

The background of the slide is a soft, painterly landscape. It depicts a wide river valley with a winding path or road. In the distance, there are rolling mountains under a pale, hazy sky. The foreground and middle ground are filled with lush green trees and foliage, rendered with visible brushstrokes, giving it an artistic, impressionistic feel. The overall color palette is dominated by greens, blues, and earthy tones.

# Optometric Care of Stroke Patients

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# Optometrists and Stroke

Optometrists have an important role in the care of stroke patients. This includes **prevention, education, diagnosis and treatment.**

- **Optometrists should be active in stroke prevention.** We can educate our patients about smoking cessation, managing diabetes and blood pressure. Glaucoma patients have a higher incidence of stroke, as do migraine patients.
- **We can often diagnose strokes.** New onset of field loss and ocular motor disorders are often missed by emergency physicians.
- **We are able to treat the vision problems caused by stroke** that will impair overall patient recovery.

# Educating Stroke patients

- Controllable factors that increase risk of stroke are *diabetes, hypertension, hyperlipidemia, smoking, alcohol use, malnutrition*.
- Smoking and diabetes cause macular degeneration and should always be discussed.
- **Smoking increases the risk of developing diabetes.** In fact, people who smoke cigarettes are 30%–40% more likely to develop type 2 diabetes than people who don't smoke.<sup>1</sup>
- **Diabetic patients who smoke have a higher risk of stroke.** The combination of persistent tobacco use and prediabetes (higher than normal blood sugar levels that may progress to Type 2 diabetes) **triples the risk of stroke** in young adults who do not have other cardiovascular risk factors.<sup>2</sup>

# Risk Factors for Stroke

- Hypertension
- Diabetes
- Dyslipidemia
- Atrial Fibrillation
- Glaucoma (non-causative comorbidity)
- Hypersomnolence
- Migraine (non-causative comorbidity)
- Infection/inflammation
- Age (<1 year, >65 years)
- Obstructive Sleep Apnea
- Pregnancy
- Substance abuse

# Diabetes and Stroke Facts

## *Did You Know:*

- Adults who have diabetes are 2-4 times as likely to have a stroke compared to people who do not have diabetes.
- People with diabetes tend to develop heart disease or have a stroke at an earlier age than people without diabetes.
- 65% of diabetics are expected to have stroke or cardiovascular disease.
- Controlling blood glucose after a stroke does NOT reduce the risk of recurrence.
- Hemorrhagic strokes have higher fatality than ischemic strokes.
- Abnormal fat is believed to cause T2DM and obesity.

- DM and Stroke is bidirectional relationship: CVA also increases risk for T2DM.
- Obesity, hypertension and dyslipidemia are also high among DM cases.
- T1DM is less likely to increase risk for stroke.
- Inappropriate management of diabetes also increases immediate and long-term morbidity and mortality associated with stroke.
- Newer drugs may have more initial side effects but reduce the likelihood of secondary MACEs.
- Fasting blood glucose is no longer considered a valid diagnostic criteria.

# Terms to learn:

- **MACE** - Major Adverse Cardiovascular Event.
- **Adiposopathy** - medical and scientific organizations are increasingly acknowledging the central importance of fat tissue in causing metabolic disease but have not agreed upon how adiposopathy is best diagnosed.
- **T2DM** - type 2 diabetes mellitus, most common.
- **GLP-1 RA** - glucagon-like peptide 1 receptor agonist.
- **Dyslipidemia** - any lipid imbalance not just high cholesterol.

