Traumatic Brain Injury & Visual Impairment

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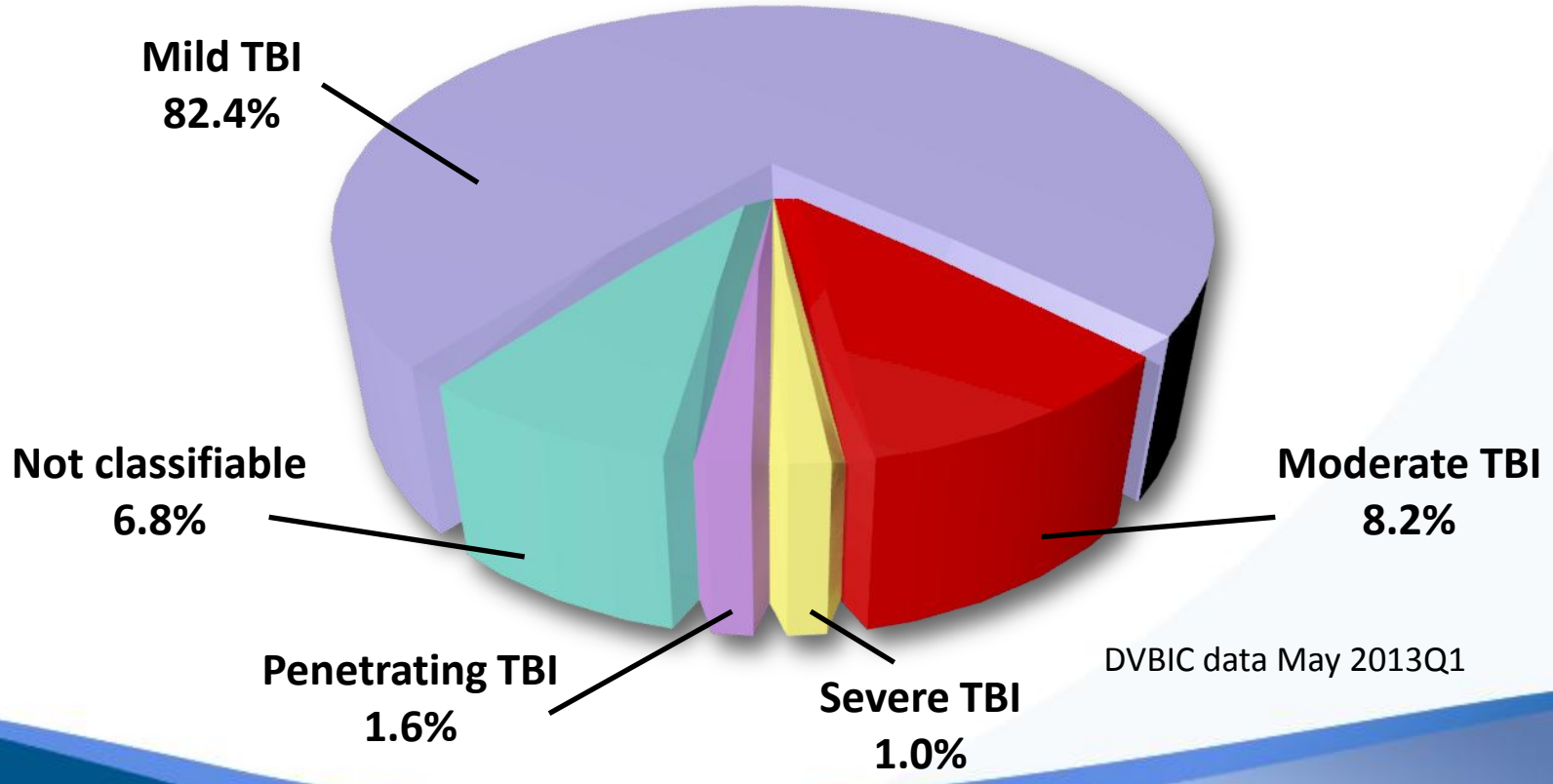
TBI in Military Personnel

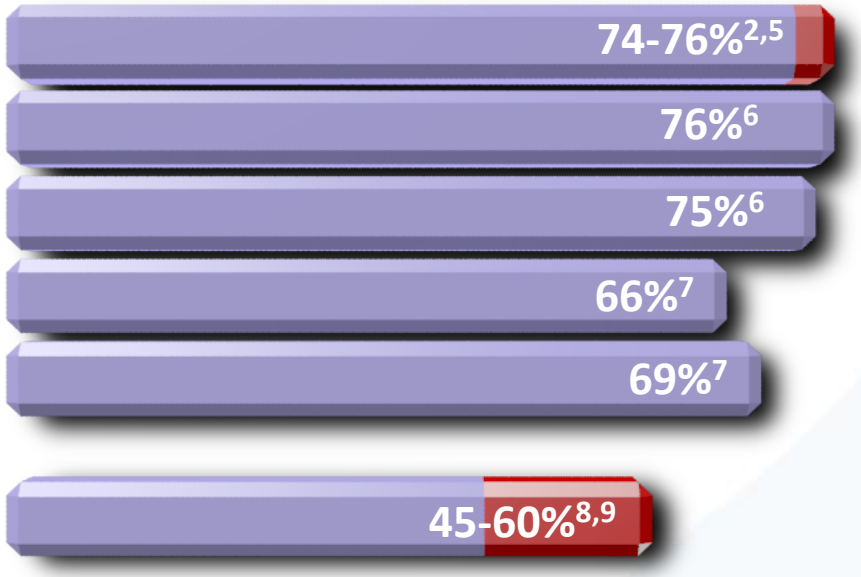
DoD TBI data for US forces worldwide 2000-2013[1]



