Neuro-Ophthalmic Considerations of Traumatic Brain Injury (TBI)

DAVID A. SAMI M.D.

Diplomate, American Board of Ophthalmology

Fellow, American Academy of Ophthalmology

Phone (888) 455 1600 Fax (888) 737 0019

---------- *Offices in* ----------

Orange / Beverly Hills / Encino /

Upland / Oakland / Sacramento

At the end of this presentation,
the attendee should have a greater understanding of:

1. How Traumatic Brain Injuries affect Visual Function

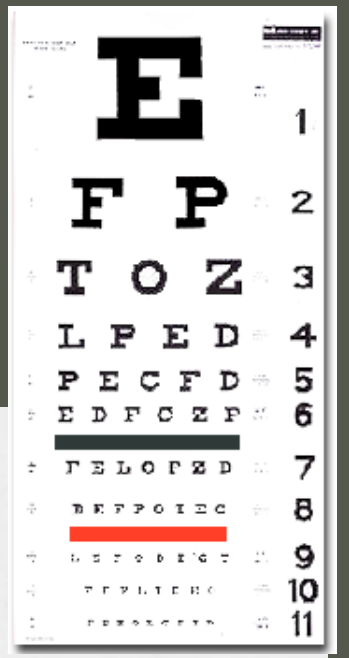
2. The interplay between cognition, visual acuity, and visual field - which combined facilitate visual function

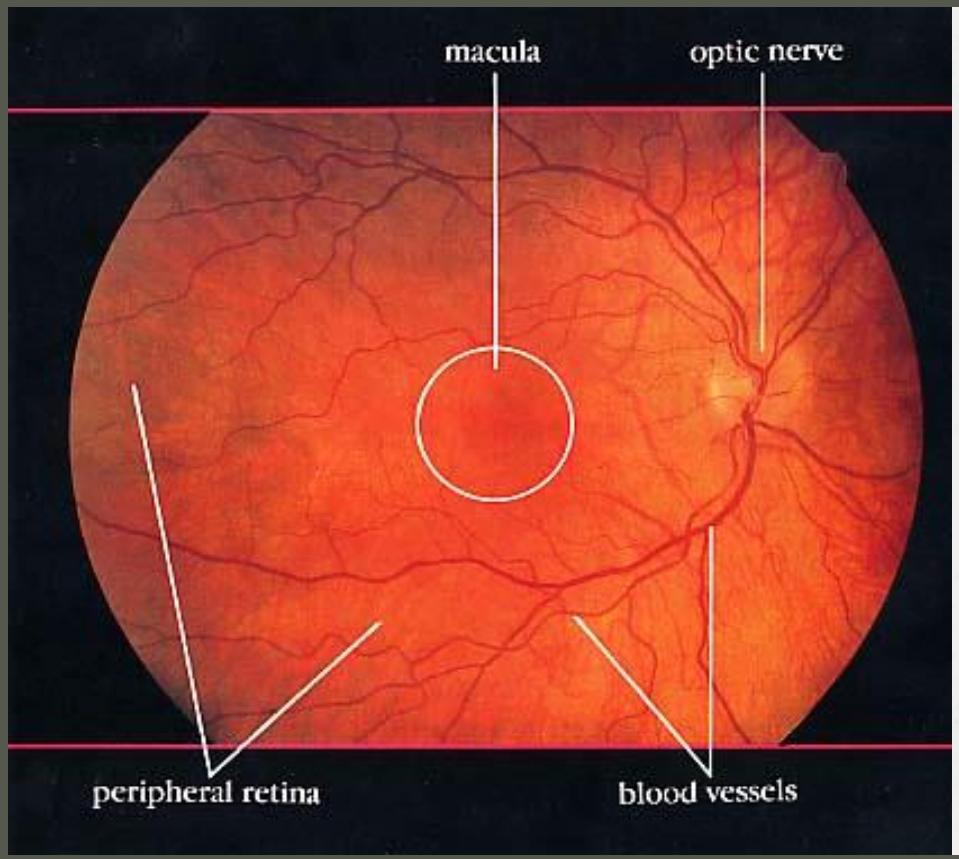
3. The methodology of the AMA Guides and considerations for application of case law, to rate Visual Disability in persons with Traumatic Brain Injury (TBI)