# Newer medications can improve outcomes

Effect of GLP-1 RAs on adverse cerebrovascular outcomes<sup>a</sup> and stroke subtypes

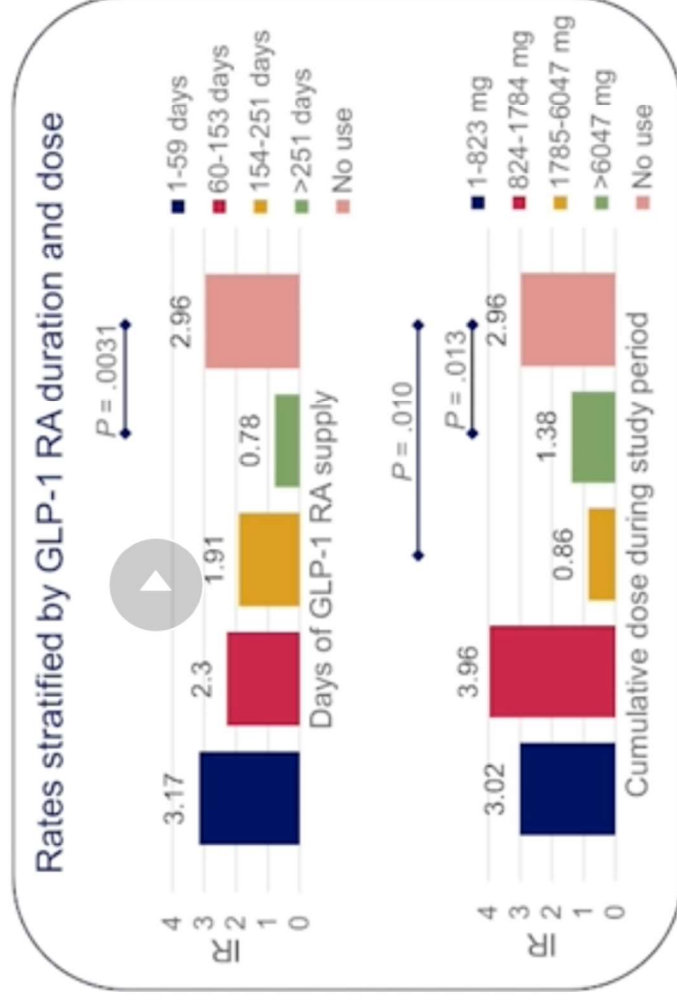
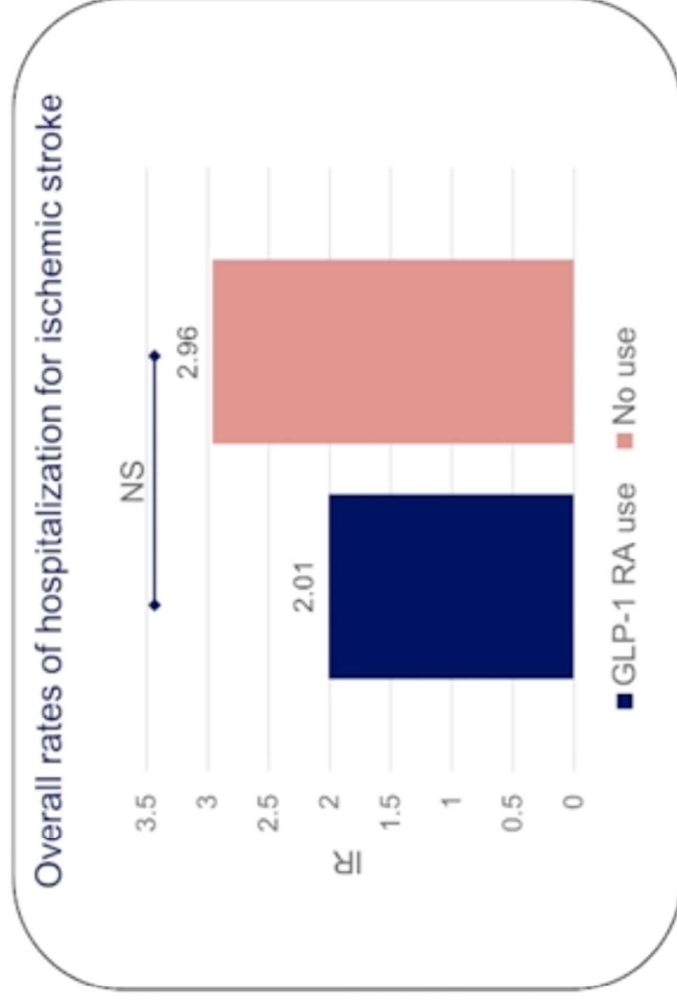
Clinical outcome	Risk ratio (95% CI)	P-value
Adverse cerebrovascular outcomes	0.83 (0.76-0.91)	< .001
Nonfatal stroke	0.85 (0.76-0.94)	< .01
Fatal stroke	0.80 (0.61-1.05)	.10
Fatal or nonfatal stroke	0.84 (0.77-0.93)	< .001
Ischemic stroke	0.73 (0.60-0.89)	< .01
Ischemic stroke or TIA	0.76 (0.65-0.90)	.001
Hemorrhagic stroke	0.92 (0.51-1.64)	.77

