Acquired Brain Injury

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Presented by the
Optometric Extension Program Foundation (OEPF)

Acquired Brain Injury

- Where does this fit into the overall OEP Clinical Curriculum protocols?
- The main thing is learning how to adjust the "burner settings" and being patient enough to give the patients with brain damage the time needed to make measurable gains.

What is a TBI/ABI?

- Began as "closed head injury" as opposed to "open head injury"
- TBI = traumatic brain injury
- ABI = acquired brain injury
  - Any injury or disease condition that has compromised in some way a part of, or the entire brain.

How it Started



BACK FROM THE DEAD





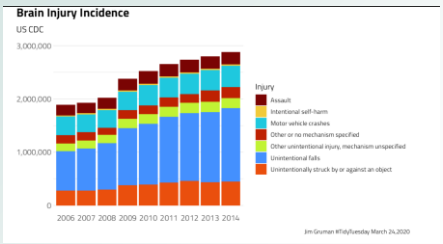




Types of Injury

- Trauma
  - accident, blow to head, gunshot
- Disease
  - multiple sclerosis, Parkinson's, etc.
- Secondary to systemic problems
  - stroke due to embolism from peripheral arterial disease.

TBI Incidence



opus1993.github.io/myTidyTuesday/BrainInjury.html

TBI Incidence

- On an annual basis in the US:
  - 2.9 MILLION TBI-related emergency department visits
  - 586 TBI-related hospitalizations and 190 TBI-related deaths per day.
  - 69,473 TBI-related deaths in 2021
  - At least 64 MILLION adults report having experienced one or more TBIs in their lifetime
- 11.4 MILLION Americans over 40 with a history of TBI that caused loss of consciousness are living with a disability

Brain Injury Facts & Statistics, Brain Injury Association of America &
https://www.cdc.gov/traumatic-brain-injury/data-research/index.html

TBI Incidence

- Each Year 1 in 10 children experience a TBI.
- Adults in the U.S. report more than 30 times as many TBIs compared to estimates using emergency department data from existing datasets.
- Since 2000, more than 500,000 service members have been diagnosed with a TBI.
- Five years after surviving a moderate to severe TBI, more than half of adults who were employed at the time of their injury no longer have a job.
- Federal funding for TBI research in 2024 was an $194 million – just $3.03 per person affected by TBI.

Brain Injury Facts & Statistics, Brain Injury Association of America

TBI Incidence

- People age 75 years and older had the highest numbers and rates of TBI-related hospitalizations and deaths.
  - This age group accounts for about 32% of TBI-related hospitalizations and 28% of TBI-related deaths.
- Males were nearly two times more likely to be hospitalized and three times more likely to die from a TBI than females.

https://www.cdc.gov/traumatic-brain-injury/data-research/index.html

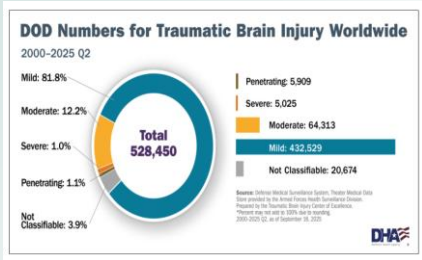
Health Disparities in TBI

- Health disparities are differences in health outcomes and their causes among groups of people.
- Older adults
- Racial and ethnic minorities
  - American Indian/Alaska Native children and adults
    - Higher rates of TBI-related hospitalizations and deaths than other racial or ethnic groups.
  - Racial and ethnic minority groups, particularly non-Hispanic Black and Hispanic patients
    - Increased rates of TBI
    - Less likely to receive follow-up care and rehabilitation following a TBI compared to non-Hispanic white patients.

Health Disparities in TBI

- Military service members and Veterans
- Studies suggest that service members and Veterans who have sustained a TBI may:
  - have ongoing symptoms
  - experience co-occurring health conditions, such as post-traumatic stress disorder (PTSD) and depression
  - have difficulty accessing healthcare (particularly mental health services)
- People in correctional or detention facilities
- People who experience homelessness
- Survivors of intimate partner violence
  - Survivors of intimate partner violence who have a TBI due to an assault are more likely to: be diagnosed with PTSD, insomnia, and depression
- People in rural areas are more likely to die from a TBI.

Blast Injuries



Stroke

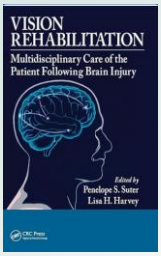
- **Incidence**: Each year, more than 12.2 million new strokes occur worldwide.
  - This translates to approximately one in four people over the age of 25 experiencing a stroke in their lifetime
- **Age**: Over 62% of strokes occur in individuals under the age of 70, and 16% occur in those aged 15-49.
- **Mortality**: Stroke is a leading cause of death, with approximately 6.5 million deaths attributed to stroke ach year. About 34% of these deaths occur in individuals under the age of 70.
- **Disability**: Stroke- related deaths and disabilities result in the loss of over 143 million years of healthy life annually.
  - Notably, 15% of this loss affects individuals aged 15-49

World Stroke Organization (WSO): Global Stroke Fact Sheet 2022

Neurological Causes

- **Brain tumors**
  - An estimated 1 million Americans are living with a primary brain tumor
  - Approximately 72% of all brain tumors are benign
  - The median age at diagnosis for a primary brain tumor is 61 years
  - The five-year relative survival rate for all patients with primary brain tumors is 76%
- **Parkinson's disease**
  - Parkinson's disease affects more than 1.1 million people in the U.S.
  - Nearly 90,000 people are newly diagnosed each year.
  - 11.77 million people worldwide (2021)
- **Multiple sclerosis**
  - 400,000 individuals in the United States and 2.5 million individuals worldwide.

Excellent References





ABI Visual Problems

- Binocularity/Accommodation
- Strabismus
- Ocular motor
- Visual perception
- Headaches/Asthenopia/Photophobia
- Visual field defects
- Visual Neglect/Inattention

Visual Problems in TBI

- Accommodation
  - Alvarez et al. found that accommodative dysfunction occurs in about 24% of non-presbyopic TBI sample (N=76/314).
- Convergence insufficiency
  - 36-42% in the adult TBI population, 28-48% of military personnel, and 49% in the pediatric TBI population.
- Strabismus and cranial nerve palsies
  - Ranges from 0-11%.
  - Heo et al. Frequency of ocular motor nerve palsy after TBI
    - 1,851 (0.071%) out of 2,606,600 patients had ocular motor nerve palsy
    - 4th nerve palsy was most common, occurring in about 38% of cases.
  - Rowe et al.
    - prevalence of ocular motor nerve palsy post-stroke
    - 54% of patients had ocular motility abnormalities
    - 18% had cranial nerve palsy
      - Sixth nerve palsy was most common (58%), followed by

Visual Perception

- Attention (Mathias and Wheaton)
  - Meta-analysis of 41 studies spanning the years 1980 to 2005.
  - Large and significant deficits were found in specific measures of information-processing speed, attention span, focused/selective attention, sustained attention, and supervisory attentional control following severe TBI.
- Memory (Shum et al.)
  - Individuals with TBI (late- and early-recovery) were found to be impaired on the SVLT.
  - They were found to learn at a slower rate and make more false-positive errors than the controls ($p<0.001$).

Visual Perception

- Visual Motor Integration (Sutton et al.)
  - Children and adolescents with TBI (n=123) or ADHD (n=65).
  - The results were compared to the grooved pegboard and the Wechsler Intelligence Scale for Children, 3rd edition (WISC III).
  - Those with a TBI performed significantly worse than the standardized sample ($p<0.001$) and those with ADHD ($p<0.003$).

Visual Perception

- Processing Speed (Su et al.)
  - Thirty stroke and thirty healthy individuals
  - Comprehensive battery of neuropsychological tests divided into the following six cognitive domains:
    - processing speed, verbal memory, visual memory, visuoperceptual function, language, and cognitive flexibility.
  - The results demonstrate that stroke patients were characterized by cognitive deficits in almost all of these domains, but have the most pronounced deficits in processing speed.

Visual Field Defects

- A visual field deficits (VFD) (i.e., scotomas) can be a result of insult along the visual pathway or the patient's ocular health (i.e., glaucoma).
  - These scotomas can vary in shape and size.
- Merezhinskaya et al. (A 2019 systematic and meta-analysis review)
  - 18% of TBI patients experience visual field loss, including homonymous or non-homonymous hemianopia, quadrantanopia, constricted visual fields, and central or paracentral scotoma.
- Suchoff et al. (retrospective analysis),
  - 40% of the TBI subgroup and in 67% of the CVA subgroup.
  - TBI group-scattered loss (~58%) followed by homonymous (~23%).
  - CVA group-homonymous (~48%), with scattered and nonhomonymous accounting for 20% of the VFDs.

Visual Neglect/Inattention

- The prevalence of neglect ranges from 30-70% in stroke survivors with right brain injury to 20-60% in survivors with left brain injury.
- The Vision in Stroke Cohort (n=915) reported the prevalence of neglect at 15%.
- A systematic review published in 2021 covering 6324 participants reported a 29% prevalence.

Visual Neglect/Inattention

- A study of geriatric stroke survivors found a 47.4% prevalence (n=114)
  - presence of neglect has a stronger negative impact on the geriatric populations.
- Records from consecutive admissions between 2013-2015 (n=88,664).
  - 30% prevalence of neglect with an increased finding of neglect with increased stroke severity.
  - The neglect cohort was slightly older (78 years v 75 years) and skewed toward females (56.4%) vs. males (43.6%).
  - Neglect was more common if the individuals were dependent prior to experiencing a stroke.
  - Congestive heart failure and atrial fibrillation also increased the likelihood of stroke.

Optometry's Role – The Past

- Until about the mid 1980's we just didn't see these people or if we did it was only to get them new glasses after they had recovered.
- Until this time we didn't see many of these patients.
  - Modern medicine is keeping them alive and some recover enough to seek out optometric services.

Optometry's Role – The Present

- We are now getting involved earlier and earlier with an ever more broadening scope.
- Rather than being peripheral to the medical care of these patients we are now becoming an integral part of their health care team.
- This means getting involved directly with many other health care practitioners.

The Team

- Neurologists
- Physical Therapists
- Occupational Therapists
- Physiatrists
- Chiropractors
- Audiologists
- Ophthalmologists
- Neuro-ophthalmologists
- Speech pathologists
- Nutritionists
- Internists
- Family practice physicians

Practice Sites

- Getting involved in TBI/ABI work may involve your having to provide care in different locations:
  - Inpatient consultation
  - Outpatient clinic
  - Rehabilitation hospital
  - Nursing home
  - Home care

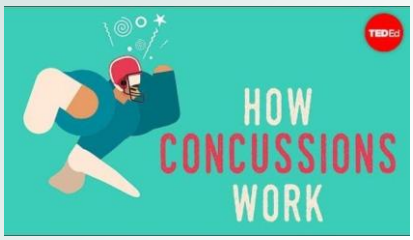
The Old Way

- Medicine generally felt that once the person was out of danger for possibly losing their life that it was best to wait for about 6 months to see what types of abilities and skills returned through normal nerve regeneration.
- Wait and recover and then let's see what we have!