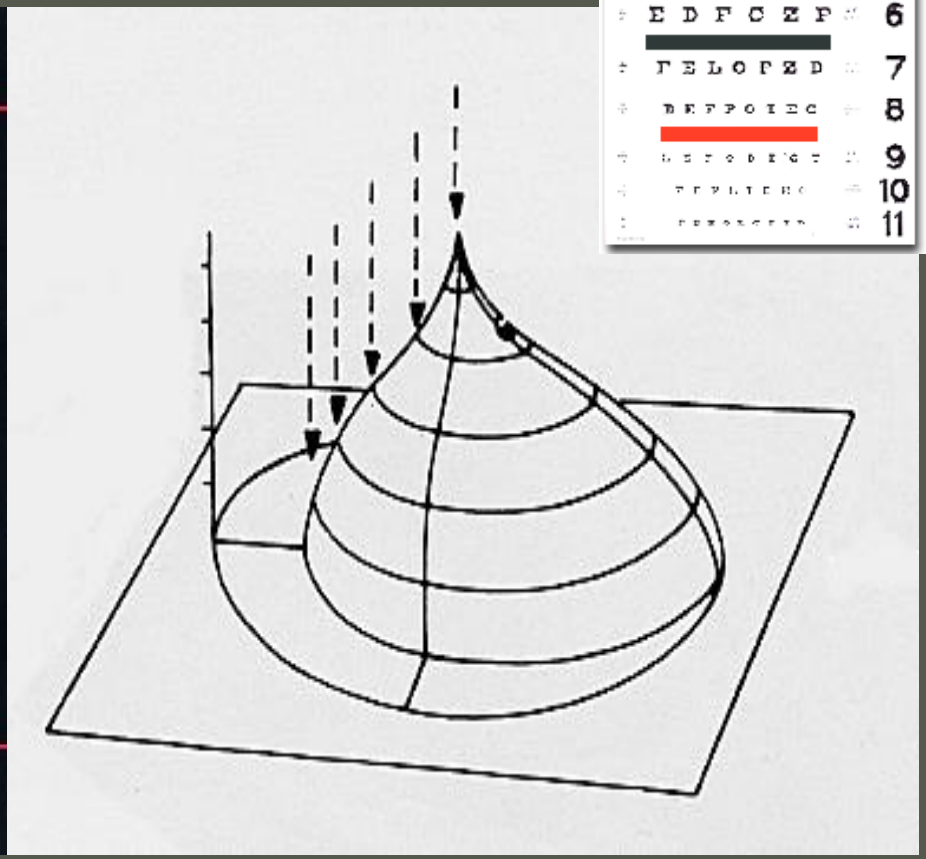
4. The scientific basis for some of the advocated treatment approaches to rehabilitate visual function after TBI

Central acuity vs. Peripheral VF

"A castle, on an island of vision, in a sea of darkness"





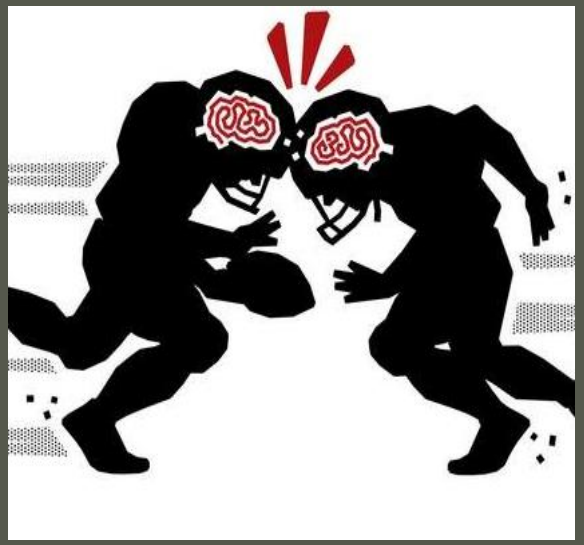


In recent years, much attention has been brought to the Neuro-Cognitive sequelae of concussions and associated Traumatic Brain Injury

Previously under-reported or unrecognized Traumatic Brain Injury may be affecting hundreds of thousands of Americans, and has become a source of significant potential financial liability - for insurers and employers.

Groups that are particularly at risk include:

1. Combat veterans from Iraq and Afghanistan
   - (IED blast exposure)
2. Professional, College and High School Athletes
   - In particular football an soccer players
3. Construction and Mining Workers



Assessment of Ocular Injury and Visual Function in Veterans with TBI from Combat Blast

---

-

1. As of 2008, over 300,000 potential cases of Traumatic Brain Injury due to blast injury, out of 1.2 Million US Military who had served in Iraq (Rand Corporation Study)

2. In a Study of 46 veterans with blast related TBI, 20 (43%) had evidence of eye injury.

   Ballistic Eyewear does Not appear to provide protection against blast injury.

Reference: Cokerham GC, et al. Closed eye oular innuries in the wars in Iraq and Afghanistan. N. Engl J Med. 2011; 364: 2172-2173

Assessment of Ocular Injury and Visual Function in Veterans with TBI from Combat Blast

---

In studies of veterans with blast related TBI:

1. 9 / 55 had acuity worse than 20/40 in at least one eye.
2. 22 / 47 had reduced contrast sensitivity (by 2 standard deviations) in at least one eye. (CSV-1000 contrast sensitivity test)
3. 31 / 49 had Visual Field abnormalities in at least one eye.
4. Other findings include

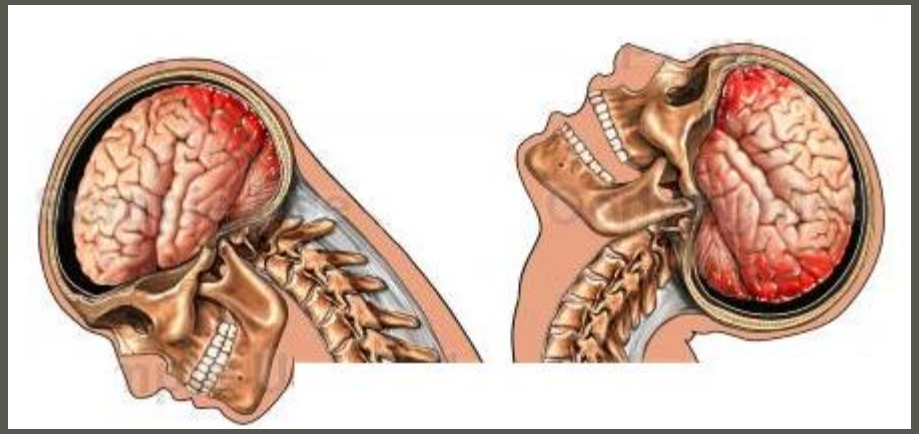
   A. Impairment of accommodation and convergence (i.e. reduced ability to focus on near targets)

   B. Reduced corneal endothelial cell counts – suggesting risk for late secondary corneal decompensation (years or decades after blast injury)

Reference: Okie S, Traumatic brain injury in the war zone. N Engl J Med. 2005;352:2043-2047

A concussion is a traumatic brain injury that alters brain function.