 Significant risk reduction with GLP-1 RA vs comparator

 No significant risk reduction with GLP-1 RA vs comparator



- Retrospective cohort study conducted in Taiwan: 6534 people with T2D on GLP-1 RAs (exenatide, liraglutide, dulaglutide) and 6534 matched individuals not taking GLP-1 RAs
- Median follow-up  $\approx$  3.5 years



IR, incidence rate per 1000 person-years.

Yang Y-S, et al. *Diabetes Care*. 2022;45:1184-1192.

## Newer drugs for DM and Obesity

Drug	Trial	Patient population	Efficacy			Efficacy driven by:
			Outcome	HR	P-value	
Liraglutide	LEADER <sup>1</sup> (N = 9340)	T2D plus • CVD (81.3%) or • CKD stage ≥ 3 (24.7%) or • CVD and CKD stage ≥ 3 (15.8%)	3P-MACE <sup>a</sup>	0.87	.01	<b>Fewer CV deaths</b>
			CV death	0.78	<b>.007</b>	
			Nonfatal MI	0.88	.11	
			Nonfatal stroke	0.89	.30	
Dulaglutide	REWIND <sup>2</sup> (N = 9901)	T2D plus • CVD (31.5%) • eGFR < 60 mL/min/1.73 m <sup>2</sup> (22.2%)	3P-MACE <sup>a</sup>	0.88	.026	<b>Fewer nonfatal strokes</b>
			CV death	0.91	.21	
			Nonfatal MI	0.96	.65	
			Nonfatal stroke	0.76	<b>.017</b>	
Semaglutide	SUSTAIN-6 <sup>3</sup> (N = 3297)	T2D plus • CVD (83.0%) • CVD with no CKD (58.8%) • CKD only (10.7%) or • CVD and CKD (13.4%)	3P-MACE <sup>a</sup>	0.74	.02	<b>Fewer nonfatal strokes</b>
			CV death	0.98	.92	
			Nonfatal MI	0.74	.12	
			Nonfatal stroke	0.61	<b>.04</b>	

<sup>a</sup> Defined as first occurrence of CV death, nonfatal MI, or nonfatal stroke.

3P-MACE, 3-point major adverse cardiovascular events; CKD, chronic kidney disease; CVD, cardiovascular disease; eGFR, estimated glomerular filtration rate.

1. Marso SP, et al. *N Engl J Med.* 2016;375:311-322; 2. Gerstein HC, et al. *Lancet.* 2019;394:121-130; 3. Marso SP, et al. *N Engl J Med.* 2016;375:1834-1844.

# Substance Abuse

- Don't be afraid to ask!
- Tell your patients that smoking causes small vessel disease including AMD and impotence.
- Ask how much ETOH they consume, *especially with unexplained vision changes.*
- Ask about long term use of prescribed stimulants.

# What patients and their families need to know:

- 1. Stroke usually affects vision, but not necessarily eyesight.
- 2. Vision affects almost everything we do, including participation in other rehabilitative therapies.
- 3. Vision problems after stroke will impact orientation, memory, balance and coordination, eye-hand coordination, reading, using a computer and driving.
- 4. Patients often have difficulty using bifocals or progressive lenses after stroke.
- 5. Most eye doctors do not know how to diagnose or treat vision problems associated with stroke. Patients do not know what to tell their doctor.