The New Way

- As soon as the patient's condition is stable find ways to restore binocularity, get the system moving, increase range of movement, and stimulate – stimulate – stimulate!!!
- As you have heard many times:
  - Nerves that fire together wire together.
  - Use it or lose it!

The Dynamics of TBI



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What happens in a TBI?

- Axons membranes are damaged (direct and rotational forces)
- K+ leaves the cell causing the cell membrane to further depolarize
- Excitatory amino acids and neurotransmitters are released
- Ca and K+ flow in and out of the cell freely
- Ca damages the intercellular function
- Cellular hypoxia
- Brain is forced into a glycolytic mechanism
- Lactic acid builds up
- Breakdown of the blood-brain barrier and cell death
- Local inflammation response—takes about 4 to 6 hours
- Large release of neurotransmitters leads to a diffuse inflammatory response

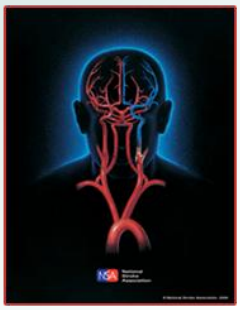
Capizzi A, Woo J, Verduzco-Gutierrez M. Traumatic Brain Injury: An overview of the epidemiology, pathophysiology and medical management. Med Clin N. Am. 2002;104:213-238.

What happens in a TBI?



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What's Going on in a Stroke?



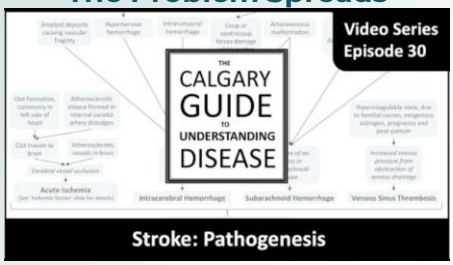
Blood supply to brain review



Anterior and Posterior Cerebral Artery
Internal Carotid
Anterior Communicating Artery
Cerebellar Artery
Vertebral Artery
Basilar Artery
Spinal Artery

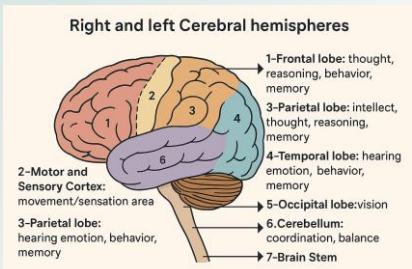
Internal Jugular vein
Occipital, Anterior and Posterior diploic vein
Superior Cerebral vein
Great Cerebral Vein
Occipital vein

The Problem Spreads

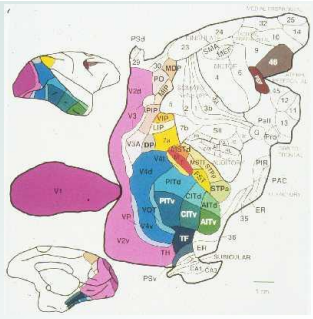


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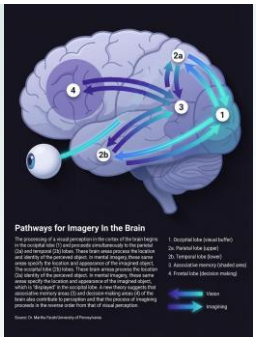
The Brain Overview of Function



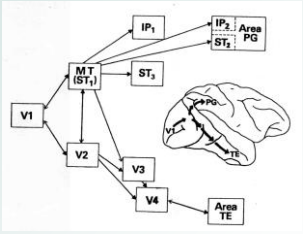
How Much is Vision?

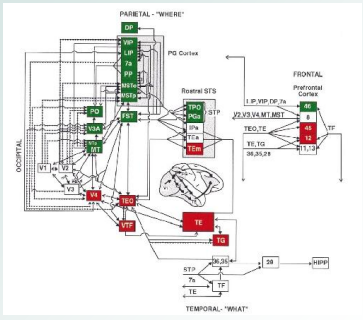


What and Where Pathways



Schematic Flow of Vision





Do I Really Need to Know All That Neurology?

- YES!
- And NO!!
- Often you are getting the history from the patient and/or a family member.
- Keep in mind that the patient, who is telling the story has had a brain injury. Thus, their story may not be that accurate.

Do I Really Need to Know All That Neurology?

- It is their story and they will give you their view of it but it comes through a filter!
- The family person with them may or may not have gotten their information directly from the health care team.
- Many times different members of the healthcare team have said different things and given conflicting information.
- Many times a patients problem is not easily understandable and changes and the views given to them may not be consistent.

Scales of Head Injury

- Glasgow Coma Scale (GCS)
- The Glasgow Coma Scale is the most commonly used tool to assess the initial severity of a head injury and level of consciousness.
- It evaluates eye opening (E), verbal response (V), and motor response (M) with a total score from 3 to 15.
  - **Severe injury:** GCS 3–8
  - **Moderate injury:** GCS 9–12
  - **Mild injury:** GCS 13–15
- The GCS is used immediately after injury and helps guide early medical decisions

Scales of Head Injury

- Rancho Los Amigos Levels of Cognitive Functioning Scale (RLAS or RLA Scale)
- The Rancho Los Amigos Scale measures cognitive recovery and behavior following a traumatic brain injury.
- It is used throughout rehabilitation (not just at the time of injury). The revised version includes 10 levels, ranging from:
  - **Level I – No Response**
    to
  - **Level X – Purposeful, Appropriate**
- It describes how patients respond to stimulation, follow commands, behave, and recover cognitive abilities over time.
- This scale is often used alongside the GCS during recovery.

Types of Biomarkers

Category	Definition	Example
Susceptibility /Risk	Signifies the likelihood of disease or medical condition development in a person who currently has no clinically apparent indicators of the disorder	A person may have a gene (i.e., a genetic biomarker) that is associated with increased future risk for breast cancer.
Diagnostic	Used for disease detection or to differentiate subtypes of a disease or disorder	Hemoglobin A1c may be used to identify people with diabetes mellitus Type 2.
Monitoring	Measured repeatedly over time to track the status of a disease or disorder, or to provide evidence of exposure to or effectiveness of a medical product or environmental agent	A COVID-19 PCR (polymerase chain reaction) test for presence of the virus' genetic material may be repeated over time to determine when a patient no longer has active infection.

Types of Biomarkers

Prognostic	Signifies the likelihood of a clinical event, or of disease recurrence or progression, in people already diagnosed with the disease or condition	The presence of mutations in breast cancer genes 1 and 2 (BRCA 1/2) in a breast cancer patient may be assessed to determine that patient's risk of a second breast cancer.
Predictive	Used to identify those people more likely to have a favorable or unfavorable response to an exposure to a medical product or an environmental agent than people who lack the biomarker	Pharmacogenetic testing is available for some medications to determine whether the patient is likely to have the desired response, no response, or is at higher risk for certain side effects to that medication
Pharmacodynamic /response	Used to indicate that a biological response (potentially beneficial or harmful), has occurred in someone who has been exposed to a medical product or an environmental agent	An increase in goblet cells (compared to baseline) in a conjunctival biopsy of a patient treated with cyclosporine can be used as evidence of a positive response to the treatment
Safety	Measured before and/or after a person is exposed to a medical product or an environmental agent to determine the likelihood, presence, or extent of toxicity of the agent or for evidence of adverse side effects	Prior to and during warfarin therapy, and INR (International Normalized Ratio) blood test is obtained as a measure of blood clotting speed, to monitor for risk of excessive bleeding or excessive clotting.

Biomarkers

- **Biomarkers for acute mTBI**
- ***Structural Imaging***
  - A "day of injury" CT may be ordered to look for gross abnormalities, such as contusions, small hemorrhages, edema, and fractures.
- The vast majority of patients who undergo MRI show no structural abnormalities which is why
  - Conventional structural MRI is not routinely recommended as part of the clinical guidelines for managing mTBI or sports-related concussions.
  - Low biomarker value.
- A technique called susceptibility weighted imaging, which uses a "gradient-echo" sequence to improve the contrast in the image, allows better detection of paramagnetic deoxygenated blood products associated with microhemorrhages.
  - With this technique, microbleeds have been shown to correlate with initial neurological deficit.

Biomarkers

- **Biomarkers for acute mTBI—FDA Approved**
  - **Ubiquitin C-terminal Hydrolase L1 (UCH-L1):** A neuronal cell-body protein. Often paired with GFAP, it rises very quickly (within 1-2 hours) of a head injury.
  - **Glial Fibrillary Acidic Protein (GFAP):** A structural protein highly concentrated in astrocytes. It spikes rapidly in the blood shortly after brain injury.
    - **Clinical Use:** FDA-approved tests for mild to moderate TBI
      - Use GFAP alongside UCH-L1 to quickly determine if a patient needs a CT scan. GFAP is also heavily used to monitor patients on life support (like ECMO) for signs of acute brain injury.

Biomarkers

- **Biomarkers for acute mTBI**
- ***Body fluids***
  - S100B
  - Inflammatory cytokines-IL-6 and TNF-α
  - Ribonucleic acid (RNA) changes
  - N-terminal fragment of spectrin known as SNTF
  - **Neurofilament Light Chain (NfL):** A structural protein in neuronal axons.
    - **Clinical Use:** Because NfL stays elevated for weeks, it is an excellent marker for tracking axonal damage, predicting long-term neurological outcomes, and monitoring neurodegeneration.

Biomarkers

- **Biomarkers for subacute and chronic mTBI**
- ***Structural Imaging***
  - MRI is better able than CT to detect subtle pathology, such as white matter abnormalities.
  - Includes quantitative analyses of the images that are not possible with CT.
  - Been shown capable of detecting residual evidence of hemorrhage for up to 2 years post-trauma.
  - As of yet, no diffusion MRI metrics can be used to detect individual injury or predict individual outcomes.

Biomarkers

- **Biomarkers for subacute and chronic mTBI**
- ***Body fluids***
  - Some TBI patients have lingering effects of cognitive impairment, neuro-endocrine dysfunction, and may even go on to develop neurodegenerative disease (e.g. Alzheimer's, Parkinson's, amyelotrophic lateral sclerosis, multiple Sclerosis),
    - Biomarkers of neurodegeneration are being assessed for utility in TBI.
      - Total Tau (T-Tau) protein, phosphorylated Tau (P-Tau), amyloid beta peptides (Aβ1– 40, Aβ1–42), autoantibody response to neuroproteins, and inflammatory markers.

Biomarkers

- **Biomarkers for acute mTBI**
- ***Body fluids***
  - Elevated tau in head injury follows both an acute and a chronic course
    - The first rise reflecting acute damage to neurons and the second rise reflecting a chronic neurodegenerative process.
    - Elevated levels of tau are significantly correlated to post-traumatic and post-concussive symptoms in subjects experiencing repetitive mTBI (>= 3 injuries).
  - Aβ42 also has been shown to be elevated in mild, moderate, severe, and repetitive mTBI, starting just days, but extending to years, after initial injury.