It can occur with a blow to the head or when the head and upper body are violently shaken.



Most Concussions do Not cause of loss of consciousness (LOC). But when there is LOC the likelihood of significant neurological sequelae is higher.

The constellation of symptoms that persist for an extended period of time after a consussion is termed "Post Concussion Syndrome" (PCS) and affects 4-20% of individuals after a concussive event

References:

1. Mild traumatic brain injury in the occupational setting. Chang VH et al. PMR 2011. Oct;3(10 Suppl2):S387-95
2. Chronic post traumatic headache: associations with mild traumatic brain injury, concussion and post-concussive disorder. Packard RC. Curr Pain Headache Rep. 2008 Jan; 12(1):67-73
3. Post concussion syndrome. Ryan LM, Warden DL. Int Rev Psychiatry. 2003 Nov;15(4):310-6.
4. Post-concussion symptoms after traumatic brain injury at 3 and 12 months post-injury: a prospective study. Sigurdardottir S, Andelic N, Roe C, Jerstad T, Schanke AK. Brain Inj. 2009 Jun;23(6):489-97
5. Post-concussion symptoms after mild traumatic brain injury: influence of demographic factors and injury severity in a 1year cohort study. Røe C, Sveen U, Alvsåker K, Bautz-Holter E. Disabil Rehabil. 2009;31(15):1235-4.

Commonly reported symptoms of post-concussive syndrome are:

A. Chronic Headaches
B. Impaired Memory
C. Difficulty concentrating
   to perform mental tasks
D. Insomnia
E. Altered Mood
   Personality Changes
   Depression

The visual (Neuro-Ophthalmic) symptoms / findings of post-concussive syndrome include:

A. Difficulty with motion processing

B. A sense of spatial disorientation

May be the cause of, or exacerbate balance problems.

C. Reading difficulty

May be multifactorial: due to poor concentration, impaired short term memory, convergence and accommodation deficiency.

D. Variable degrees of Light Sensitivity (“Central Photophobia”)

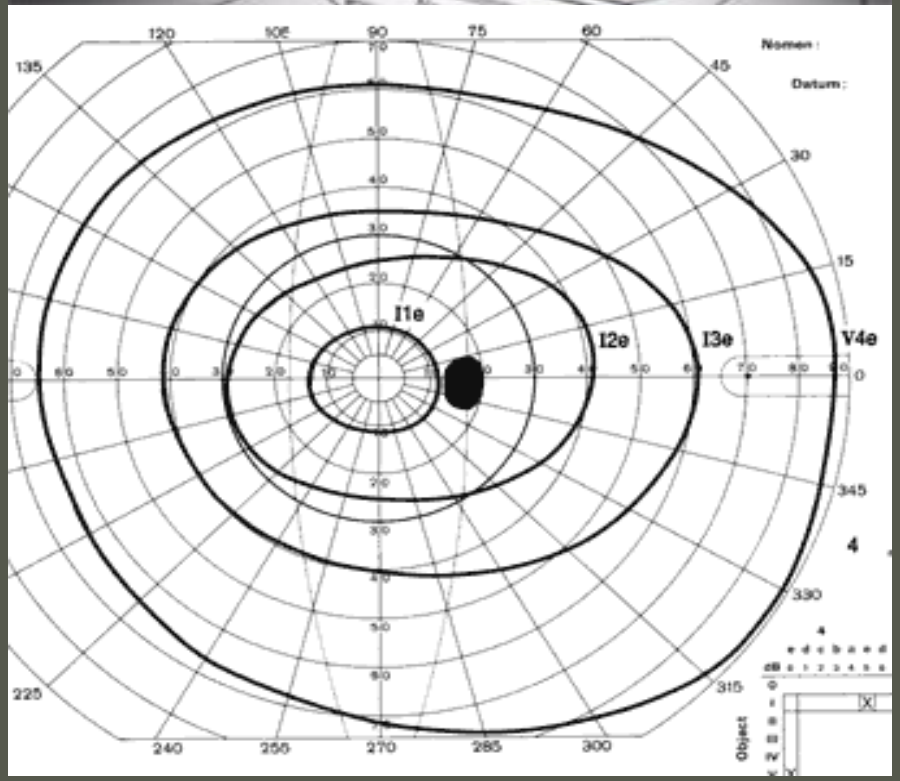
E. Visual Field Constriction

Patients may not be “aware” of this, even in severe cases

Reference:

1. Photophobia in patients with traumatic brain injury: Uses of light-filtering lenses to enhance contrast sensitivity and reading rate. Jackowski MM, Sturr JF, Taub HA, Turk MA. NeuroRehabilitation. 1996;6(3):193-20
2. Concurrent vision dysfunctions in convergence insufficiency with traumatic brain injury. Alvarez TL, Kim EH, Vicci VR, Dhar SK, Biswal BB, Barrett AM. Optom Vis Sci. 2012 Dec;89(12):1740-51