## **Common vision problems after stroke include:**

- Double vision
- Visual field loss
- Poor depth perception
- Poor control of eye movements
- Poor focusing
- Visual processing impairments

# Quick Stroke Diagnosis

- Maddox Rod - anomalous responses including pieces of rod not seen.
- Ocular motor disorder including jerky eye movements, nystagmus, reduced range of movement and loss of fixation.
- Loss of convergence with or without diplopia. ***If one eye goes in and the other out on convergence, this can indicate homonymous hemianopsia.***
- ***Keystone Visual Skills cards will pick up most signs of stroke including language issues and anomalous visual spatial processing.***
- Visual field testing (but not confrontation testing).

# Case Report

- 67 y.o. female referred for in-patient rehabilitation due to suspected stroke (ruled out), impaired balance and diplopia. Vestibular therapy started secondary to TIA.
- Initial NOR evaluation showed no loss of ROM of any extra ocular muscles, no nystagmus. Diplopia eliminated with BNO. Ocular motor therapy started.
- Day of discharge Neuro-OD rechecked patient for new onset headache. Patient was found to have a new partial CNIII palsy OD.
- New ischemic stroke found on MRI.

# Sensory loss from stroke

Visual loss, intensive vertigo, double vision, unilateral hearing loss, nausea, vomiting, photophobia, phonophobia... hemianopia, or loss of visual field on one side, is a result of a stroke and is detected after 36% of right brain strokes and 25% of the left brain strokes. **Vision impairment is one of the most commonly overlooked and under-treated conditions of the elderly and those who have had traumatic brain injury or stroke.** However, vision rehabilitation after a stroke is worthwhile and often necessary for a stroke or brain injury survivor to enjoy a normal life.<sup>3</sup>



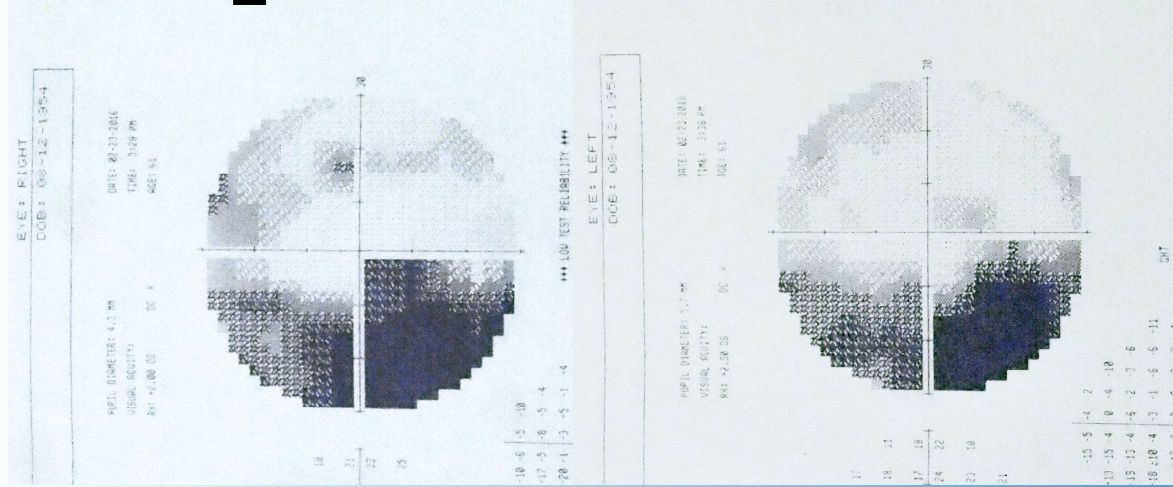
# Visual Field Loss

- Loss of peripheral vision is most likely to occur in the field opposite the area of brain trauma.
- Hypoxic brain injury often causes loss of peripheral vision in all directions, with resulting “tunnel vision.”
- Comorbidities including retinal vascular infarcts, glaucoma, macular degeneration and giant cell arteritis can cause loss of visual field.
- Ischemic optic neuropathy - essentially a stroke of the optic nerve, can affect anterior or posterior portions and cause altitudinal visual field loss.
- Unilateral or bitemporal field loss can be due to chiasmal lesion.