DVBIC data May 2013Q1

Percentage of TBI Patients with Visual Symptoms

- Military
  - PRC /PNS
  - Polytrauma/TBI
  - TBI
  - PRC blast
  - PRC non-blast
- Civilian Estimates



Types of Visual Symptoms in TBI

Symptom	In-patient	Out-patient
Photophobia[6,8,10]	7%	13-59%
Diplopia[2,6]	7%	8-15%
Eyestrain[10]		35%
Blur when reading[10]		35%
Loss of place reading[10]		60%
Reduced reading speed[10]		50%
Words run together[10]		40%
Reduced reading comprehension[10]		40%

Military Blast vs. Non-blast TBI

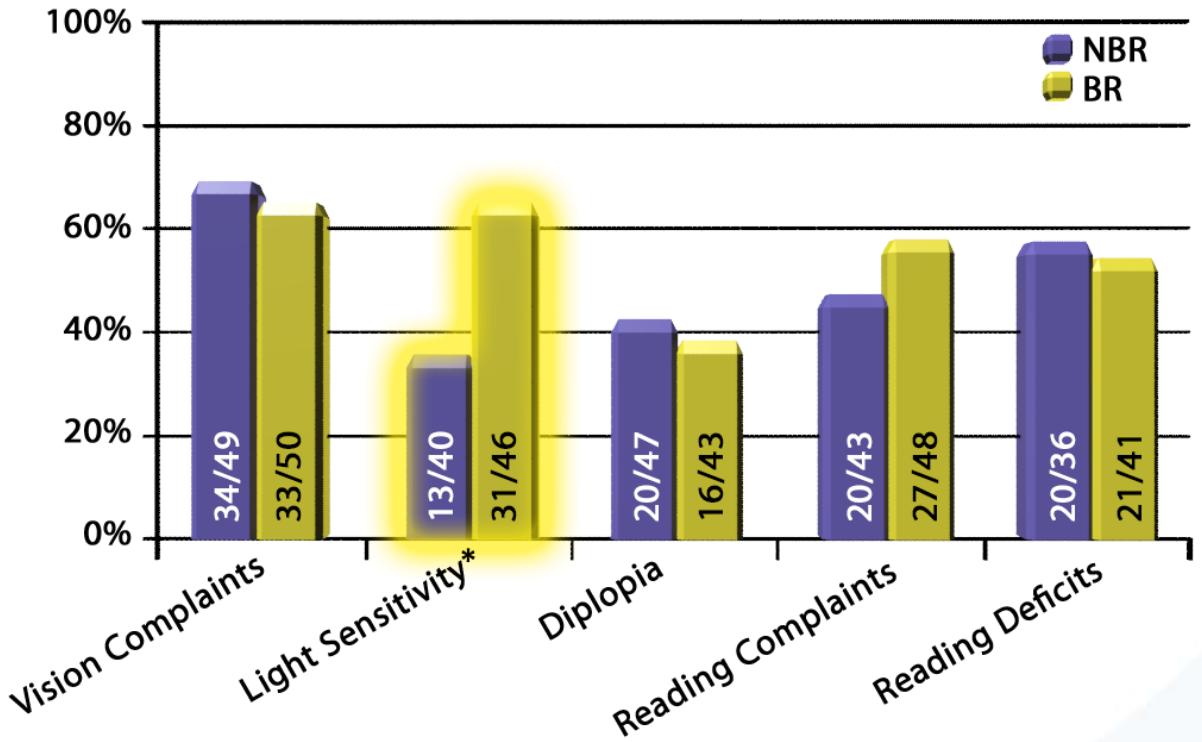
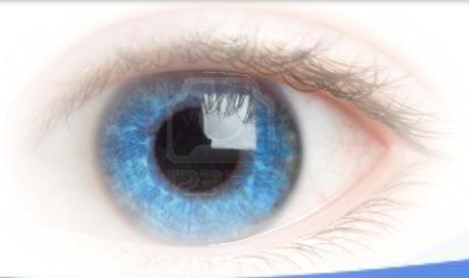


Figure 1.
Percentage of patients with subjective vision complaints and reading performance deficits. The number of patients with each anomaly/total number of patients measured is given in each bar. *Light sensitivity was found at a significantly higher frequency in the BR TBI group (p = 0.002).