Field of vision
right eye


Nomen :
Datum :
I1e
I2e
I3e
V4e
Object

Constricted Visual Fields in a pt with TBI

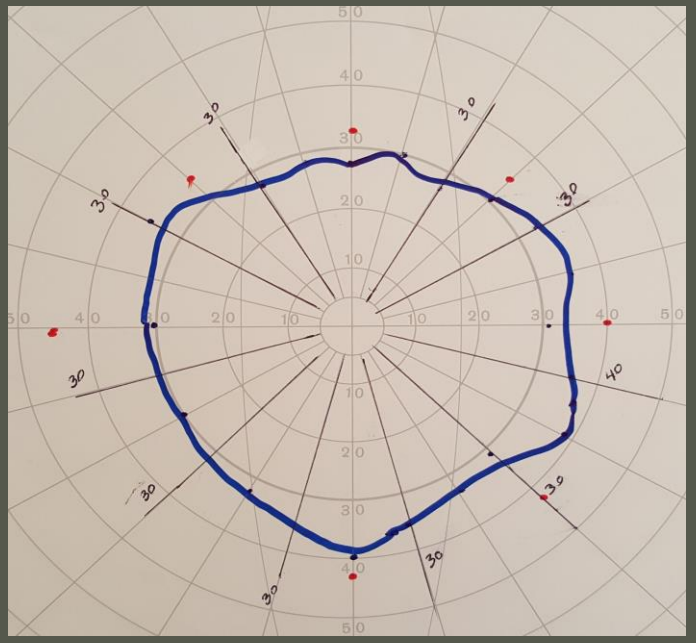
Case Study (Pt A.G.) :
40 yo male,
struck by a metallic pipe that
came loose from a support bracket,
falling about 6 feet to hit him
on the top of the head.

Diagnoses include:

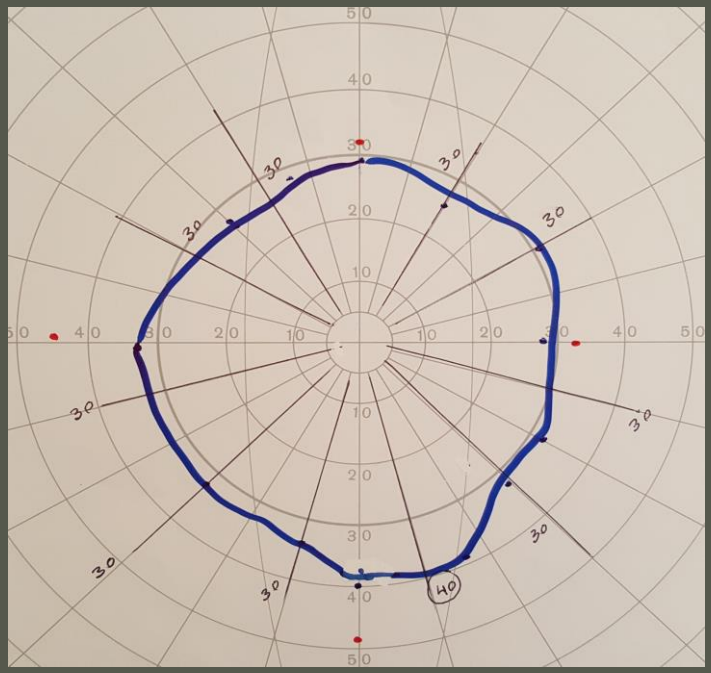
1. Cerebral Contusion
2. Post Traumatic Headaches
3. Cognitive disorder
4. Speech Difficulty
5. Episodic Dizziness
6. Cervical Radiculopathy
7. Depression and Anxiety
8. Post Traumatic Seizure Disorder

Va:
20/25 + each eye
No detectable optic atrophy, each eye.

OD



OS



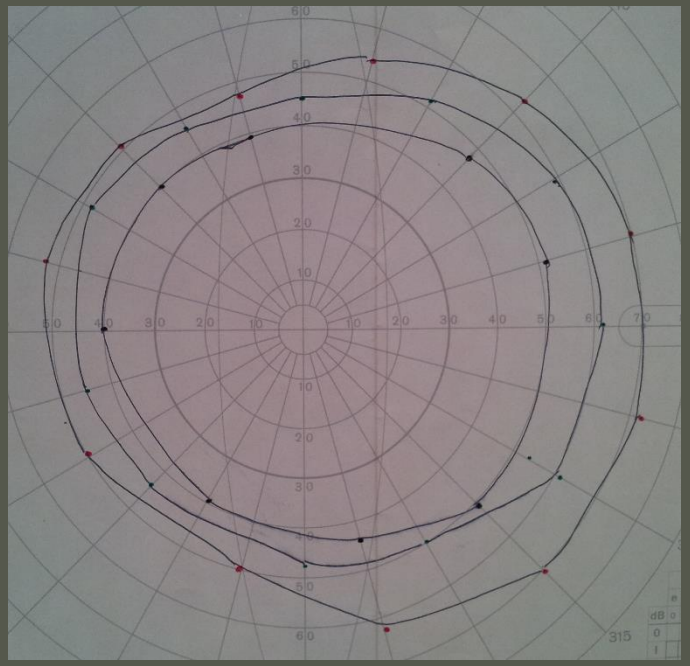
Case Study :

Traumatic Optic Neuropathy Left Eye from exploding oxygen tank.