# Visual Field Loss Case Report

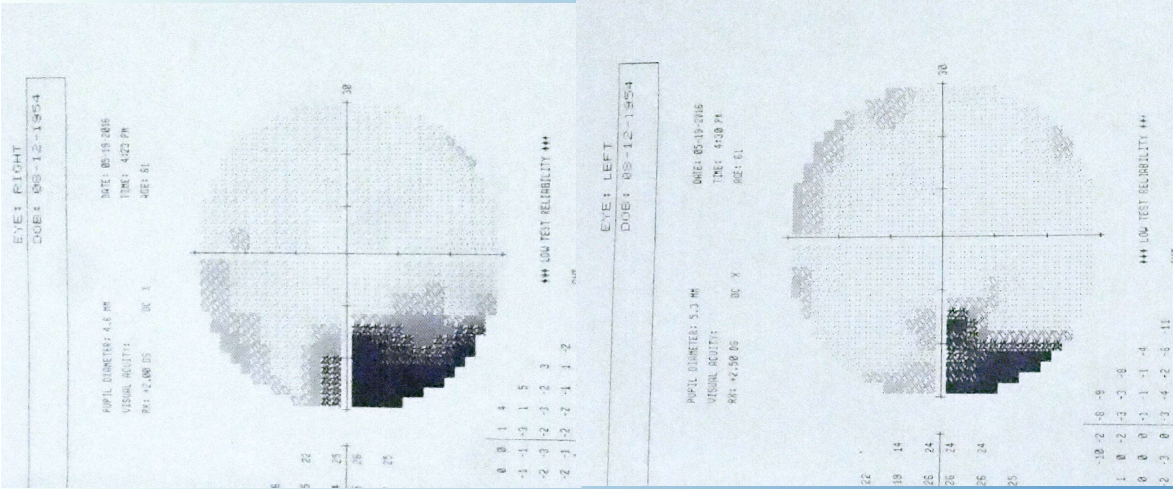
- 58 y.o. male suffered a severe hemorrhagic stroke with decompressive craniotomy in 2013.
- He had left hemiplegia and left homonymous hemianopsia.
- 3 years later he had partial field recovery. He participated in vision therapy with an optometrist who was an FCOVD with no further change.
- He presented for Neuro-Optometric Rehabilitation.
- After 6 hours of in-office NOR (with daily home therapy) he demonstrated significant vision recovery. He returned to driving and work.

Right eye, 2/2016



Left eye, 2/2016

Right eye, 5/2016



Left eye, 5/2016

## VISUAL SPATIAL NEGLECT

- Patients must use their vision for identification and localization.
- Loss of visual-spatial information can be global or just the left visual field. Right visual-spatial inattention is rare.
- VSN interferes with visually guided motor activities.
- VSN is generally related to right-brain damage.
- VSN is often diagnosed using an Optokinetic Drum and is sometimes seen with ocular motor screening.
- VSN can manifest as an ambient processing disorder.

# VISUAL FIELD RECOVERY

- Spontaneous recovery starts within 2 weeks.
- Spontaneous recovery is a strong prognostic indicator for overall recovery.
- Visual field recovery is possible years after a stroke.
- Always start from the midline out.
- Work bilaterally as much as possible.
- Use motor feedback for afferent feedback to the visual system.
- Mirror therapy works.

# USE OF LENSES

- All lenses affect our perception of space.
- Patients who are neurologically compromised can't compensate; they have to see to know.
- Single vision lenses cause less spatial distortion than multifocal lenses.
- Weak prism powers can sometimes reduce visual field impairment. Start with 4<sup>Δ</sup> yoked with the base on the side of the field loss. If no response try 6<sup>Δ</sup>.
- Yoked prism with base opposite the affected field can stimulate recovery for neglect. *This doesn't work with hemianopsia.*

