common diagnosis
  - ▣ No formal classification distinction between diagnosis of concussion and mild TBI
    - Physicians: don't want to needlessly alarm versus potential need to know
- Classification of TBI usually broken down into
  - ▣ Mild
  - ▣ Moderate
  - ▣ Severe
    - Occasionally you'll see penetrating as a category
      - Denotes that injury penetrated the skull

# TBI Classification: Glasgow Coma Scale \*

Criteria	Mild	Moderate	Severe
Structural Imaging	Normal	Normal or abnormal	Normal or abnormal
Loss of Consciousness	0-30 minutes	>30 min and <24 hrs.	>24 hrs.
Alteration of Consciousness	A moment up to 24 hrs.	>24 hrs. severity based on other criteria	>24 hrs. severity based on other criteria
Post-traumatic Amnesia	0-1 day	>2 day < 7 days	>7 days
Glasgow Coma Scale (first 24 hrs)	13-15	9-12	<9

\* Severity of brain injury not highly correlated with severity or type of visual loss

# Vision in Humans

- Vision injury one of most prevalent injuries in TBI
  - ▣ Due to blast, MVA, assault, fall, gunshot, stroke, etc.
- Vision represents ~70% - 80% of sensory input in humans
  - ▣ Vision is integrated with other senses (e.g. hearing) and directly mediates learning, memory, cognition, as well as, day to day tasks: reading, walking, driving, etc.
- It is interesting that the visual system can almost instantly determine what is “relevant” in pure surroundings and ignore the vast number of “irrelevant” elements – all without much awareness on our part!
  - ▣ For example, the human visual system can determine if a briefly presented photo contains an animal or not – a very complex task (“spot”, classify, name, etc.)

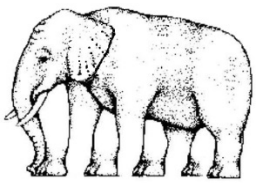
# Can You Name the Animal?



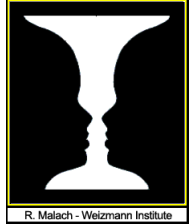


# What You Saw in 0.5 Seconds





# Are We Aware of Vision or Its Loss?



- Much of how we use our visual system is via unconscious mechanisms. It is only when we turn our attention to something that we become the “directors” of our visual systems.
  - ▣ Examples, walking, driving, picking up a cup of coffee, etc.
- One intriguing finding from our studies is that while patients with TBI-related visual impairments report difficulty doing visual tasks, they often do not attribute the difficulty to their vision
  - ▣ The difficulty is reported as a problem in concentration, poor memory, or other non-visual aspects (usually) related to the individual's TBI

# Visual Sequelae

- Most symptoms resolve within days to a few weeks
  - ▣ TBI may result in total blindness, but not common
  - ▣ In most patients visual symptoms will not be revealed in a routine eye examination
- TBI visual symptoms include:
  - Loss of acuity, color discrimination, brightness detection, contrast
  - Visual field defects
  - Eye movement disorders
  - Fixation disorders
  - Accommodation deficits
  - Etc.

# Self-reported Visual and Reading Symptoms in a Veteran TBI Population

Visual Symptom	Percent
Vision-related complaints following injury	79%
Light sensitivity	69%
Blurred distance vision	63%
Floaters	61%
H/O Refractive error	49%
Blurred near vision	47%
Flashes	38%
Pain in or around eyes	32%
Loss of peripheral vision	22%
Pain with eye movement	16%
Diplopia	11%
H/O Strabismus/amblyopia*	4%

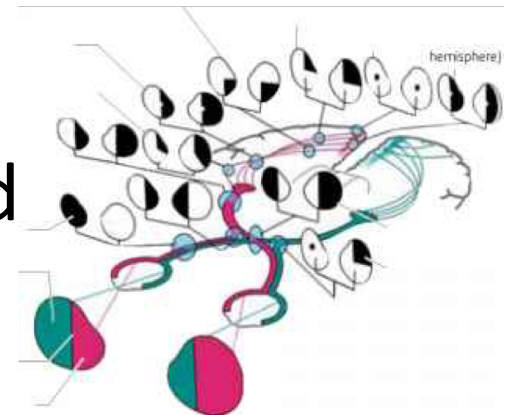
Reading Symptom	Percent
Reading difficulty	84%
Difficulty remembering what was read	78%
Reduced ability to concentrate while reading	77%
Symptoms new since injury	75%
Loses place while reading	71%
Eyes tire while reading	71%
Unable to do sustained reading	65%
Falls asleep while reading	64%
Easier to read when rested	42%
Covers/closes one eye to read	12%