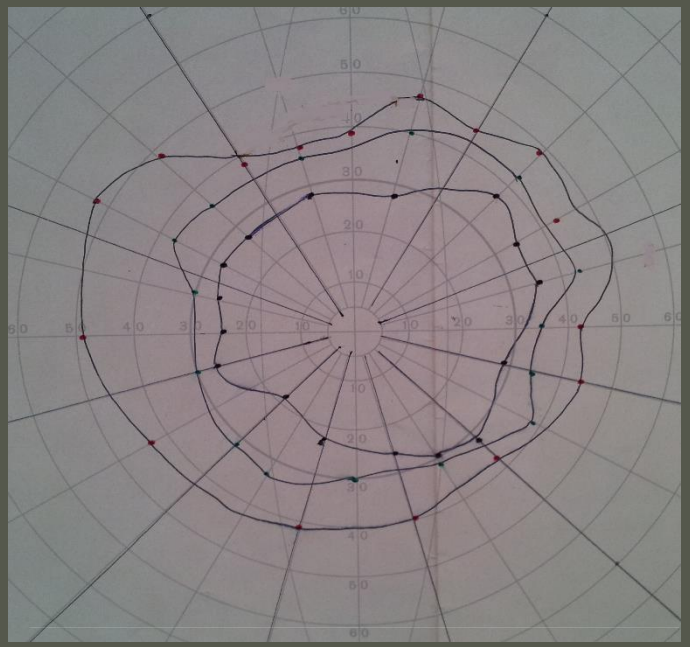
Otherwise high functioning
No evidence for TBI

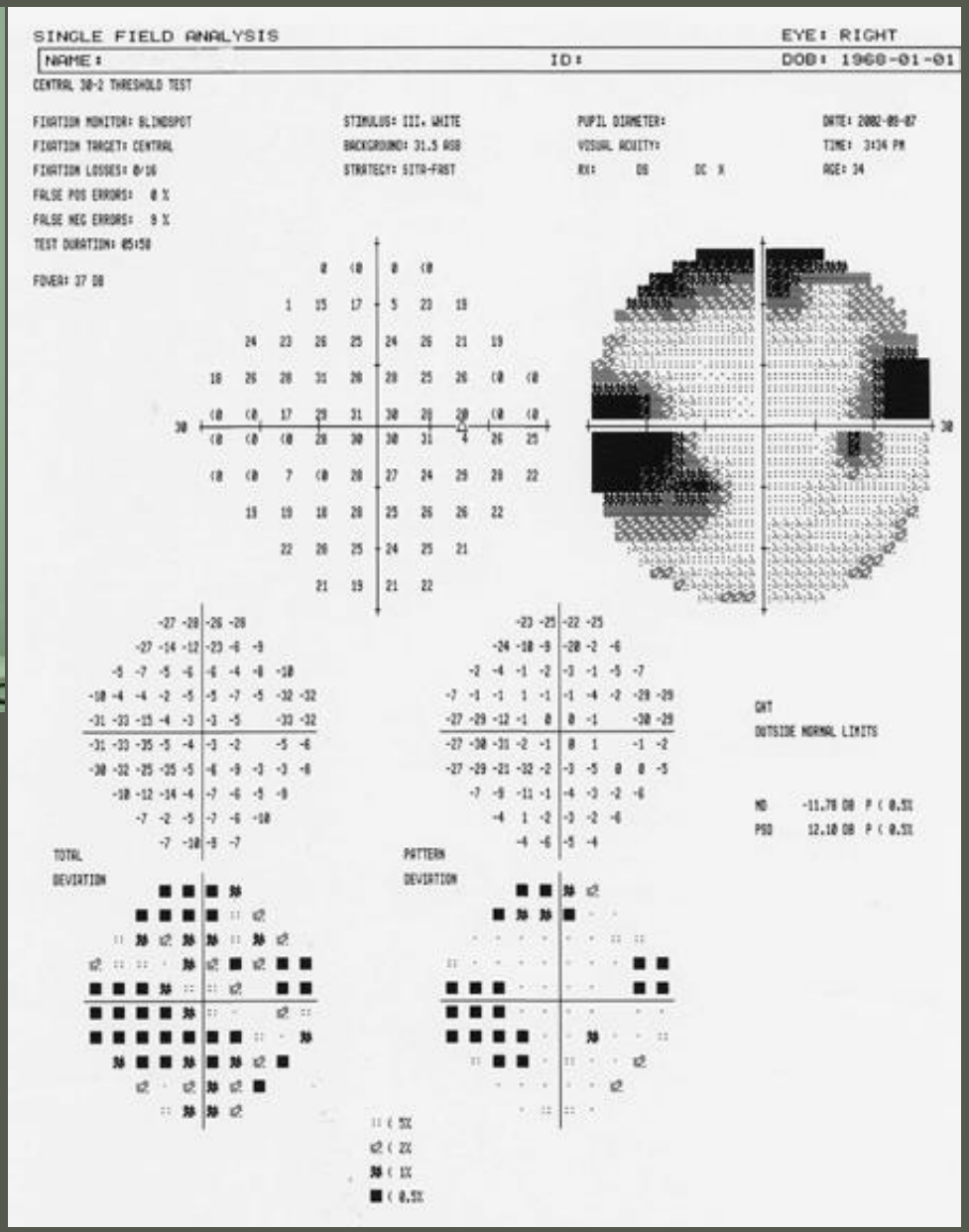
VA OD 20/20, OS 20/25,
Decreased color vision Left Eye