Testing-How to Alter Your Exam

- Exam conditions
  - Turn lights down
  - Tinted glasses
  - Wheelchair access
- Take it slow
  - Break up the exam if needed
  - You may need to stabilize and bring back for more testing
- Problem-oriented



Testing-How to Alter Your Exam

- Modification of exams
  - Never use the phoropter!
  - Retinoscopy-use loose lenses
  - Pursuits/saccades
  - Cover test
  - BV/Accommodative testing
  - Fields
  - Measuring for small vertical deviations
  - Reach and touch
  - King-Devick or DEM
  - Trial frame
  - VIP testing
  - Give them time and grace
  - You do not have to solve every problem in one visit!
  - You do not have to run every test in one visit!

Exams at Rehab vs in-office

- What is our role at rehab?
- Using rehab specialists on the ground to our advantage.
- Communication is crucial.

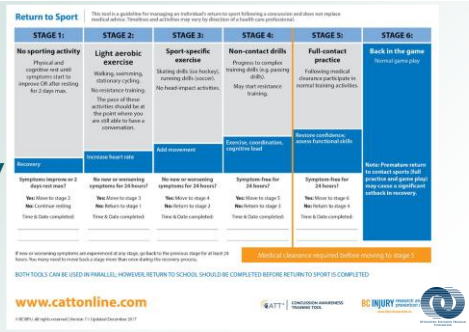
Symptoms Surveys

- Post-Concussion QoL Questionnaires without vision
  - Vision Symptoms EmphasisSCAT5 Concussion Symptom Survey (CSS)
  - Rivermead Post Concussion Symptoms Questionnaire
  - Post-concussive Symptom Questionnaire (PCSQ)

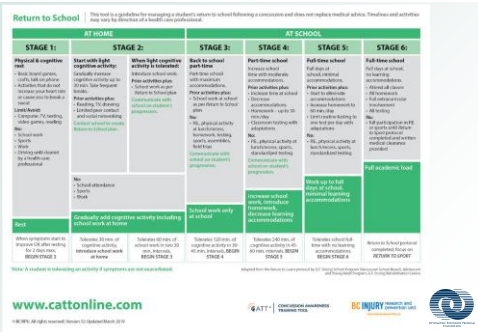
Symptom Surveys

- Post-Concussion/mTBI QoL Questionnaires with Vision Symptom Emphasis
  - Convergence Insufficiency Symptoms Survey
  - Conlon Visual Discomfort Symptom Survey
  - Brain Injury Vision Symptom Survey

Return to Activity -mTBI



Return to School /Work-mTBI



Retrograde destruction

- "V1 damage destroys not only an important visual processing center (V1 itself), but also causes the retrograde degeneration of neurons in retinotopically corresponding areas of the dorsal lateral geniculate nucleus (dLGN), and subsequently, the death of a large portion of parvocellular retinal ganglion cells in the eye. "

Retinal damage and OCT

- Lyons et al.
  - Queried PubMed, Embase, Cochrane Library, and ClinicalTrials.gov for reports of mTBI published through Sept. 1, 2022. conducted in accordance with PRISMA guidelines.
  - The initial screening yielded 341 publications, three of which met all inclusion criteria.
    - 148 adult patients and 74 healthy controls.
  - Thinning of the RNFL, but not of the GCL, is associated with mTBI.
    - If RNFL thickness decreased by more than 30%, the possibility of developing visual field defects was statistically significant.

Ocular Disease and ABI

- Irwin Suchoff, OD (1999)
  - 23% of a sample of 62 adults with ABI were found to have external ocular pathologies, which included dry eye and blepharitis.
- Rutner et al. (2006)
  - Retrospective review of 220 records of TBI (160) or CVA (60)
    - Most common were dry eye and blepharitis
    - Found to be greater in the ABI population compared to a non-ABI population.
- Lee et al. (2007)
  - Dry eye occurred at higher frequency in the TBI group compared with non-TBI group (37.2% vs 29.1%)
  - A diagnosis of TBI elevated the risk of having a dry eye diagnosis by 1.45.
  - The ABI group used more artificial tears,

Top Ten Tops for Tackling ABI





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If you've seen one brain injury... you've seen one brain injury

#1

We must think outside the box to treat brain injury

#2

History is crucial to understanding how to best help the patient's needs

#3

Communication is an important aspect of your success

#4

Trust your instincts

#5

If you don't know-phone a friend

#6

Change can be slow so don't push too hard or too fast

#7

Don't be afraid to use all your tools

#8

Some patients follow patterns, and some don't. Be prepared for both types

#9

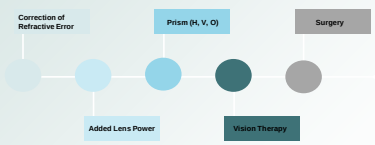
Start where they are and go where they ain't.

#10

Treatment

- Lenses
  - Prescribing for ABI
- Prism-temp vs grind in
- Occlusion
  - Binsal
  - Full
  - Spot
- Tints
- Syntonics
- VT

OPTOMETRIC ASSESSMENT SEQUENCE OF MANAGEMENT



Prescribing

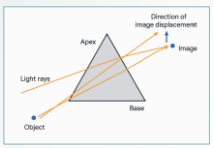
- PAL vs FT vs two pair
- Should you prescribe large shifts?
- When should you make changes?
- Head vs eye pointing

Prism

- Diplopia (double vision)
- Strabismus
- Cranial nerve palsies
  - Especially CN III, IV, or VI palsies that cause eye movement problems.
- Temporary or changing conditions
  - They're ideal when the alignment may change over time (e.g., during healing).
- High prism power
  - Traditional ground-in prisms become very thick at higher powers; Fresnel prisms avoid that bulk.

Prism

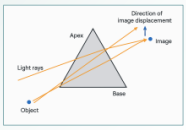
- Light travels at different speeds in different materials (air, glass, plastic).
  When light enters a prism:
  - It slows down when entering the denser prism material
  - It speeds back up when leaving the prism
- Any time light changes speed, it changes direction…refraction.
- A prism has two non-parallel surfaces (a wedge)
  - Light bends toward the base inside the prism
  - When it exits, it bends away from the base



Prism

- The net effect is:
  - The entire light ray is shifted toward the prism's base.
- The brain interprets direction based on the exiting light
- Your eye does not see where an object really is….It sees where light appears to come from.
  - If the prism bends the light downward, your brain thinks the object is higher.
  - If a prism bends light to the left, your brain sees the object as being to the right.
  - So the image is displaced toward the apex (pointy end) of the prism.

- **Rule of thumb:**
- **Image moves toward the apex**
- **Light rays bend toward the base**



Fresnel Prism

- A Fresnel prism is an ultra-thin, flexible plastic sheet that contains a series of small, stepped prism segments.
- A Fresnel prism achieves the same effect, but:
- Uses many small prism segments ("ridges") instead of one large wedge
- Is very thin and lightweight
- Can be applied temporarily to the front of a patient's glasses
- Available in high powers (often up to ~40Δ)
- Drawbacks
  - Slight reduction in visual clarity (due to grooves)
  - Visible ridges on the lens
  - Slight rainbow-like diffraction in certain lighting
  - Not as cosmetically appealing as ground-in prisms
  - Usually a temporary or diagnostic solution (though some wear them long-term)



Fresnel Prism Leap-Frogging

- 75 year old black female complains of diplopia and her left eye not moving to the left following her stroke.
- Patient is deaf and communicates via white board
- Visual acuity with current glasses
  - 20/25 OD, 20/25 OD
- EOM: full and smooth OD, abduction deficit (goes about 30 degrees past midline)

Fresnel Prism Leap-Frogging

- Left eye appears inward on observation in straight ahead gaze
- Using loose prism, single vision with 20 BO prism in front of the left eye
- Fresnel prism cut for fitting on her current prescription and educated on looking behavior.
- RTC in 1 month
- Over the course of 4 months, we were able to lower the magnitude and stabilized at 6 BO.
- Refraction performed and prism ground in.
- Happy patients are the best!

Fresnel vs. Ground in Prism

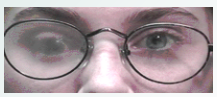
You anticipate making changes in weeks or months	You anticipate few if any changes are expected over time
The prism amount is greater than 12-14 diopters	The prism amount is below 12 diopters
Weight is a factor	The patient can tolerate the weight
Clarity through the one side is not a high priority	Clarity through both channels is very important
Appearance is not as important	Best appearance needed (actor, TV personality, etc.)
Cost is a factor	The higher cost is not a concern
Changes are needed right away	Time lag when changes are made
Prism only needed in parts of the visual field	Prism will be used full field

Occlusion

- Used when no response to other therapies
- Binasal/bitemporal
- Nasal patch for eye movement shifts
- Partial occlusion
  - semi opaque occlusion
  - sector cling occlusion
  - spot occlusion
  - mirror occlusion







Binasal Occlusion

- Proposed Mechanisms
  - faulty spatial-temporal filtering mechanism
    - the filtering mechanism in the visual field is not working properly to filter out visual information that is not needed.
      - After a TBI, the visual system cannot inhibit unnecessary information. BNO works to block the bitemporal retina physically filtering and allowing an increased amplitude in the VEP.

Binasal Occlusion

- Proposed Mechanisms
  - Spread of suppression
    - Those with mTBI have the tendency for cortical suppression to reduce visual confusion. The suppression is faulty and does not improve the confusion.
      - The BNO blocks the area suppressed reducing the cortical suppression, thus, increasing the VEP amplitude.

Binasal Occlusion

- Proposed Mechanisms
  - Visual attention
    - The visual attention theory states that BNO reduces the distraction on peripheral motion by blocking the bitemporal retina, encouraging the individual to use their central attention, increasing the VEP amplitude.

Binasal Occlusion-Research

- Padula et al. (1994)
  - Compared visual evoked potential (VEP) amplitudes of visually normal people to those with a mTBI.
  - The mTBI group had an increase in the VEP amplitude while wearing BNO and base in prism.
- Ciuffreda et al. (2013)
  - Visually normal individuals' VEP amplitudes with and without BNO
    - While wearing the BNO, the visually normal group had a decrease in the amplitude.
    - In the mTBI group, those wearing the BNO had an increase in the VEP amplitude compared to those not wearing BNO.