Goodrich, et. al., 2013

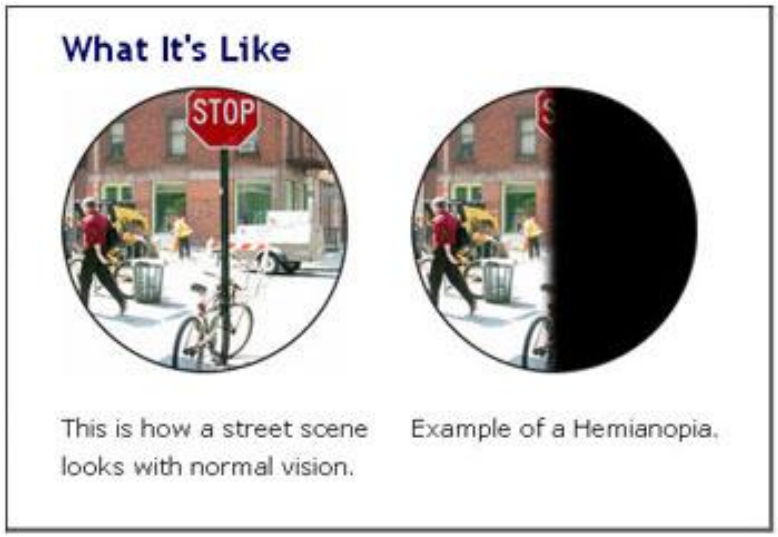
Visual Acuity and TBI

Acuity level	Civilian[8]	PRC[5]	PNS[5]
20/60 or better	85%	78%	98%
20/70 – 20/100	3%	6%	0%
Worse than 20/100	5%	13%	2%
NLP (1 or both eyes)	7%	3% (OU)	0%



Visual Field Defects and TBI

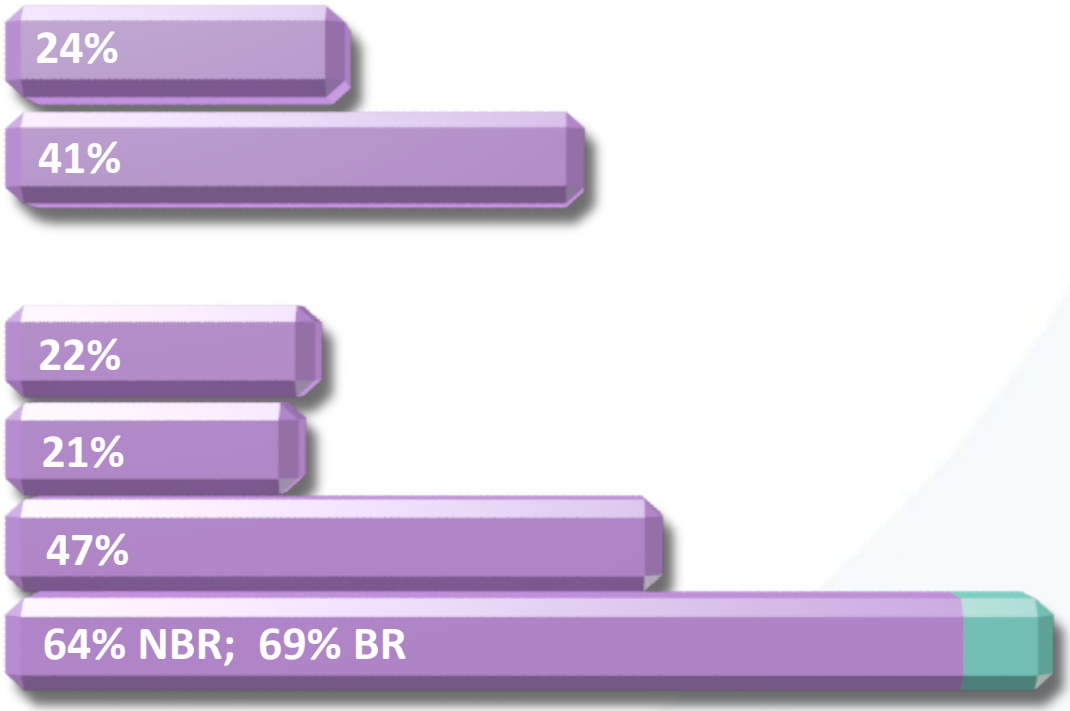
Type of VF Defect	Civilian[8]	PRC[2]
RHH	4%	2%
LHH	4%	16%
Quadranopsia	6%	4%



http://www.lighthouse.org/about-low-vision-blindness/vision-disorders/hemianopia/

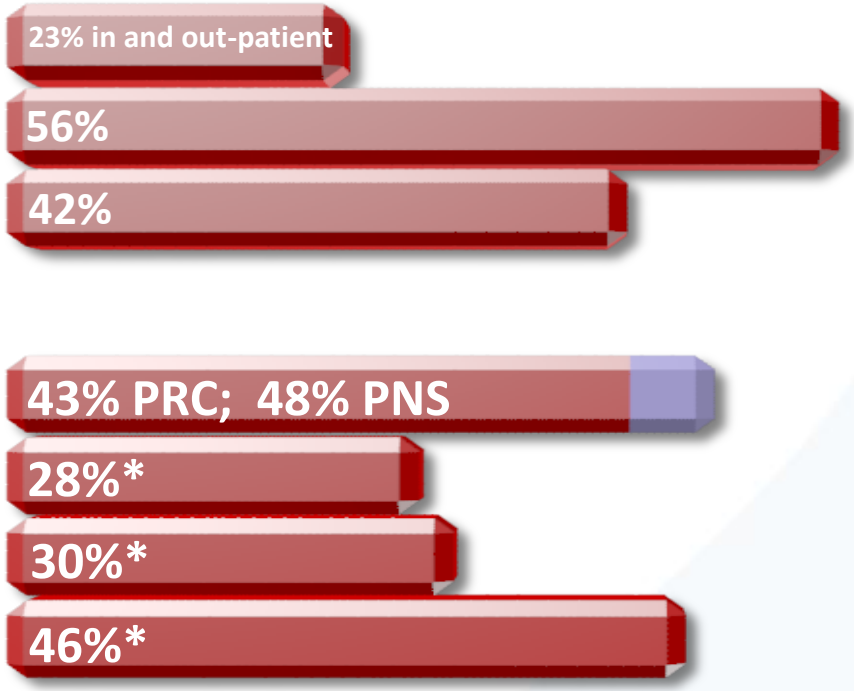
Accommodative Dysfunction and TBI

- Civilian
  - Alvarez, et al[8]
  - Ciuffreda, et al[11]
- Military
  - Goodrich, et al[2]
  - Lew, et al[12]
  - Stelmack, et al[6]
  - Goodrich, et al[7]