OD



OS



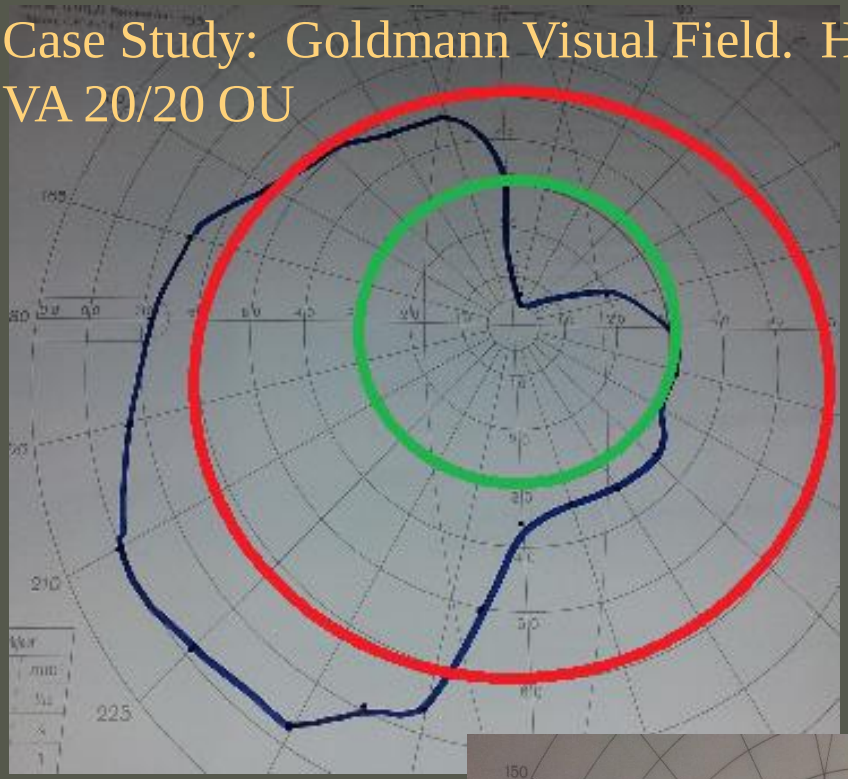


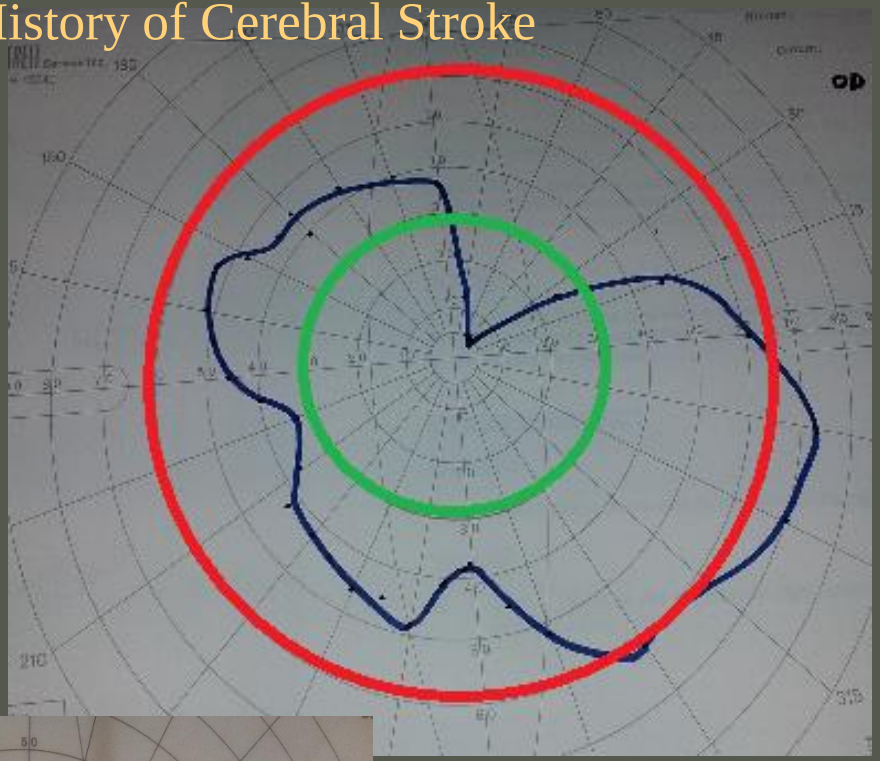
Visual Field Measurements

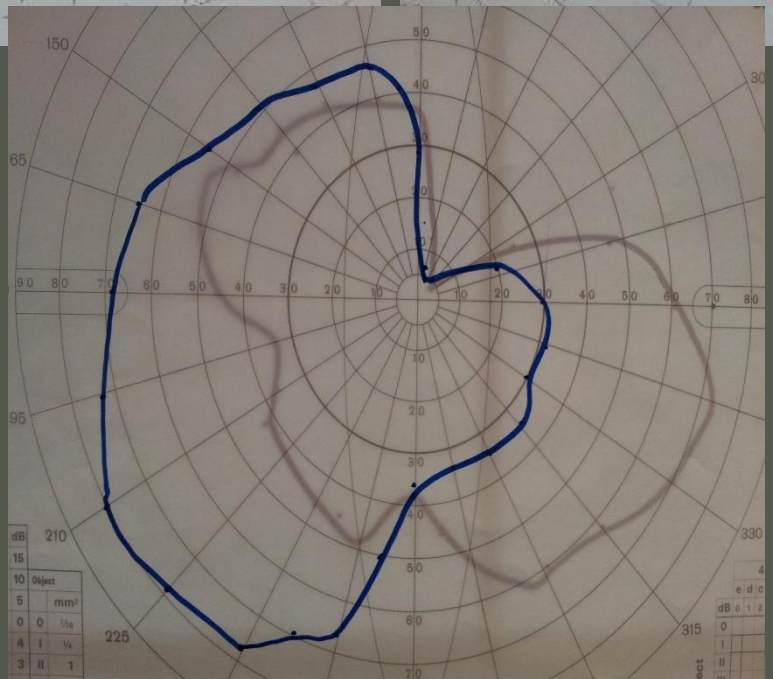
Must be taken past 60 degrees !