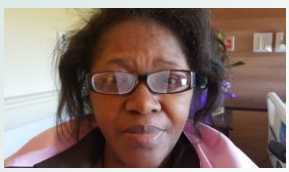
Binasal Occlusion-Research

- Ciuffreda et al. (2014)
  - The impact of prism had on the VEP amplitude with BNO alone, BNO with prism, and prism alone
    - Visually normal individuals had a decrease in amplitude with BNO only and BNO and prism, but had mixed results (some increasing and some decreasing) with prism only.
    - The mTBI group showed no significant difference between the baseline measure and the prism alone.
    - The mTBI group did have a VEP amplitude increase with BNO compared to baseline and prism alone.
    - When measuring BNO only to BNO with prism in those with mTBI there was no significant difference.
    - **Summarizing this research, VEP amplitude in those with mTBI is increased while wearing BNO.**

Binasal Occlusion-Research

- Materials
- How much occlusion?
- Length of occlusion





Progress in the Rehab



Semi opaque Occlusion

- Press on patches
  - Alternate to black patch, improve cosmesis
- Translucent patching foil
  - light and some motion still seen with occluded eye, but blocks diplopia
  - while some image is seen though the patch, the awareness of image is very reduced
  - at night ad clip on occluder due to strong headlights of car
  - can put a mirror coating to hide the patching material completely

Sector Patching

- Patch only the sector where binocular vision occurs
- Allows for continued use of both eyes
  - e.g., if gaze to right causes diplopia when patient looks to right and up, then this sector is patched with translucent material

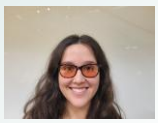
Spot Occlusion

- Eliminates diplopia without compromising peripheral vision
- A round patch of translucent tape
- Placed directly in the line of sight contributing to the diplopia
- When properly placed eliminates central vision in the partially occluded eye



Tints

- Photophobia
- Headaches
- Increased flicker sensitivity
- Visual snow
- Visual processing
  - Cone cells in the retina that are responsible for perceiving color are processed in separate pathways and sent to different areas of the brain for processing.
  - When brain injury patients respond positively to one color of tint or filter over another, this suggests that one pathway may be more damaged than others.



Tints



- Grey
  - Commonly prescribed for sun lenses.
  - Do not filter out specific wavelengths of light, rather, they evenly reduce the transmission of light across the entire visible spectrum.
- Brown
  - Commonly prescribed color for sun lenses
  - Reduce glare symptoms
  - Absorb ultraviolet (UV) light waves below 400 nm
    - Can also aid in contrast, unlike gray tints

Tints



- Yellow/Amber
  - Commonly prescribed for low on patients due to the excellent contrast enhancing effects of these tints.
  - Absorb short wavelength light, such as blue light, violet light, and UV light.
    - Because these tints absorb shorter wavelengths, they have a light enhancing effect that helps reduce asthenopia and enhance contrast.
  - Commonly used for patients with macular disease due to their contrast enhancing and glare reducing properties.

Tints



- Yellow/Amber
  - Jackowski et al. looked at using amber tints post-TBI (CPF 450, CPF 527, and CPF 550)
    - Tints did improve reading rates in the post TBI patients and enhanced contrast sensitivity.
  - A case series by Lynch et al.
    - Tinted lenses decreased symptoms of photophobia, glare, and asthenopia in both patients, and helped improve symptoms of decreased reading speed and academic performance

Tints



- Green
  - Absorb UV light
  - Beneficial in alleviating symptoms of photophobia post traumatic brain injury.
  - Clark et al.
    - after blue tinted lenses, green tinted lenses provided the most relief in symptoms of photophobia in patients who had suffered a TBI.
  - Liu et al.
    - used a green tinted lens effectively to manage symptoms in a patient post-traumatic brain injury when other forms of rehabilitation (vision therapy and optometric phototherapy)

Tints



- Red
  - Block the transmission of short and medium wavelengths of light, such as blue and blue-green wavelengths.
  - Beneficial in low-lighting conditions.
  - By blocking the transmission of short and medium wavelengths of light, red tints can help with depth perception when there is low light.

Tints



- Pink
  - Absorb both UV and short (blue) wavelengths of light, but otherwise have a uniform transmission across the visual spectrum of light,
    - do not cause disturbance in color perception.
  - Used in indoor lighting conditions with fluorescent lights.

Tints



- Pink
  - FL-41 blocks short wavelength light.
    - Transmits 10% of light wavelengths between 400 to 500 nm and transmits 90% of light at 700 nm and higher.
    - By blocking these shorter wavelengths, the FL-41 tint is blocking out the flickering effect of fluorescent light, which is mainly composed of shorter wavelengths of light.
      - Many of these patients have a lower critical flicker frequency threshold (e.g., they are more sensitive to flickering lights) than patients who have not suffered a brain injury.
    - Study et al (1999)
      - FL-41 tinted lenses not only reduced symptoms of photophobia, but also showed decreased activation of areas of the brain that are associated with pain processing

Tints



- Blue
  - Absorbs light of medium wavelengths, such as orange and yellow.
  - The mechanism by which blue tints and filters help to reduce symptoms in this population is not well understood
  - Richman et al. (Case Report)
    - Using blue tinted overlays, both DEM and Visagraph readings improved compared to baseline with no tinted overlays in a patient post-TBI

TINTS CAN MAKE AN IMPACT



Bihemispheric Dissonance Test (BDT)





The Grids

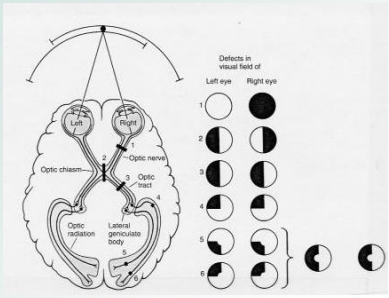
- TBI/ABI with Strabismus
- TBI/ABI without Strabismus
- Working with a Monocular Patient

Working With the System

- Department of Vocational Rehabilitation
  - Only interested IF THEY THINK the person might work again! If not employable in some capacity – no interest – no money spent to help!
  - Have to deal with each case-worker individually!

Managing Visual Field Loss

- Where in the neurology is the problem?
  - Does the field problem seen, match with what is known about the injury?
  - Does the functional field problem give us insights into other problems not yet addressed by the medical team?

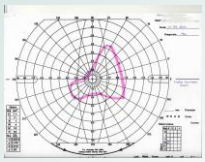


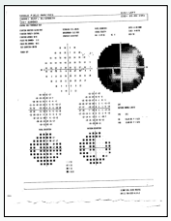
Visual Field Defects Types

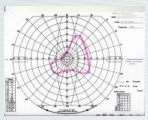
- Hemianopias
  - Right vs. left
  - With or without neglect
  - Altitudinal – more rare
  - Chiasmal
  - Quadrant

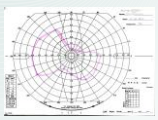
Visual Field Testing

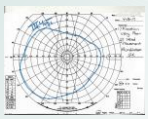
- You may need to be flexible.
- Automated
- Free-space

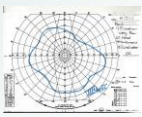


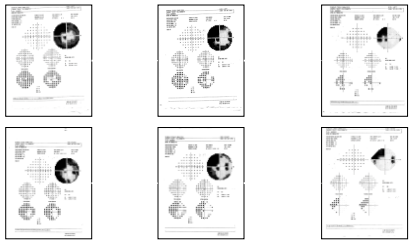












Homonymous Hemianopsia vs USI

HH	USI
Post-chiasmal pathway to the occipital lobe	Right posterior parietal lobe
Basic visual sensory dysfunction	Higer-order perpetual dysfunction
Is retinotopic (+) perimetric findings	Is NOT retinotopic (-) perimetric findings
Patient is AWARE	Patient is NOT AWARE
No USI behaviors	USI behaviors

Treatment

- Inform and educate
- Behavioral methods
  - Anchoring: use red lines or markers
  - Circling or crossing out specific words in a body of text.
- Optical methods: prisms or mirrors
- Prism adaptation

Spotting Prisms/ Scanning

Prism Field Shifting System

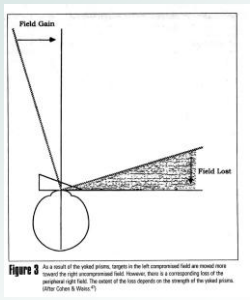
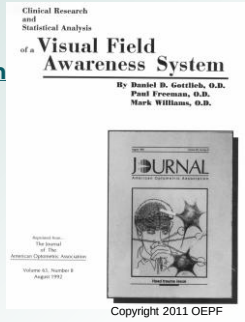


Figure 3 As a result of the yoked prisms, targets in the left compromised field are moved more toward the right uncompromised field. However, there is a corresponding loss of the peripheral right field. The extent of the loss depends on the strength of the yoked prisms. (After Cohen & Waios.[4])

Copyright 2011 OEPF

The Gottlieb System

Peli Driving Prisms



Copyright 2011 OEPF

Gottlieb Visual Field Enhancement System

- Small round wafer type prism BO prism on the side of visual field loss
- Prism on one side only, 18.5 diopters
- Goal for patient to make a small scanning movement
- Requires training from mobility therapist
- Requires awareness of problem to be successful





Gottlieb & Suter

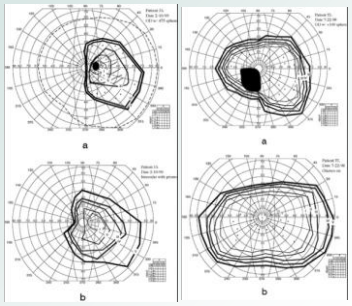
- "The prism works by superimposing what is not seen over what is seen. Patients are better able to see and perceive a combined, or gestalt view of the surroundings. Being able to fill in the gaps and understand the missing area is invaluable in function and safety."

Peli Prisms – temporary/original



Peli Prisms

- 40 diopter prisms
- Fitting protocol at www.chadwickoptical.com
- System is based on a model of developing AP/ARC type of response in a single channel!
- As adaptation occurs field expansion MAY take place.



Xtreme Optics





Driving and Field Loss

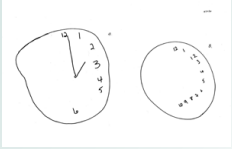
- **Binocular Visual Field Loss and Crash Risk: An eFOVID Population-Based Study--Manner et al. (2024)**
- **Methods:** Using a database of visual field tests obtained from ophthalmologists in Western Australia (WA) between 1990 and 2019, deficits in field sensitivity were identified and classified into three severities across five regions.
- **Results:** Of 31,296 people, 4,307 (13.76%) older drivers were involved in 5,537 vehicle crashes.
- Binocular visual field loss (regardless of severity and location) significantly increased the odds of a crash by 84% (OR 1.84; 95% CI 1.71–1.97).
- Severe visual field loss significantly increased the odds of a crash by 98% in the upper left quadrant (OR 1.98; 95% CI 1.70–2.06), 97% in the lower left (OR 1.97; CI 1.80–2.16), 89% in the lower right (OR 1.89; CI 1.72–2.06) and 95% in the upper right quadrant (OR 1.95; CI 1.78–2.14).
- **Conclusion:** The large population-based study provided robust estimates on the degree of severity and specific locations of visual field loss that threaten safe driving

Neglect/USI

- Neglect: Seems to be only left side!
- Inattention can be either side!
  - Patients with this syndrome act as though whole regions of space contralateral to their lesions do not exist.
  - In early stages, patients may deny ownership of their contralateral limb and also neglect parts of their own body.
    - When dressing, they might not clothe the contralateral side and may fail to groom their hair or shave parts of their faces on that side.

Neglect/USI

- Right hemisphere damage is a more common and more severe cause of unilateral neglect than left hemisphere damage (Chatterjee, 1995).
- Damage causing left-sided neglect is usually centered on the inferior parietal lobule or superior temporal lobe of the right hemisphere.
- Patients with such damage ignore events occurring on the left side of space (Bartolomeo & Chokron, 2002).