Convergence Insufficiency and TBI

- Civilian
  - Alvarez, et al[8]
  - Ciuffreda, et al[11]
  - Cohen, et al[13]
- Military
  - Brahm, et al[5]
  - Stelmack, et al[6]
  - Goodrich, et al[2]
  - Lew, et al[12]



A Retrospective Study of the Prevalence of Visual Deficits after Mild TBI Secondary to Blast Exposure during Military Deployment[14]

BV/Accom Dx	# of Subjects (26)	% of Subjects	% in General Adult Pop.
Vertical	8	31	0.5 (HrT)
Ac Infacility	6	23	xx
CI	4	15	7.7
Ac Insufficiency	4	15	6.2
Strabismus	2	8	3.9
Basic EP	2	8	1.5
Ac Spasm	2	8	10.8
Basic XP	1	4	3.1
FVD	1	4	1.5
CN Palsy	1	4	xx

Military Patient Case:

- 27 year old male
- Active duty army sergeant
- CC:

  (+) Intermittent vertical diplopia

  (+) Words look “bunched up on the page” and he often skips lines when reading

  (+) Motion sickness and dizziness with walking

Additional History:

- 2 deployments
  - 2004-05 Iraq
  - 2/07-12/07 Iraq
- 6 IED blasts
- Last blast hit his vehicle and it was lifted from the ground
- He lost consciousness for 6 min

- Being treated for:
  - Headaches
  - PTSD
  - Dyslipidemia
- Being treated with:
  - Topamax (topiramate)
  - Klonopin (clonazepam)
  - Seroquel (quetiapine)
  - Lipitor (atorvastatin)
  - ASA
- POH (+) Glasses

Exam Findings:

- Subjective Refraction:
  - OD: -2.50 -2.00 x 014 20/20
  - OS: -2.50 -1.75 x 180 20/20
- EOMs: +1 OAIO OS
- Maddox Rod @ near:

R		L
	7BI, 3BU	
5BI, 3BU	6BI, 2BU	5BI, 3BU
5BI, 3BU	6BI, 2BU Prism over OD	5BI, 3BU

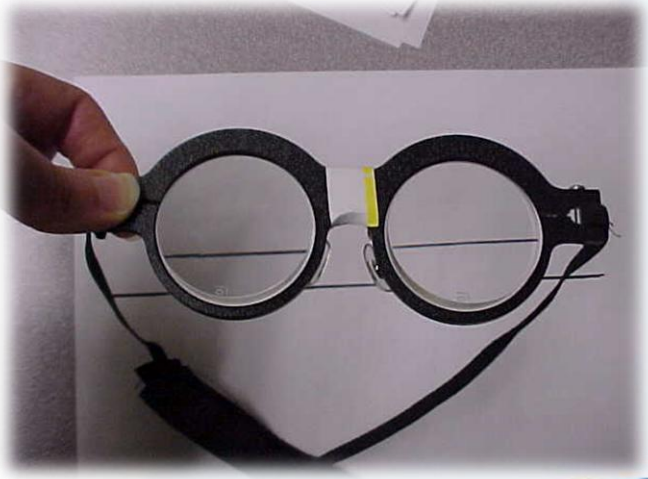
- Associated Phoria:
  - 2BU OD (Wesson)
- Stereo acuity:
  - Randot: 250”Global, 70” Local
  - With 2BU OD: 20”Local

Outcome:

- Assessments:
  - CMA OU
  - Intermittent diplopia secondary to left hyper-deviation
  - Ruled out CN IV palsy
- Plan:
  - New spec Rx
  - 2BU OD Fresnel prism added to specs
  - F/U in 2 weeks