Automated Humphrey Visual Field machines are designed to screen for Glaucoma, and test only the central 30 or 24 degrees.

Case Study: Goldmann Visual Field. History of Cerebral Stroke
VA 20/20 OU





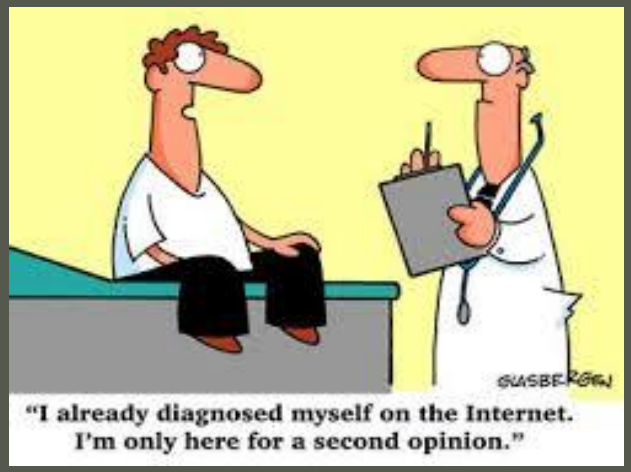


The Eyes are not organs that work in isolation.

It is estimated that 50% of the sensory input into the brain is visual.

Patients with Traumatic Brain Injury are generally referred to a Neurologist who performs a battery of tests, that may show cognitive, as well as visual memory and spatial reasoning deficits.

But often the overall visual function,
which is determined by a combination of :
visual acuity,
contrast & color sensitivity,
visual fields,
& higher order processes
("visual integration") such as spatial and motion processing



is not adequately addressed.

Rating Neuro-Ophthlamic deficits of post-concussive syndrome

The AMA Guides has a limited, formulaic interpretation of visual disability, that is based solely on visual acuity and visual field measurements.

Patients with TBI often have significant limitations of visual function that are not captured by the AMA rating methodology for calculating whole person impairment.

Rating Neuro-Ophthlamic deficits of post-concussive syndrome

The AMA guides allows up to a 15 point adjustment in such cases.

This adjustment is often adequate in patient with mild traumatic brain injury TBI.

Reference: AMA Guides to the Evaluation of Permanent Impairment,
Fifth Edition, 2001, page 297, section 12.4b

But in severe cases even a full 15 point adjustment may not be adequate to address the degree of visual disability

Patient Example:

30 year old male who suffered a severe blow to the back of the head, at the job site, producing loss of consciousness, a skull fracture, and subdural hematoma.

Subsequent to the injury he has developed mood disorder, insomnia, chronic severe daily headaches.

1. *Patient is unable to drive, as busy intersections and cars passing at high speed are visually "overwhelming" and can precipitate panic type attacks.*

2. *Patient is unable to shop unassisted, as supermarket isles can be quite disorienting and has gotten "lost" on the way back to the cashier on several occasions.*

Patient Example continued:

3. *Patient is unable to go outside in bright setting due to severe light sensitivity. Car headlights at night time are "unbearable." He wears dark tinted lenses whenever outside.*

4. *Patient reports that he has suffered significant loss of reading ability. He often forgets the paragraph he just read, and has to read the same page 4 to 5 times to "comprehend it." He also experiences exacerbatoin of headache and a sense of ocular fatigue after 20 to 30 minutes of reading.*

5. *Looking at ocean waves at the beach or a line of trees from a moving vehicle can produce nausea and disorientation ("motion sensitivity")*

Patient Example continued:

6. *Goldmann Visual field testing shows signifciant constriction of visual fields to about 30-35 degrees.*

Testing with multiple fixation targets is consistent, ruling out any possible malingering.

Normal visual field is about 50-70 degrees in each direction (generally larger temporally, and more retricted nasaly an superiorly, due to nose and brow, respectively)

Patient Example continued:

7. *The corrected visual acuity of each eye is 20/25 or better.*
8. *Color and Contrast sensitivity appear to be normal.*
9. *The sensorimotor examination shows mild convergence insufficiency.*
10. *There is not a detectible optic atrophy, each eye.*
11. *There is no corneal surface irregularity or intraocular inflammation to account for photophobia (light sensitivity)*

How would you "score" this patient for visual disability?

Which chapters in the Guides are most relevant?

Ophthalmology: *for visual acuity and field calculation*

Pain: *for severe light senstivity*

Neurology: *for impairment of short term memory and concentration affecting reading ability*

Patient Example continued:

Under Guzman III, the physician may utilize any chapter, table or method in the Guides that most accurately reflects the injured workers' Impairment.

The Combined Values Chart can be used to combine the formulaic Ophthalmic rating based only on visual acuity and visual field with other relevant tables / chapters to the get a more accurate representation of whole person visual deficit.

Patient Example continued:

Recommendations / Need for Future Medical Care:

1. *This Patient requires long term assistance and is not expected to hold employment or be self supporting.*

2. *There may be continued slow improvement over time (years), but a significant change in functional status from visual-perceptual standpoint is not expected.*

3. *Patient should not drive Class A, B, or C vehicles*

What is scientific basis for some of the advocated treatment approaches to rehabilitate visual function after TBI

Approaches, such as "Yolked" Prisms and Colored "Irlen" Lenses, used by therapists in children with neuro-disabilities have been "extended" to adults with TBI.

In the Pediatric population, these approaches are highly controversial. And there is no proof that its "extension" to adults with TBI is appropriate or efficacious.