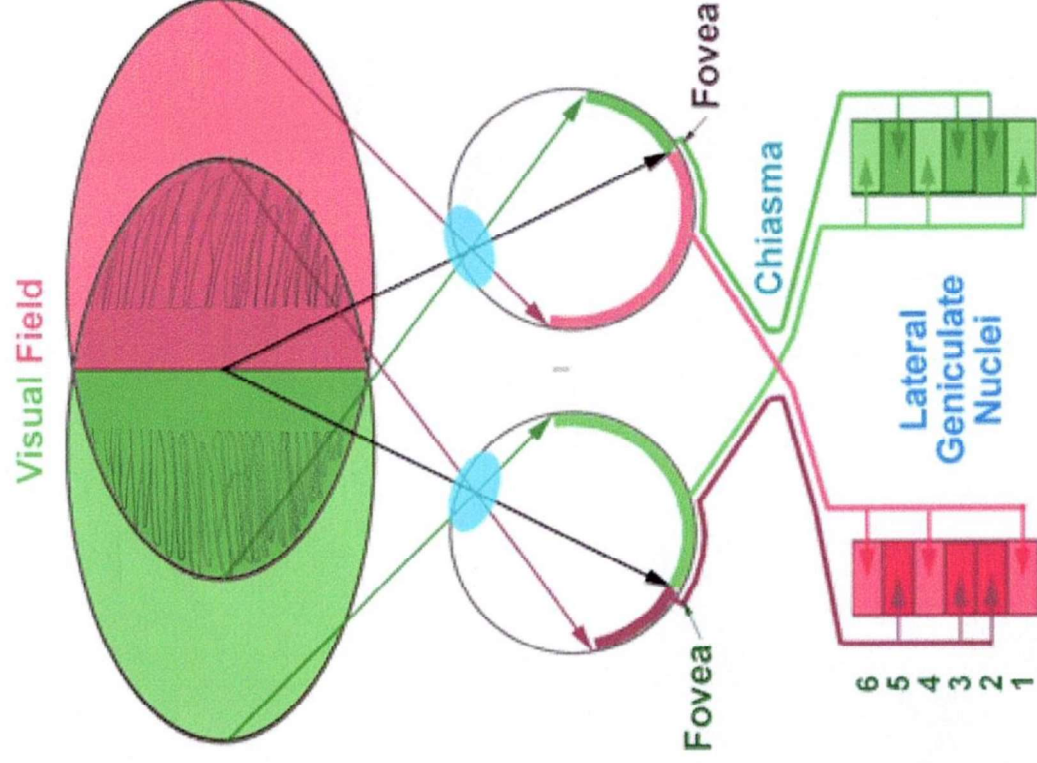
**BNO** is a neurological intervention.

It should not impact sight.

It does reduce visual-spatial confusion.

It does reinforce midline.

It does stimulate vision recovery.



# Visual skills needed for reading

- Acuity - form perception, visual memory.
- Ocular motor - fixations and saccades.
- Accommodation - sustained focusing.
- Convergence - sustained eye alignment.
- Visual language processing.



# Visual skills needed for walking

- Visual-motor integration- rapid motor response to visual stimuli.
- Visual-auditory integration - rapid visual orientation to auditory stimulus.
- Ocular motor - scanning.
- Visual spatial orientation.
- Peripheral vision.
- Depth perception.

# Visual skills needed for driving

- Visual-motor integration - rapid motor response to visual stimuli.
- Visual-auditory integration - rapid visual orientation to auditory stimulus.
- Ocular motor - rapid scanning.
- Visual spatial processing.
- Peripheral vision.
- Depth perception.

# Abnormal egocentric localization: Visual-Midline Shift Syndrome

- Affects balance and mobility.
- AEL / VMSS occurs when the patient has an error in their perception of any midline. This can be caused by brain injury, hemiparesis, neglect, visual field loss, focusing imbalance, strabismus (or amblyopia), uncorrected refractive error.
- AEL/VMSS can be induced by any sensory or motor imbalance and affects balance and coordination.
- Can be corrected with lenses and therapy.