Draw a Clock

Copy the house



Clinical Things to Look For

- VA
  - Leaves off the beginning letter of each line or starts in the middle of the line.
- Cover Test
  - When target is in the “blind” left field (for example if in an exo posture and the cover moves from OD to OS then the Wolff wand is in the left visual field of the OD) then there is no movement to refixate.

Clinical Things to Look For

- When you tell the patient to look to the neglected side, they remain looking pretty much straight-ahead.
- Watch the entry to the office space/exam room.
- Do they pay attention to things on one side of the room?

Heterogeneous Disorder

- Functional damage in three areas:
  - Attention
  - Intention
  - Spatial representation
- Classical differentiation
  - Low-level sensori-motor
  - High-level cognitive

Unilateral Spatial Inattention (USI)

- Term coined by Suchoff and Ciuffreda in article in JAOA May 2004.
- "..*neglect* carries the connotation of a willful act on the part of the individual, while *inattention* more accurately describes the individual's unawareness of, and lack of attentional control over, the condition." (page 305)

Unilateral Spatial Inattention (USI)

- USI is most frequent and long-lasting when associated with insult to the right inferior parietal lobe also called the right posterior lobe.
- This area primarily serves as the location of the persons cognitive representation of both personal space, or body image, and external space.
- Thus, problems here can and do cause somatic affect.

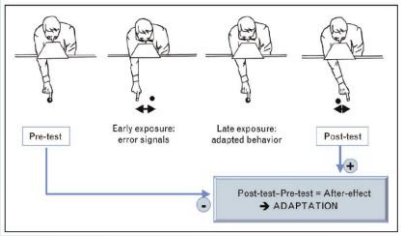
Classes of USI

- Somatic Dysfunctions (personal space):
  - Impaired tactile perception
  - Denial of existence of the left side of the body
- External Dysfunctions:
  - Visual motor control
  - Visual localization
  - Impaired representation of the outside world.
  - Peri-personal space: in which the person makes purposeful motor actions, such as reaching for and manipulating objects.

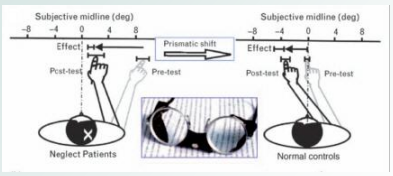
USI an Umbrella Term

- Hemi-Inattention
- Hemi-Spatial Neglect
- Extinction
- Allesthesia
- Anosognosia

Prism Adaptation



Adaptation Differences

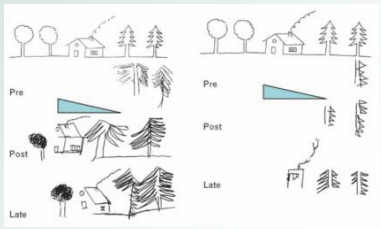


From Pisella, et. al., 2006 "Prism adaptation in the rehabilitation of patients with visuo-spatial cognitive disorders", Current Opinion in Neurology

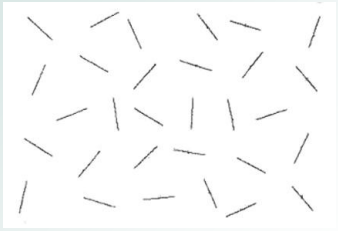
Effects Last Longer

- In the same patients where other sensory adaptations last a maximum of 15 minutes, prism adaptation last 2 hours or more!
- The cognitive effects are stronger in the 2-4 hour range than the immediate ones.

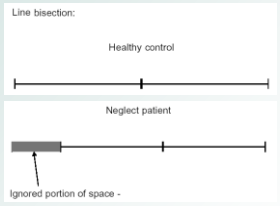
Neglect Symptoms Change



Line Bisection in Neglect



Line Bisection in Neglect



Wicked Neglect



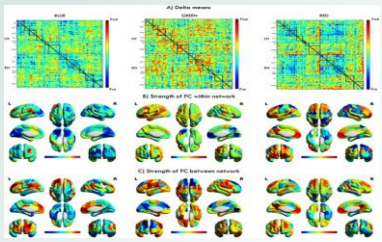


Clinical Pearl

- With all patients with neglect and/or unilateral spatial inattention, try active-closed-loop prism adaptation activities before prescribing yoked prisms on a long-term basis.

Syntonics

- Syntonics - The science of light
- Eastern like philosophy
- Ying and Yang
- homeostasis
- Sympathetic – parasympathetic balance
- Different wavelengths will stimulate or calm sympathetic or parasympathetic systems
- Test to see if the patient is in or out of balance
- College of Syntonic Optometry https://csovision.org/



Argilés et al. Functional connectivity of brain networks with three monochromatic wavelengths: a pilot study using resting-state functional magnetic resonance imaging. Sci Rep. 2022 Sep 28;12(1):16197. doi: 10.1038/s41598-022-20668-9. PMID: 36171254; PMCID: PMC9519584.

Report Writing

- Many different people will be reading these reports.
- Take extra time to avoid the use of jargon and explain things and give examples.
- Try to avoid speculation as these often get introduced into legal proceedings. If you speculate be sure to identify it as such.
- Stick to the point and stay in optometry.
- Don't say anything negative about others.

Vision Therapy

- - Everything takes longer
- Frequent breaks vs shorter visits
- Lying vs sitting vs standing vs moving
- Begin where they are and build to where they ain't
- Motion sensitivity = mismatch within components of 'Where am I' and between 'Where am I' and 'Where is it'

Vision Therapy

- Advise patients to be EXTRA self aware
- They should stop BEFORE the discomfort gets too bad
- They need to give themselves permission to take the time necessary to heal
- You need to give them permission to take the time necessary to heal
- Do Not Push!!

Vision Therapy
How Much is Too Much?

- - Concept of 2 gas tanks
  - primary tank
  - secondary tank
- When the primary gas tank is emptied, it can take 6-12 hrs to recover
- When the secondary gas tank is emptied, it can take 2-3 days to recover!!!
- Do Not Push Too Hard!!!
- Gradually increase duration as stamina improves

VT - Fundamental Concept

- Patients with brain injury are sensitive to motion
  - Of their body
  - Of their visual world
  - Disequilibrium (“Dizziness”) vs vertigo
- In extreme cases, they have forgotten how to walk and talk
- It should not be surprising that even with mild cases, they may have ‘forgotten’ how to move
- The recapitulation of motor learning is foundational to visual-motor rehabilitation

Basic Therapeutic Principles

- **In order to change a behavior, you must first be aware of the behavior**

  How can you stop doing something that you do not know you are doing? Conversely, how can you do something you do not know you are not doing? Awareness is key.

Basic Therapeutic Principles

- **The best way to create awareness is by asking questions.**

  You could bark commands, like they do in the military. But this would increase stress and is not very therapeutic. Remember, the goal is to create a therapeutic environment and to change behavior, not to traumatize the patient. The best way to create awareness is by asking questions.

Basic Therapeutic Principles

- **Place emphasis on good posture at all times.**
  Body should be erect but relaxed, without tilt or leaning. Weight should be evenly distributed on both feet. Have them imagine a cord coming out of the top of their head tied to the base of their spine and someone pulling up on that cord.

Basic Therapeutic Principles

- **Every exercise should be done smoothly, efficiently, and in as relaxed a manner as possible.**
  Try to keep the body relaxed throughout each activity. This helps to reduce stress and open up the side vision.

Basic Therapeutic Principles

- **Place an emphasis on peripheral awareness as much as possible in each procedure in which it is appropriate**
  This also helps to keep the body relaxed and increases awareness of side vision. When under stress, we tend to shut down and turn off our side vision.

Basic Therapeutic Principles

- **Encourage visualization**
  Prior to each procedure, have the patient close their eyes and try to picture themselves doing each activity. Encourage them to describe the clothing they see themselves wearing. The next time they visualize, have them change the color of the clothes they see themselves wear.

Basic Therapeutic Principles

- **Provide specific praise, not general praise**
  General praise is easy, but does not really provide the kind of feedback that kids (especially boys) need. "Good job" is nice, but often not heard by the child. So rather than give general praise (like by saying 'good job'), it is much better to give specific praise, like "I really like the way you were able to keep your head still and keep looking at the alligator the whole time".

Basic Therapeutic Principles

- **There is no "I can't do that". There is only "It may be difficult, but I will do my best."**
  If they say "I can't", they are sending a signal to their brain that "This is impossible". This message is heard loud and clear by the unconscious, and so they will act in such a way that they likely won't be able to do it. Conversely, if they believe they can do it and will do their best, they are much more likely to succeed.

Basic Therapeutic Principles

- **It should not hurt to move your eyes.**
  If it does, this tells you that vision therapy is needed to remove the discomfort. We are on the right track.

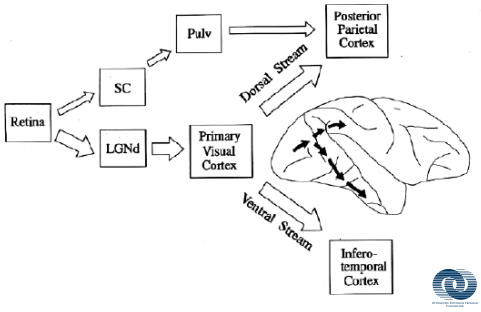
Basic Therapeutic Principles

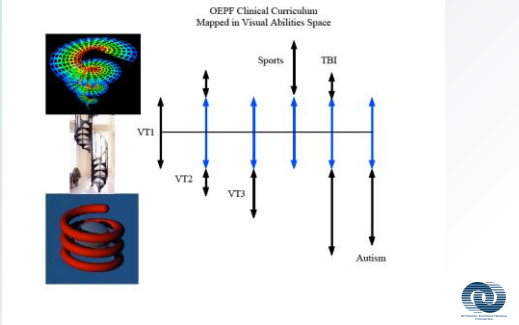
- **Only try to change one thing at a time**
  Even though we would like to, it is too difficult to try to change too many things at once. Pick one thing that needs work, say posture, for example. Provide feedback on posture till you see it improve. Then you can work on the next thing that needs improvement, such as keeping the head still. Try to work on keeping the head still while also keeping good posture. Once those two things improve, you can work on the next thing that needs to change, such as tracking the alligator.

Basic Therapeutic Principles

- **There is a difference between making something happen and letting it happen**
  Making something happen forces you to do the activity. This is different from allowing it to occur. Trust yourself. Allow yourself to do it or see it. It is already there if you just remove what is blocked and let it happen.


Skeffington
Four Circles of Vision
CENTERING
IDENTIFICATION
Vision
ANTIGRAVITY
SPEECH
Auditory


Retina
SC
LGNd
Pulv
Primary Visual Cortex
Posterior Paricta Cortex
Dorsal Stream
Ventral Stream
Infero-temporal Cortex


OEPF Clinical Curriculum
Mapped in Visual Abilities Space
Sports
TBI
VT1
VT2
VT3
Autism

Body lifts	Palming	Thumb Rotations	Far Near Jumps	Hart Chart Near Far Rock
Angels in the Snow	Relaxation Technique			
ATNR Tap the Ball		Eye Stretches		
Crime Scene			Eye Control	Monocular Accomm Rock
Eat the Ball	Releasing Tension	Aligator Pursuits		
Rhythm and timing				
	Hanging onto Space	Look, Touch, Hold, Back		
Cross Crawl	Mirror Hands	Star Dotting	Coin Circles	
				Binocular Accomm Rock
Rhythmic Walk	C-P Saccades	Number Saccades		
			Phys Dip	
Slap Tap	Motor Equivalents	Letter Saccades		
				Doll's Head
		Column Jumping	Brock String	
				Greenwald Eye

Why Do We Have Vision?