UK College of Optometrists commissioned a review of behavioral optometry, and found "a continued absence of rigorous scientific evidence to support treatment approaches."

Reference: Barret BT. A Critical Evaluation of the evidence supporting the practice of behavioral vision therapy. 2009. Ophthal Physiol Opt. 29:4-25

What is scientific basis for some of the advocated treatment approaches to rehabilitate visual function after TBI

A. Yolked Prisms

Cochrane review of randomized controlled trials found No studies to show efficacy of yoked prism lenses in children with cerebral palsy.

A few Studies have looked at the use of yoked prisms for treatment of *posture, balance and gait* in children with autism. All studies had small sample sizes and used subjective outcome measures.

References:

1. Scheiman M, et al. Non-Surgical Interventions for Convergence Insufficiency. Chocrane Database of Systematic Reviews. 2011 Issue 3.
2. Carmody DP, et al. Spatial Orientation Adjustments in Children with Autism and Hong Kong. Child Psychiatry & Human Development. 2001. 31(3):233-247
3. Chok JT, et al. A Singe Case Experimental Analysis of the Effects of Ambient Prism Lenses for am Adolescent with Developmental Disability. Behavior Analysis ins Oractic. 2010. 3(2):42-51
4. Kaplan M, et al. Behavioral Changes in Autistic Individuals as a Result of Wearing Ambient Transitional Prism Lenses. Child Psychiatry & Human Development. 1998. 29(1):65-76

What is scientific basis for some of the advocated treatment approaches to rehabilitate visual function after TBI

Williams et al (2014) systematically reviewed published evidence for vision based interventions to help children with neurodisabilities:

Did not find any studies which involved yolked prisms, finding that "in general, there is a lack of evidence on effective vision-based strategies for children with neurodisabilities."

References:

1. Williams C, et al. How to Help Children with Neurodevelopmental and visual problems: A Scoping Review. Br J Ophthalmol. 2014. 98:6-12

What is scientific basis for some of the advocated treatment approaches to rehabilitate visual function after TBI

B. Chromatic Filters (Irlen Lenses)

A theory that some children with neurodisabilities have a *"Scotopic Sensitivity Syndrome"* : a problem with the brain's ability to process visual information, which tends to run in families, and is not currently identified by other standardized educational or medical tests. (as advocated by Helen Irlen, a therapist; and Olive Meares, a teacher)

The idea is that some people with learning disabilities have improved performance with visual tasks, such as reading when certain frequencies of light are filtered out with colored lenses or overlays.

What is scientific basis for some of the advocated treatment approaches to rehabilitate visual function after TBI

B. Chromatic Filters (Irlen Lenses)

Functional magnetic resonance imaging findings in Meares-Irlen syndrome: a pilot study. Kim JH et al. Korean J Ophthalmol. 2015 Apr;29(2):121-5.

This study showed activation of the left middle and superior temporal gyri during sentence reading after wearing color-tinted lenses.

"These results could explain the effectiveness of color-tinted lenses in patients with Meares-Irlen syndrome"

What is scientific basis for some of the advocated treatment approaches to rehabilitate visual function after TBI

B. Chromatic Filters (Irlen Lenses)

Irlen colored overlays do not alleviate reading difficulties.Ritchie SJ, Della Sala S, McIntosh RD. Pediatrics. 2011 Oct;128(4):e932-8.

61 children (age 7-12 yrs) with reading difficulty were evaluated. 44 were diagnosed with Irlen syndrome by an "Irlen diagnostician"

Examined differences in reading rate across 3 conditions:

1. Overlay of prescribed color 2. Overlay of nonprescribed color 3. No overlay.

"In a subset of 44 children, all of whom had a diagnosis of Irlen syndrome, We found no evidence for any immediate benefit of Irlen colored overlays as measured by the reading-rate test or the global reading measure."

What is scientific basis for some of the advocated treatment approaches to rehabilitate visual function after TBI

With Respect to "Yolked Prisms" and "Irlen Lenses"

In the Pediatric population with Nuerodisabilities of Autism, Cerebral Palsy and Reading Difficulty (Dyslexia), both the scientific basis of the prescribed treatments, and evidence based proof of treatment efficacy, is generally lacking.

There is no scientific proof that "extension" of these treatments to adults with TBI is appropriate or efficacious.

Ophthalmologist's Perspective on the appropriate work-up / referrals for a patient with a history of concussive head trauma

A. Patient should be screened for common Neuro-Ophthlamic symptoms/ findings of post-concussive syndrome:

These include:

1. *Difficulty with motion processing and a sense of spatial disorientation.*
2. *Reading difficulty, which may be multifactorial*
3. *Light Sensitivity ("Central Photophobia")*
4. *Visual Field Constriction - Patients may not be "aware" of this, even in severe cases*

B. Any time that a blast or explosion is involved there should be a high suspicion for Ocular injury in addition to Neuro-Ophthalmic injury.

Ophthalmologist's Perspective on the appropriate work-up / referrals for a patient with a history of concussive head trauma

C. A Brain MRI using Susceptibility Weighted Imaging (SWI) protocols

Reference: Magnetic Resonance Imaging Application in the Area of Mild and Acute Traumatic Brain Injury: Implications for Diagnostic Markers?.Toth A. In: Kobeissy FH, editor. Brain Neurotrauma: Molecular, Neuropsychological, and Rehabilitation Aspects. Boca Raton (FL): CRC Press; 2015. Chapter 24.

D. Home Safety and Driving Safety Evaluations.

E. Neurology, Endocrinology, and Ophthalmology Evaluations.

Thank You

for your attention.