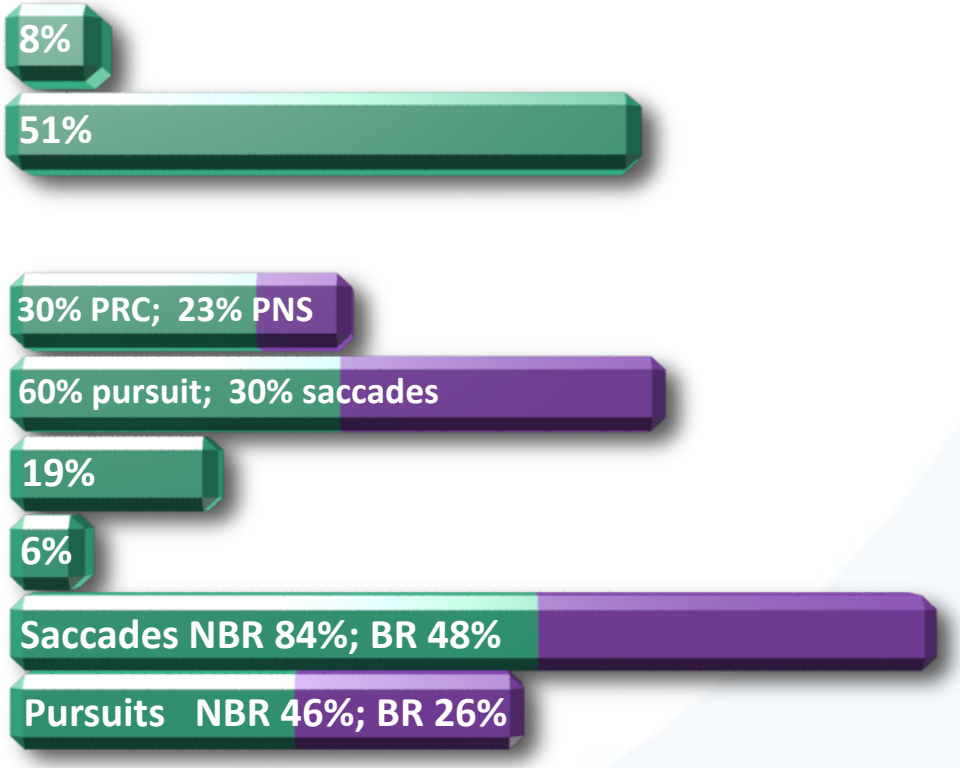
2 Week Follow-up Summary:

- Assessment:
  - OS hyper deviation with much improved symptoms since addition of prism
- Plan:
  - Prism will be ground into new spectacle Rx



Saccadic/Pursuit Dysfunction and TBI

- Civilian
  - Alvarez, et al[8]
  - Ciuffreda, et al[11]
- Military
  - Brahm, et al[5]
  - Capo Aponte, et al[10]
  - Goodrich, et al[2]
  - Stelmack, et al[6]
  - Goodrich, et al[7]
  - Goodrich, et al[7]



Oculomotor Deficits in TBI

	Military Estimates	Civilian Estimates	Non-TBI General Population Estimates
Accommodative Dysfunction	21-69%[2,6,7,12]	24-41%[8,11]	6-17%
Convergence Dysfunction	28-48%[2,5,6,12]	23-56%[8,11,13]	7-8%
Vertical Deviation	31-55%[10,14]	Not Available	5-9% (20%)
Saccadic &/or Pursuit Dysfunction	6-84%[2,5,6,7,10]	8-51%[8,11]	<1.0%

Military Blast vs. Non-blast TBI

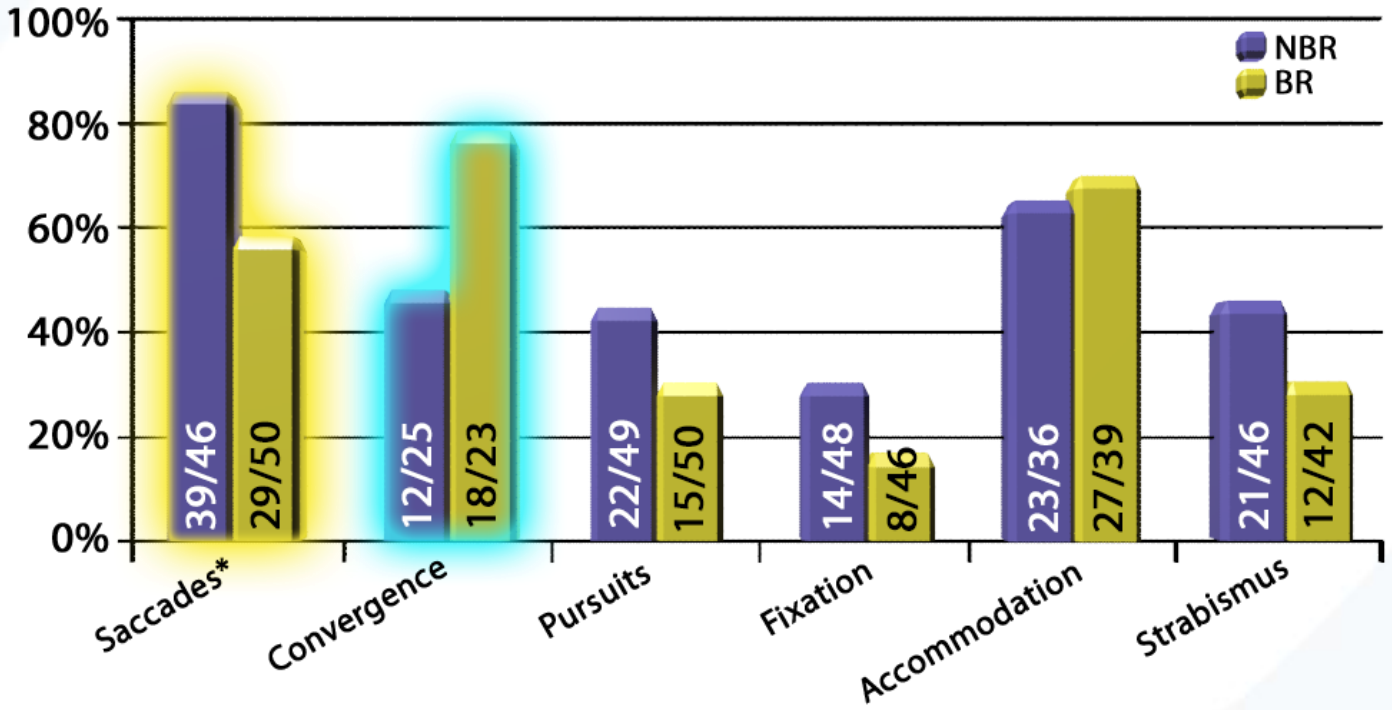


Figure 2.
Percentage of patients with oculomotor deficits. The number of patients with each anomaly/total number of patients measured is given in each bar.
*Saccadic was dysfunction was significantly higher in the NBR TBI group (p = 0.006).