# Visual Acuity

- Interestingly, visual acuity is often not impacted
  - ~3% - 14% in most severe TBI
  - ~1% - 2% in less severe TBI
- Blast events result in (usually monocular) enucleation (18%) or blindness (6%) of most severely injured patients but much lower rates (~1% - 2%) in less severely injured
- Visual acuity considered “gold standard” of visual function
  - This “status” may hinder identification of patients with visual deficits since clinicians may not assess visual function if acuity “normal”

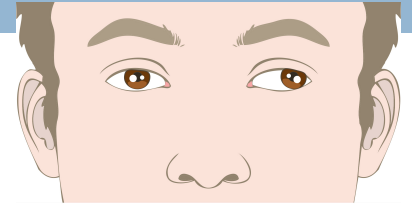
# Visual Field

- Visual field loss following TBI in active duty service members/veterans
- Reported rates 14% - 33% in studies of polytrauma patients
  - ▣ Hemianopia one of most common type of field loss,
    - Usually homonymous but may be bi-temporal
    - Monocular or binocular
    - Quadrant loss or field constriction
- Lower rate in less severely injured

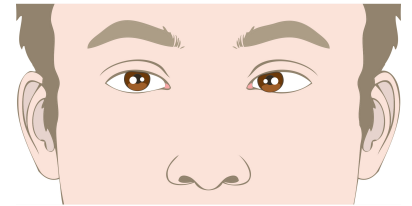


# Visual Dysfunction

- Most common visual finding in TBI (~75%)
  - ▣ Occurs at all TBI severity levels
  - ▣ May also be present in patients with visual acuity or visual field loss
- Visual dysfunctions (partial list)
  - Accommodative excess
  - Accommodative insufficiency
  - Photophobia
  - Exotropia/esotropia
  - Hypertropia/hypotropia



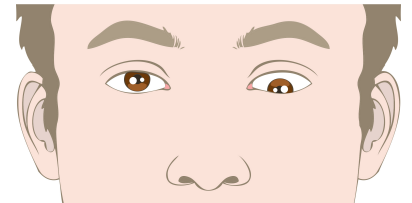
Exotropia



Esotropia



Hypertropia



Hypotropia



# Complications Associated with TBI

- Studies with veterans show mTBI often associated with psychological factors
  - ▣ In OEF/OIF veterans
    - 23% have PTSD
    - 8% to 21% have depression
    - 11% substance abuse
  - ▣ In OEF/OIF veterans with mTBI
    - 73% have PTSD
    - 45% have depression
    - 20% substance abuse
- Psychological factors
  - ▣ Treatment
    - Psychological therapy
    - Medications
- Wide variety of psychological problems reported in civilian TBI cases (<https://www.brainline.org/article/behavioral-and-emotional-effects>)





# Children and Concussion

- In school sports the question often asked following a concussion is “when is it safe for the child to return to play?”
- Recent studies suggest that a better question would be “when is it safe to return to learning?” (Swanson et al. (2015), Optometry and Vision Science, 94 (1), 60-7)
  - ▣ Academic performance and vision problems may continue beyond resolution of other concussion symptoms (N = 276)

# Implications

- TBI is a major cause of death and disability in the United States (Traumatic brain injury & concussion, CDC.gov accessed July 2018)
- TBI may be the leading cause of death in children ([https://www.cdc.gov/traumaticbraininjury/assessing\\_outcomes\\_in\\_children.html](https://www.cdc.gov/traumaticbraininjury/assessing_outcomes_in_children.html))
  - ▣ 3k die, 29k hospitalized, 400k treated in ER
- Elderly also disproportionately at risk
- Children with post-concussive symptoms, including academic and vision problems, should receive multidisciplinary evaluation

# Parting Thoughts

- Personnel in schools should be aware of the implications of concussion/TBI
  - ▣ May have long term consequences for academic performance
  - ▣ Treatments are available and effective
- Given that TBI is a major public health concern for death and disability it receives far too little attention and discussion - except for high profile cases of military personnel and athletes

# Thank you!

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- Power point is available via email:

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