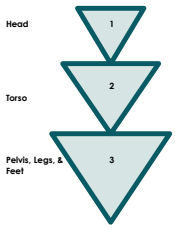
- Vision is the deriving of meaning and direction of action as triggered by light
- The primary purpose is to guide action

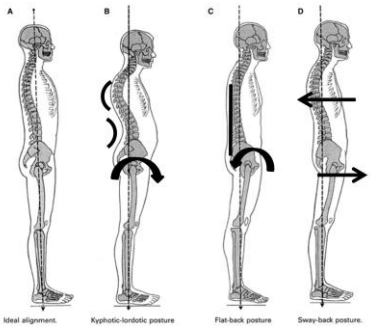
Yoked Prism Demonstration

- Need a volunteer
- "He who is insecure in his vision is insecure in his ego" Skeffington

Posture

- What does your posture tell you about your patient?
- To do anything, you first need to come to terms with gravity, then you need to come to physical terms with the task.

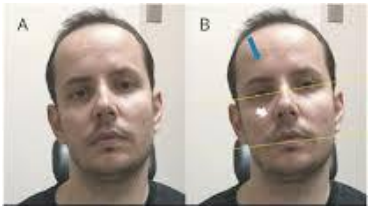




Be a good OBSERVER!!

https://www.yourpilatesphysio.com/blog/How-your-posture-can-affect-your-spine

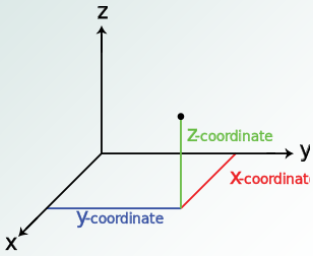
Head Tilt



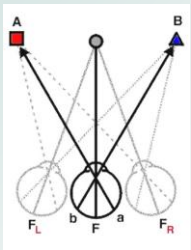
https://www.neurology.org/doi/10.1212/WNL.0000000000012082

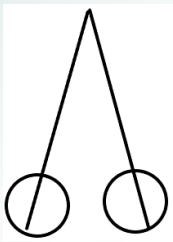
NOTE: 1) line of mouth is not parallel with ocular line
2) down sloping frontalis crease
3) Shallow naso-orbital fold

Spatial Coordinate System

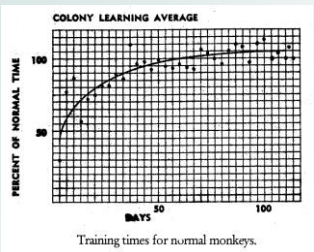


Kraskin's "Computing Space"

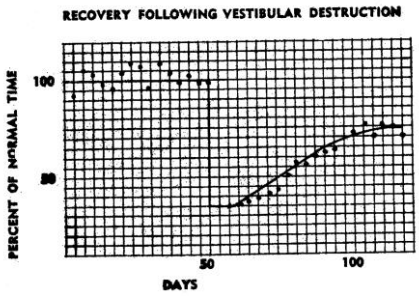


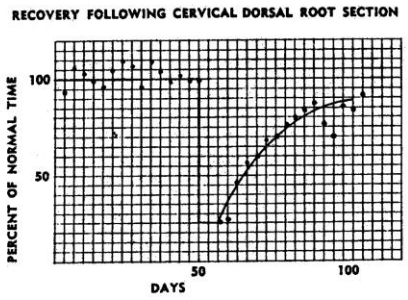


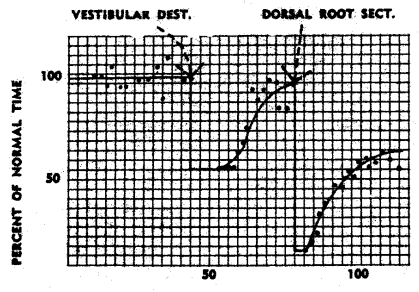
Baseline Training on Ladder Climbing



Training times for normal monkeys.


RECOVERY FOLLOWING VESTIBULAR DESTRUCTION
PERCENT OF NORMAL TIME
100
80
50
100
DAYS


RECOVERY FOLLOWING CERVICAL DORSAL ROOT SECTION
PERCENT OF NORMAL TIME
100
50
50
100
DAYS


VESTIBULAR DEST.
DORSAL ROOT SECT.
PERCENT OF NORMAL TIME
100
50
50
100

Palming

- Purpose – to bring immediate relief an ailing visual system
- Reset to neutral
- Similar to hitting ‘control – alt – delete’ on the computer
- Rub palms together vigorously X 1-2 minutes till warm
- Place over eyes so that absolutely no light gets through
- Open eyes and look into the blackness
- Combine with slow, deep breathing

Relaxation Technique

- Sit in a quiet, comfortable place in low lighting and close your eyes
- Picture a beautiful, quiet, peaceful beach
- Slow, deep breath in through your nose and out slowly through pursed lips
- No one else around you

Relaxation Technique

- Safe and comfortable place
- See the crisp, clean water
- See the sun up in the cloudless sky
- Imagine yourself lying on a beach
- Feel the warmth of the sun on your skin
- Slow, deep breath in and out

Releasing Tension

- Purpose – To allow the patient to gain control of identifying where there is tension in the body and to control the ability to release that tension
- Modification of a Chekhov acting technique
- General idea – place your body in a state of tension to learn how to release it
- Remember Basic Therapeutic Principle – Every exercise should be done smoothly, efficiently, and in as relaxed a manner as possible!

Releasing Tension

- Lie down, relaxed neutral position
- Start with hands – How do they feel? Any tension?
- Tighten them X 5 seconds – What does that feel like?
- Then slowly let go and relax your hands – What does that feel like?
- Feel what you are doing to release the tension
- Feel the difference in your hands when tight and when relaxed
- Repeat with both arms, then both legs
- Repeat AT LEAST 3 times till you can feel the difference

Releasing Tension

- Repeat with entire body as a whole
- Fill it with tension from toes to head (including face)
- Tighten everything and hold X 5 seconds
- Then slowly relax and release that tension
- Feel it leaving your body and feel body sink into floor
- Repeat AT LEAST 3 times until you can feel the difference between holding tension and releasing tension

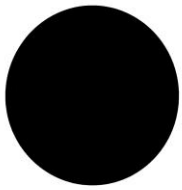
Releasing Tension

- At higher levels, have the patient stand straight, tall, and relaxed
- “Search your body for areas you feel yourself holding tension. Use the same feeling as when you were on the floor and release that tension. You can do this at any point throughout the day and SHOULD do this before and during other activities.”
- NOTE: The language we use is important here. Rather than ‘you are tense’ have the patient understand ‘you are holding tension’. When you are holding something, you can let it go. YOU are in control of your body!!

Look Hard Look Soft

- PURPOSE: To enhance the ability to select a spot in space and give it one's full and complete attention. To allow the patient to take control of how and what they see. To aid in therapist and patient communication in future activities. ("How does this feel? Does it feel like you are looking soft or looking hard, etc.")

O F N P V D T C H E
Y B A K O E Z L R X
E T H W F M B K A P
B X F R T O S M V C
R A D V S X P E T O
M P O E A N C B K F
C R G D B K E P M A
F X P S M A R D L G
T M U A X S O G P B
H O S N C T K U Z L



Why Do Motor Activities?

- Many TBI patients have ‘forgotten’ how to move
- Build motor coordination
- Emphasize ‘Where am I” circle
- Concentrated mental effort
- To do anything, you need an ‘image of achievement’

VT – Where am I

- Body Lifts
- Angels in the snow Picture it then do it!!
- ATNR activities
- Cross Crawl
- Rhythmic Walk
- Randolf shuffle
- Chalkboard OO’s

Where am I - Body Lifts

- Patient lies on back (eyes open) and lifts body parts that you touch. Only touch one body part at a time.
- Same as above but with eyes closed, one part at a time.
- Patient lies on back and you touch several parts in some particular order. Patient lifts in same sequence that you touched them. (i.e. R elbow, L knee, head, L leg, both legs)
- Repeat above with patient lying on stomach

Where am I - Angels in the snow

- Purpose – to develop awareness and control of the two halves of the body
  - Lying down
  - Arms only and Legs only
  - Single arm or leg
  - Ipsilateral
  - Contralateral
  - Sequential combinations
  - Plan movement first, picture it, then do it smoothly, efficiently, and as relaxed as possible

Where am I - Angels in the Snow

- Lying vs standing
- Isolated movements
- Ipsilateral
- Contralateral
- Movements in series
- Demonstration



Some Thoughts About Primitive Reflexes

- Innate movement patterns that emerge during the pre- and perinatal period
- Brainstem directed, not cortical
- Act as the foundation from which we learn to move
- Typically become 'integrated' during the first year of life
- Reflexes may persist and interfere with optimum development of visual-motor system and visual-spatial concept formation



Asymmetric Tonic Neck Reflex

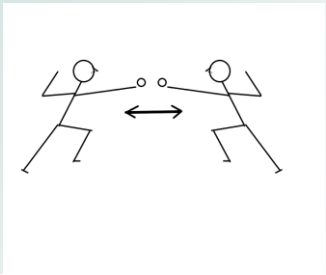


- "Fencing Stance"
- Head turns to the side
- Ipsilateral arm and leg extended
- Contralateral arm and leg flexed

Asymmetric Tonic Neck Reflex Activities

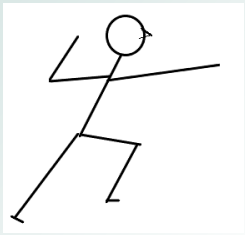
- ATNR Tap the Ball
- Crime Scene
- Eat the Ball

ATNR Tap - simultaneous movement



- Look at ball
- Tap 3 times
- Picture yourself changing positions
- Switch sides
- Smoothly and efficiently
- Move whole body at once

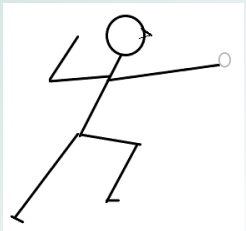
"Crime Scene" - Sequential movement



Sequence

- Turn head
- Lower arm
- Lower leg
- Bend leg
- Bend arm

Eat the Ball - Sequential movement



Sequence:

- look at ball
- ball to mouth
- leg straightens
- leg bends
- ball to other hand
- head to other side

Rhythm and Timing

- VT1
  - Most can start at 120 and do well; have internal timing
- VT2
  - Needs more time than VT1 to get it
  - May give as homework with tape (or 2x4)
- VT3
  - Lost in time and space
  - Need lower levels than others
  - Need much more time to get it

Rhythm and Timing

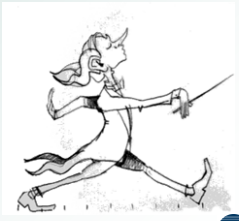
- Start with easy and SLOWLY work up
- March to music
  - Stationary
  - Moving
- Snap fingers
- Clap hands
- Complicate the rhythm

Where am I - Cross Crawl

- Purpose – to warm up the body and prepare the mind for VT, to help develop routine
- March to a rhythm
- Right hand slaps left knee, left hand slaps right knee
- Then use pointer finger, thumb, 'mash potatoes,' elbows
- Then foot in front, then foot in back
- All are done in a count of eight
- Can count in foreign language

Where am I - Rhythmic Walk

Have child swing arms in an exaggerated walk to the beat of a metronome. Have them point to an object in front of them, again in time to beat, while walking.