Goodrich, et. al., 2013

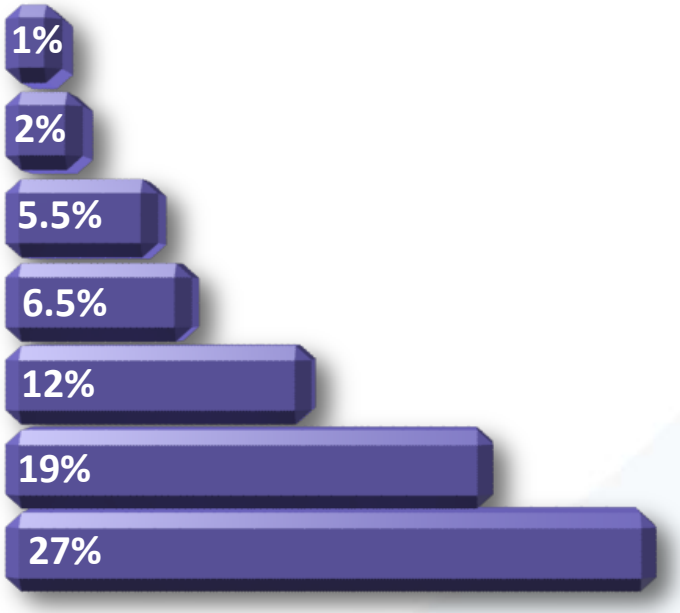
Cranial Nerve III, IV, VI Palsies and TBI

	CN III	CN IV	CN VI
• Civilian			
– Alvarez[8]	6%	10%	4%
– Ciuffreda[11]	4%	3%	1%
– VanStavern[15]	12%	13%	6%

- Military
  - Goodrich[7] (Data combines CN III, IV, VI palsies)
    - 16% of non-visually impaired
    - 42% of visually impaired
    - 20% of non-blast related polytrauma
    - 32% of blast related polytrauma

Ocular Pathology and TBI

- UK civilian study of 200 consecutive cases in an ED
- 84% of TBI patients had ocular findings within hours of admission to the ED[16]
  - ON trauma
  - Corneal/scleral tears
  - Papilledema
  - Pupil abnormality
  - Orbital fracture
  - SCH
  - Peri-ocular ecchymosis



Overall, the military and civilian TBI populations have much in common

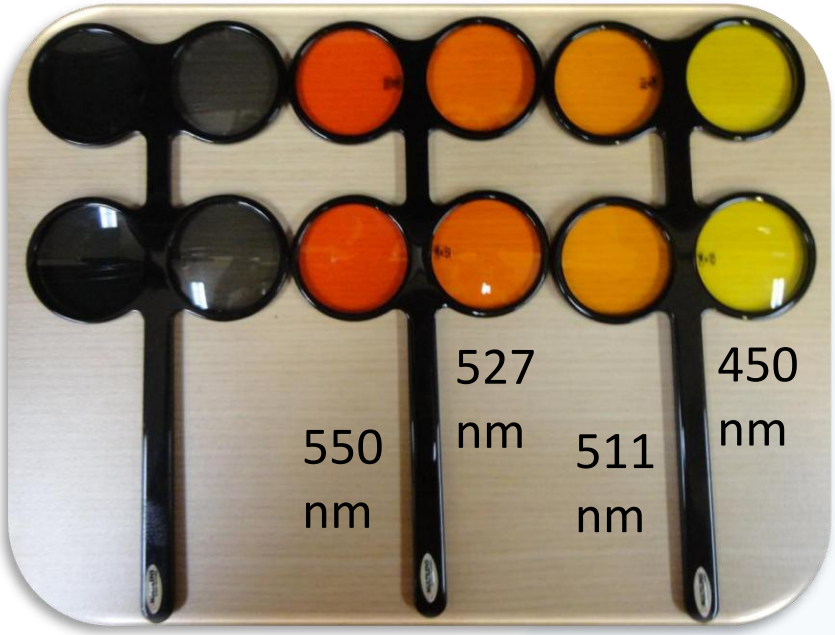
Patient Case: Soccer Player

- 28 year old male
- Professional soccer player
- CC: Concussion 2 months prior with visual & vestibular symptoms, difficulty tracking the ball, trouble with near asthenopia, and photophobia
- “Feeling off and out of balance” since concussion
- “How long until I can get back to practice and games?”

- Additional History:
  - Took header to right temple in practice
  - Felt “dizzy & out of it” afterward, continued with practice
  - C/O: intermittent blur, trouble focusing, trouble tracking, and photophobia x 2 months
  - Will be starting vestibular therapy soon
  - (+) Phonophobia
  - When he does light training, his symptoms increase
  - Prior concussion in 2003, but “fully healed from it”
  - No prior ocular or visual deficits in past
  - No prior systemic conditions
  - No medications

Exam Findings:

- DVAsc: 20/10 OD, OS
- NVAsc: 20/12.5 OD, OS
- Retinoscopy: plano OU
- Filter Eval: 550nm (I/O)
- CVF/AVF: normal OD, OS
- Pupils: normal OU
- OH: normal OD, OS



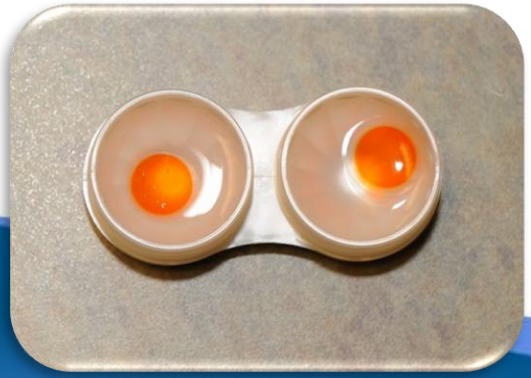
- EOM: FROM OU
- (+) end gaze nystagmus
- Pursuits adequate
- Saccades inaccurate
- NPC x 3: 7cm with effort
  Mild head shaking/tremor
- DCTsc: orthophoria
- NCTsc: 14pd XP
- Stereo: 250”G/25”L

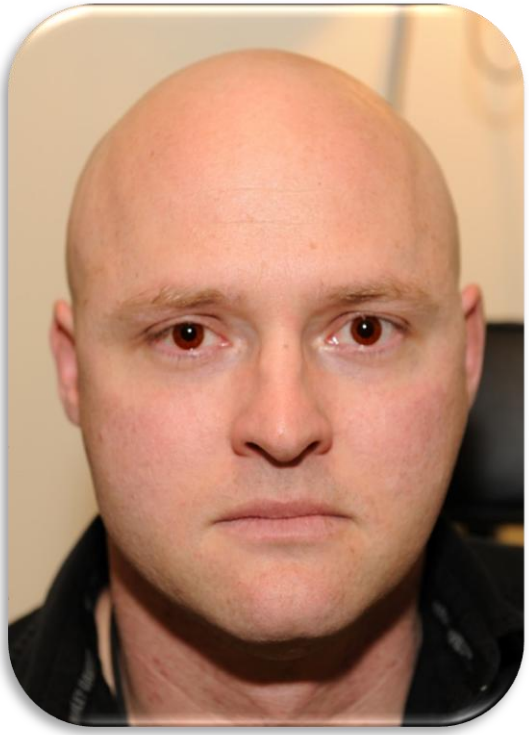
- Prism Bar Vergence @ N:
  - BO: x/20/10
  - Significant effort
  - Scrunching forehead
- AA: 9D OD, OS
- MEMsc: +0.75D OD, OS
- Accom Facility +/- 2.00
  - 9 cycles/min with effort
  - Binoc. (+) more difficult

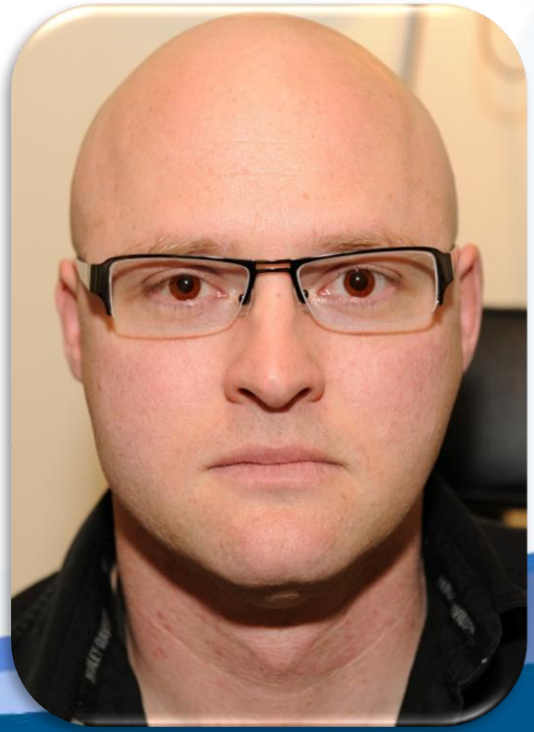
Initial Assessment & Plan

- Photophobia indoors/outdoors related to concussion
- Prescribe selective wavelength filter contact lenses (CL)
  - Counseled about induced color distortions