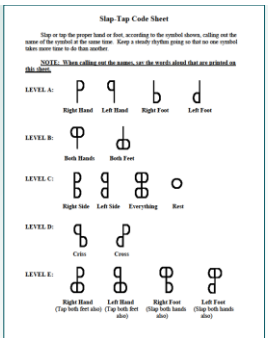
Slap-Tap

PURPOSE - To provide the patient with the opportunity to have the necessary meaningful experience to integrate all the left/right activities that have come before and to embed laterality and directionality.

The shapes and the patterns are read in a left to right, top down sequence with the symbols being converted to both physical actions and verbal labels with the metronome being added to provide structure.

Expect that it will take extra time to put it all together. May hold off on metronome.

Code Sheet



Slap-Tap Code Sheet

Slap or tap the proper hand or foot, according to the symbol shown, calling out the name of the symbol at the same time. Keep a steady rhythm going so that no one symbol takes more time to do than another.

NOTE: When calling out the names, say the words aloud that are printed on this sheet.

LEVEL A: Right Hand, Left Hand, Right Foot, Left Foot

LEVEL B: Both Hands, Both Feet

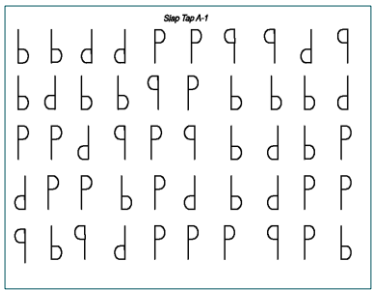
LEVEL C: Right Side, Left Side, Everything, Rest

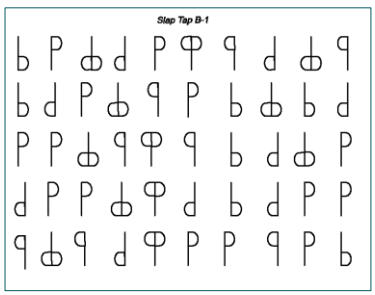
LEVEL D: Criss, Cross

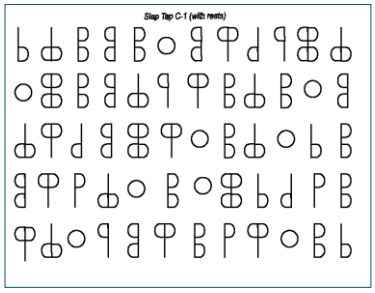
LEVEL E: Right Hand (Tap both feet also), Left Hand (Tap both feet also), Right Foot (Slap both hands also), Left Foot (Slap both hands also)

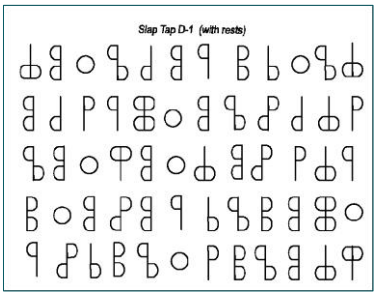
Slap Tap

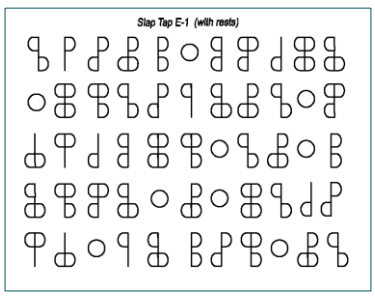

OPTOMETRIC EXTENSION PROGRAM
FOUNDATION


Slap Tap A-1


Slap Tap B-1


Slap Tap C-1 (with rests)


Slap Tap D-1 (with rests)


Slap Tap E-1 (with rests)

Where am I - Randolf Shuffle

- Purpose – to learn how to efficiently integrate the two halves of the body in movement
- Metronome at 120 beats
  - Single movement-"Front, side, front, back"
    - Arm
    - Leg
  - Combination movements
    - Ipsilateral
    - Both arms + one leg
    - Contralateral

Where am I - Chalkboard Double O's

- Bilaterality to BUILD binocularity
- Helps organize the two halves of the body
- Metronome at 120 beats
  - Same side
  - Opposites
  - Cross over
  - Cross over - opposites



Chalkboard Double O's

Rhythm and Timing

- **Theraball**
  - Encourages righting reflex and good posture
  - First just sit, stable
  - Gently begin to bounce, barely moving
  - Just bounce without shoes: it has a natural rhythm.
  - Get the feel for the bounce
  - Add in clap at bottom.
  - Clap every other time.
  - Count out loud with claps.

Rhythm and Timing

Notice posture



Image From:
https://posturepeople.co.uk/sitting-gym-ball-work-facts/

Peripheral Awareness

- Crucial in TBI/ABI
- Stress = restricted peripheral fields
- The more relaxed, the more open the field

- Relaxation Technique
- Releasing Tension
- Hanging onto space
- Mirror Hands
- C-P Saccades

- Later Techniques
  * Walking Rail
  * Motor Equivalents

VT – Eye Movements

- Thumb rotations
- Eye stretches
- Alligator pursuits
- Saccadic activities

- Watch for discomfort!!
- Do not push!!!
- Patients often do NOT realize how hard they are pushing themselves

VT – Eye Movements

- Thumb rotations – Eyes closed
  - Lying down
  - Sitting
  - Standing
  - (2 - 3 weeks)

VT – Eye Movements

- Eye stretches
  - Lying down
  - Sitting
  - Standing
  - (2 – 3 weeks)

Eye Stretches

- Purpose – To physically stretch eye in all positions, to move eye without moving head/body, to reduce/eliminate discomfort
- Stand in good posture, body relaxed
- Move target in random directions as far as they can go, then hold for 4 seconds
- Cover as large an area as they can
- Go to four corners and sides often



Eye Stretches

- Eso – stretch out more (can patch one eye)
- Exo – stretch in more (can patch one eye)
- Ask questions for feedback
  - discomfort?
  - posture? Relaxed?
  - head/body moving?
  - breathing?
- Give frequent breaks initially
- Build to 4 minutes without break



Eye Stretches

- Easier – lay on ground, up against a wall, touch one shoulder, don't move as far
- Keep patient on eye stretches if it hurts a lot or if they have difficulty keeping head still
- Usually 2 weeks



VT – Eye Movements

- **Alligator pursuits - (4 – 6 weeks)**
  - Lying down, sitting, standing
  - Horizontal only
  - Add Vertical
  - Add Diagonal
  - Add Circles
  - Add Circles with touch

Saccadic Activities

- Look, Touch, Hold, Back
- Star Dotting
- Number Saccades
- Letter Saccades
- Column Jumping

Saccades - Look, Touch, Hold, Back

- Need a pointer and chalkboard with 4 numbers
- Metronome 120 beats
- "Look, touch, hold, back"
- Each time you say 'Look', you shift your eyes to the next target
- "Touch" = touch with pointer
- Watch timing!!
- Usually 2-3 wks



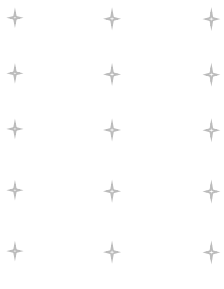
Saccades - Star Dotting

- Helpful to develop accurate oculomotor and visual-motor skill
- Metronome starts at 100 bpm
- Goal is > 200 bpm
- 2 columns
- 3 columns
- 3 columns irregular
- Standing, holding pencil straight down

Two Column



Three Column



Irregular



Number and Letter Saccades

- Exactly the same as Star Dotting EXCEPT you change the stars to numbers
- Call the numbers out loud
- Start at 100 bpm, goal = > 180
- Number Saccades first, then Letter Saccades
- Generally two weeks each

Number saccades

- Harder – faster, smaller font, closer together
- Easier – slower, larger font, farther apart

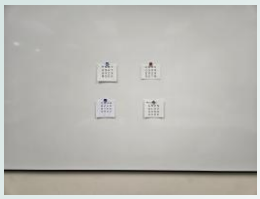
6	8
3	1
4	0
2	9
5	7
9	4

Letter saccades

- Similar to number saccades
- Start at 100 bpm and build from there
- Observe errors
  - Naming
  - Skipping
  - Reversals

Y	B
T	L
S	E
Q	I
W	D
F	V

Four Corner Saccades





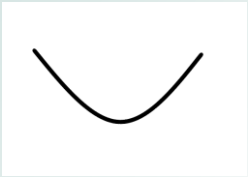
Tach Work
How Quickly Can You See It?

- Purpose – To increase the speed, accuracy, and volume of visual spatial processing
- Forms – same size, same shape, same location
- Letter recognition
- Word recognition

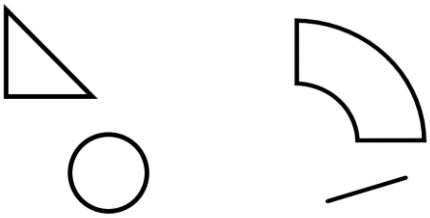
https://visionbuilder.com/



Form Tach



- Forms presented at 100 ms
- “draw the picture you saw, same size, same shape, same location”
- Observe their approach to problem
  - Posture
  - Starting location
  - Grouping



Form Tach

- Watch for verbalizations!!
- Most kids with VRLP emphasize VERBAL and not visual
- It is their habit!! They do it automatically!
- This works to break that habit and allows them to process visually

Tach Work

- What kind of errors do you see?
- What do those errors tell you about how the patient is seeing the space?