Military Patient







Oakley

Oakley

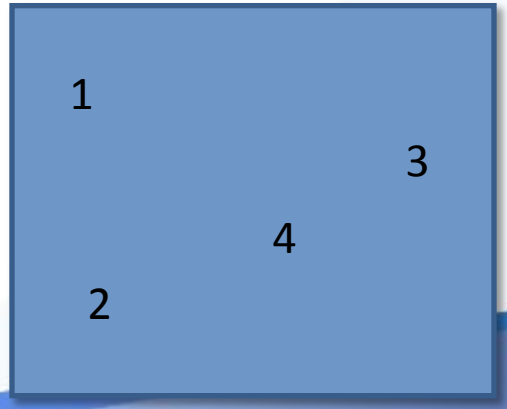
Filter Glasses

Adidas

Adidas

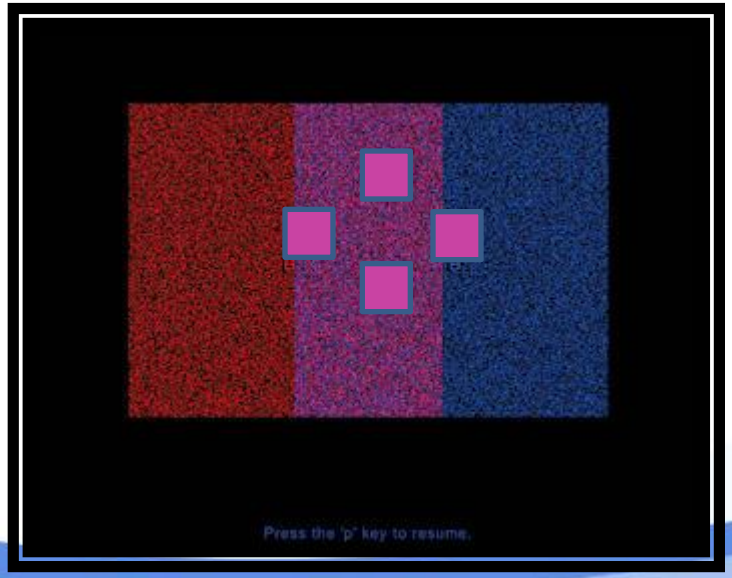
Initial Assessment & Plan

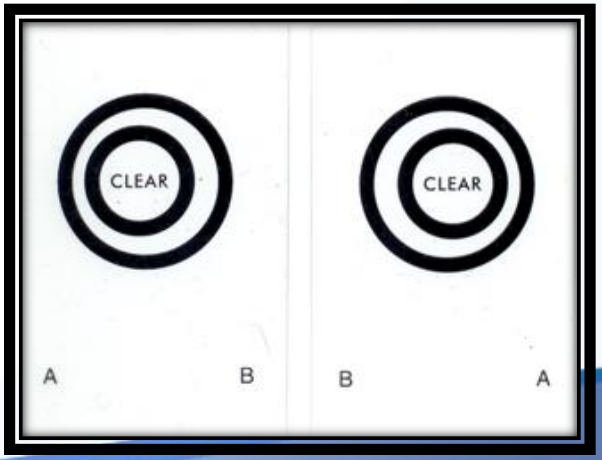
- Difficulty with saccadic accuracy after concussion
- Rx: HTS pursuit & saccadic therapy; 3 min each 2x/day
- At practice and games while on sidelines and in stands track ball in real time



Initial Assessment & Plan

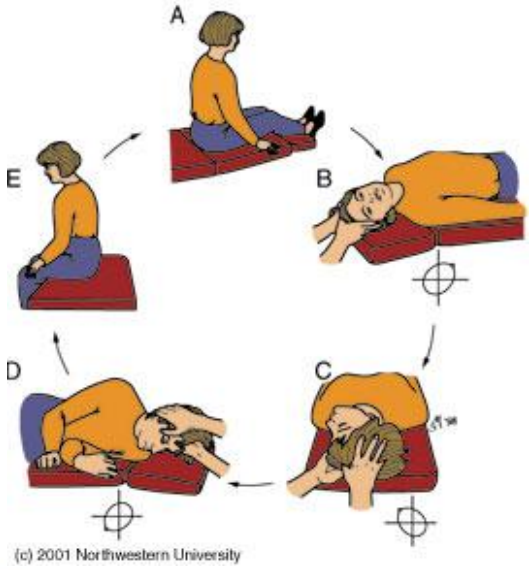
- Asthenopia secondary to convergence insufficiency (CI)
- CI decompensated secondary to concussion
- Rx: Gross convergence therapy & HTS therapy: Vergence BO, Autoslide vergence, Jump ductions; 5 min each, 2x/day





Initial Assessment & Plan

- The eye movement deficits and CI may be contributing to the patient's dizziness; however, likely otolith mislocation causing most of vestibular symptoms.



Initial Assessment & Plan

- All findings and recommendations conveyed to patient and his team trainer in person.
- Summary report sent to team physician.
- Summary sent to vestibular therapist.

Follow-up Summary

Time since initial eye examination	**10 days**	**1 month**	**2 months**
Compliance with Vision Rehab	Doing more than Rx'd	Reduced slightly	Stable
Symptoms	Stable	Improving	Resolved
Kinesthetic Awareness	Improving	Normal	Normal

Follow-up Summary

Time since initial eye examination	**10 days**	**1 month**	**2 months**
Vergence	Improving	Significant Improvement	Better than goals
Saccades & Pursuits	Stable	Pursuits good Sac improving	Normal
Vision Rehab	HTS+EcCircles	HTS+EcCircles	Discontinued

At time of vision rehab discharge:

- Loves his filter CLs!!!
- Vestibular therapy continues
- Started RTP protocol
  - Light running, goal kicking
- Returned to game play 6.5 months after concussive event

2 years later:

- "My light sensitivity hasn't been a problem for the past year now. I definitely found the tinted contacts helpful as a transitional step for me towards reintegrating into practice and play. I don't have any real residual side effects from the concussion but find that I monitor potential symptoms more closely and still wear a rugby helmet for comfort and peace of mind…"

Final Thoughts

References

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