Vision Builder letter recognition

- Groups of letters flashes rapidly
- Task is to recognize them among 5 options that appear
- Set at 100 msec
- Rapidly and automatically process the target VISUALLY
- Monitor for subvocalization!!!
- Process as one unit (as a whole) in one instant

y a y a



e d d e d e e



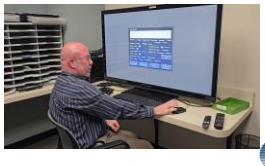
Vision Builder - word recognition

- Similar to Letter Recognition
- Three small words presented initially
- More complex and longer words presented later
- Monitor for subvocalization!!
- Kids are taught to 'break the words down' – this encourages them to see the parts and not the whole

Tach Work



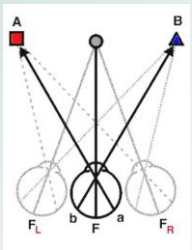


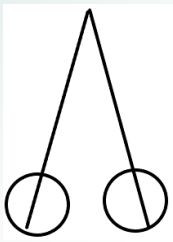


VT - Where is it

- Far – Near Jumps
- Eye Control
- Coin Circles
- Phys Dip
- Brock String

Kraskin's "Computing Space"





Far-Near Jumps (2 - 4 weeks)

- Far – Near Jumps (2 – 4 weeks)
  - Look out a window
  - Hold target at near
  - How close? Should be comfortable!!
  - Jump to near target
  - Jump back to far
  - Body still and relaxed, open side vision
  - Repeat, slowly bringing it closer
  - Goal = symmetrical jump to near and distance, all the way to the nose

VT – Eye Movements

- Eye Control
  - Now ready to plug into VT1
  - May take a week or two longer than typical VT1 case

Eye Control (4 – 6 wks)

- Finger in steeple position, body relaxed, good posture, open side vision
  - Rubbing or tapping, stationary
  - Rubbing or tapping, moving
  - Rubbing or tapping, tromboning
  - Rubbing or tapping, tromboning 9 positions of gaze
    - Goal = to the nose
  - Doll's Head (optional at this point)

Eye Control

Coin Circles (3 – 4 weeks)

- ALWAYS: Head + body still and relaxed, good posture, open side vision
- Horizontal
- Add vertical
- Add diagonal
- Add figure 8

- Slowly move coin in circle at eye level
- R hand, then L hand, each in both directions

Coin Circles (3 – 4 weeks)

Coin Circles

Physiological Diplopia (2 – 4 weeks)

- Demo – show the double at distance when looking near and double at distance when looking far, double increases as you move object closer to nose, tilting head makes one higher than other
- MAKE SURE DOUBLE IMAGES ARE SAME HEIGHT!!!
- First look at distance and move target in
- Next look at target and move it in to nose
- Next is fast jumps from far to near (goal = to the nose)

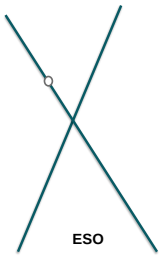
Brock String (5 – 6 weeks)

- Basic string – Ensure no eso when looking at a bead anywhere on string. Open side vision, balance posture, RELAX, look softly!!!

- Bead Jumping
- Bead Sliding
- Bead Sliding 3 positions of gaze
- Bead Sliding 9 positions of gaze
- Bug on a string

Basic Brock String





Brock String – Use 10 foot string!

- Bead jumping – Ensure no eso when looking at a bead anywhere on string. Open side vision, balance posture, RELAX, look soft
  - Look at green bead. See where yellow bead is. Plan the jump to the yellow bead.
  - Yellow, ready, jump!
  - Where did you land? In front of the bead or behind? (error assessment)
  - What could you do differently? OK, let's try that again.
  - Distance to near and near to far.

Brock String

- Bead sliding – Ensure no eso when looking at a bead anywhere on string. Open side vision, balance posture, RELAX, look soft
  - Therapist holds one bead at far end of string, patient holds other beads
  - **SLOWLY** move bead to patients nose, hold X 5 seconds, **SLOWLY** move it back
  - "Look at the bead. Where do strings cross?"
  - "Keep your body relaxed, eyes on easy, open side vision, follow bead as I move it."
  - "What did you notice? How did that feel?"

Brock String

- Bead sliding – Ensure no eso when looking at a bead anywhere on string. Open side vision, balance posture, RELAX, look soft
  - Therapist holds one bead at far end of string, patient holds other beads
  - **SLOWLY** move bead to patients nose, hold X 5 seconds, **SLOWLY** move it back
  - Second week, add right and left gaze (asymmetric convergence)
  - Third week, add 9 positions of gaze

Bead Sliding

Bug on a String

What is it?

- Heart Chart Near Far Rock
- Monocular Accommodative Rock
- Mental Minus
- Binocular Accommodative Rock

- Watch posture!!
- Relaxed, balanced, open side vision, look softly!!
- Go easily initially. Gradually increase demand.

Hart Chart Near Far Rock

- PURPOSE: To provide the patient with the opportunity to have the necessary meaningful experience to shift the area in space from which the person will derive meaning from along the Z axis, expanding the range as well as the efficiency and accuracy of the shifts.

- Begin where they are, build to where they ain't
- How to make it easier?
- How to make it harder?

Monocular Accommodative Rock

- PURPOSE: To provide the patient with the opportunity to have the necessary meaningful experience to shift the area in space which the person will derive meaning from along the Z axis, expanding the range as well as the efficiency and accuracy of the shifts. MAR helps to refine the control gained in Hart Chart Near Far Rock, doing this in an artificial environment.
- The lenses transform space and are a less natural condition.
- Control under these conditions is generally more difficult than in real space with real objects.

Monocular Accommodative Rock



- Use a stand
- Start with low powers and work up
- Go gently!!
- Monitor for symptoms
- Begin with low plus lenses
- Add minus lenses as able
- End goal = +3.00/-6.00

Monocular Accommodative Rock

Mental Minus/Lens Feeling

- PURPOSE: To provide the patient with the opportunity to have the necessary meaningful experience to gain conscious control over where in three-dimensional space they can use identification optimally.
- This involves gaining control of the mechanism of accommodation. In addition, the patient will learn to recognize and understand the different ways that space can be organized and altered.

Binocular Accommodative Rock

- PURPOSE - To provide the patient with the opportunity to have the necessary meaningful experience to give them constant feedback as to whether both eyes are "turned on" while they are reading under different conditions of binocular lens demand.
- The activity provides a situation in which the person can learn to deal with different levels of demand on identification while maintaining a stable relationship to the task (centering).

Binocular Accommodative Rock

Visual Motion Desensitization

- Motion sensitivity is very common post TBI
- Disequilibrium is symptomatic manifestation of disruption in “Where am I”
- Goal of therapy is to re-establish that foundation to decrease symptoms
- General technique is to gradually reintroduce motion in order to build their sense of ‘Where am I’ and increase tolerance to motion
- Patient must give themselves permission to take the time to heal
- Do not push!!!

Visual Motion Desensitization

- Mirror Hands
- Aligator Pursuits
- All the peripheral awareness activities
- Doll's Head
- Infinity Walk
- Greenwald Eye Movements

Mirror Hands

- Purpose – To acquire the ability to increase the volume of space they can attend to at one time and to improve peripheral awareness
- Stand facing each other with hands at shoulder height and hands about 10 inches apart
- Look at helper's nose and use ONLY peripheral vision to guide hands
- Helper SLOWLY moves hands
- Horizontal, vertical, diagonal, wax-on, wax-off, bicycle wheels, drop outs, other asymmetrical movements

Mirror Hands

- Key is keeping the body relaxed to open peripheral vision
- VERY slow movements initially, but never fast
- Ask the patient:
  - Are you looking at my nose?
  - How is your posture?
  - Do you feel any tension? Can you release it?
  - Can you see the whole room?
  - Are you relaxed?
  - How is your breathing?

Alligator Pursuits

- Purpose - To learn to move eye smoothly while keeping head and body still and relaxed, to open side vision, to reduce/eliminate discomfort
- Proper standing position, feet parallel and flat at shoulder width apart, hands at sides
- "I want you to stand nice and tall and follow the alligator while keeping your head and body still and relaxed"

Alligator Pursuits





Alligator Pursuits

- Patch one eye
- **SLOWLY** move alligator and observe smoothness of eye movements
- Week 1 - Horizontally and vertically
- Week 2 - Add diagonally
- Week 3 - Add circles clockwise and counter-clockwise
- Week 4 - Add septum

Alligator Pursuits

- Questions
  - Can you feel the eye moving?
  - Smooth or jumpy?
  - Can you feel the other eye moving?
  - Are you holding your breath?
  - Is your body relaxed?
  - Can you see the space around you?
  - How is your posture?

VOR =
Vestibulo Ocular Reflex

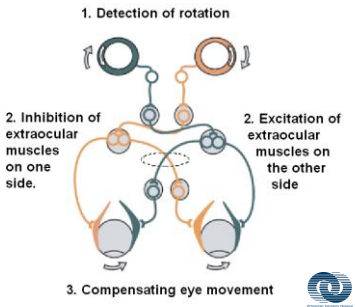


IMAGE FROM:
https://en.wikipedia.org/wiki/Vestibulo-ocular_reflex

Doll's Head

- Purpose – To use vestibular input to drive eye movement, to strengthen the vestibular-visual connection, to reduce eye strain and motion sickness
- Relies on the connections between the vestibular system and the oculomotor nuclei
- Supplementary to pursuit eye movements

Doll's Head

- Look at your face/eye in mirror
- Slowly move head side to side while still looking at your face/eye
- Wide range of motion
- Then slowly move head up and down (as if saying 'yes)
- Keep eyes on target

Doll's Head

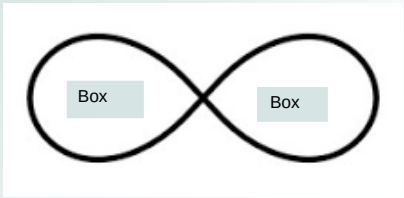
- Second week
  - Add circles
  - Slowly move head in small circular motion, in ever increasing size
  - Clockwise and counterclockwise
  - Patients with motion sickness
  - usually need this for a month

Infinity Walk

- Purpose – to warm up the body and prepare the mind for VT, to increase arousal by stimulating the vestibular system, to help develop routine
- Walk in a figure 8 for three times around looking at one spot, then turn around and repeat in the other direction
- Then read off Hart Chart while walking in figure 8 (like the symbol for infinity)
- Half way through, turn around and go in the other direction
- Can add front/back clap, alternate knee slap, walking backwards, creeping on hands and knees

Infinity Walk

Hart Chart



Infinity Walk

- Purpose – to warm up the body and prepare the mind for VT, to increase arousal by stimulating the vestibular system, to help develop routine
- Walk in a figure 8 for three times around looking at one spot, then turn around and repeat in the other direction
- Then read off Hart Chart while walking in figure 8 (like the symbol for infinity)
- Half way through, turn around and go in the other direction
- Can add front/back clap, alternate knee slap, walking backwards, creeping on hands and knees

Greenwald Eye Movements

- **PURPOSE** - To provide the patient with the opportunity to have the necessary meaningful experience to normalize and equilibrate the neurology involved with head and eye movements as well as the balancing of the eye alignment mechanisms.
- Mal-development or asymmetric development in the neurological control of the extraocular muscles is associated closely with input from the vestibular apparatus.

OEPF VT3 (C)

Greenwald Eye Movements

- These movements help the patient explore all the degrees of freedom that should exist between all the subparts of the systems; eye movements with head movement, eye movements without head movement, both types of movements with and without the influence of the vestibular apparatus by changing head positions and both types of movements with differing levels of visible background.
- These activities have also been found to be extremely helpful in cases of motion sickness including, sea, car and air sickness.

Greenwald Eye Movements

- Works with VOR and working with and against it.
- Vary the lighting conditions
- Change height of ball
- All head movement vs. all eye movement
- Do balanced, on one foot, holding heavy weight on one side, etc.

Greenwald Eye Movements



Greenwald Eye Movements



Greenwald Eye Movements