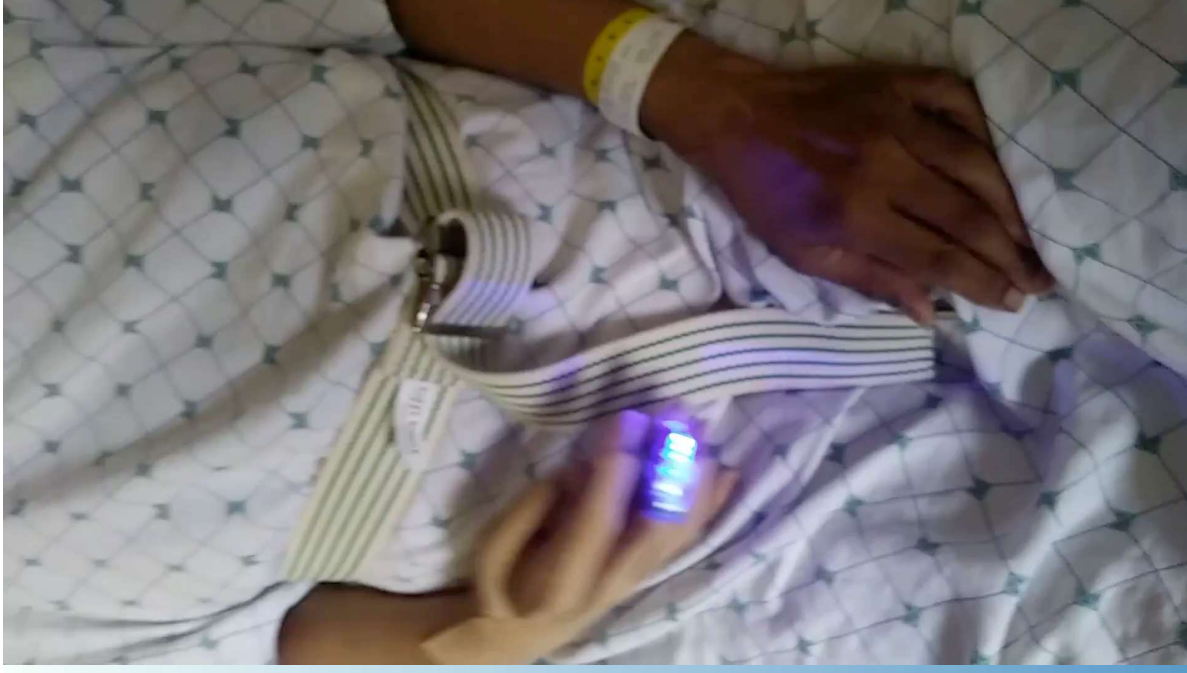


# Visual stimulation of motor skills

- Afferent feedback is needed for recovery after stroke.<sup>5</sup>
- Vision provides 80% of stimulation to the brain.<sup>6</sup>
- Visual feedback can be used for motor recovery.
- Neuro-Optometric Rehabilitation isn't just about vision; it is about recovery of visually guided function.

# Using vision to regain motor function

- Afferent feedback is critical to establishing motor control.
- Vision can be used for afferent feedback.
- Enhancing visual feedback to position and movement can trigger motor control in a hemiplegic patient.



Functional scales for patients are visually based - doctors, nurses and therapists are observing visual function and it's impact when patients are evaluated:

**Eating\*** **Grooming\*** **Bathing\***

**Upper body dressing\*** **Lower body dressing\***

**Toileting\*** **Bladder management, Bowel management**

**Bed to chair transfer\*** **Toilet transfer\***

**Shower transfer\*** **Locomotion\*** **Stairs\***

**Cognitive comprehension\*\*** **Expression\*\***

**Social interaction\*\*** **Problem solving\*** **Memory\***

**\*Visually guided.**

**\*\*Impacted by/impacts vision.**

# Initiating Neuro-Optometric Rehabilitation

1. Identify vision disorders that will impact rehabilitation.
2. Control vision disorders as much as possible with lenses.
3. Make sure your patient has their correct glasses and is wearing them appropriately.
4. Look at the patient's posture and performance. Do the glasses make rehab therapies easier or harder? What can you change right now?
5. Contact other therapists and tell them what you want them to do and not do with the patient.

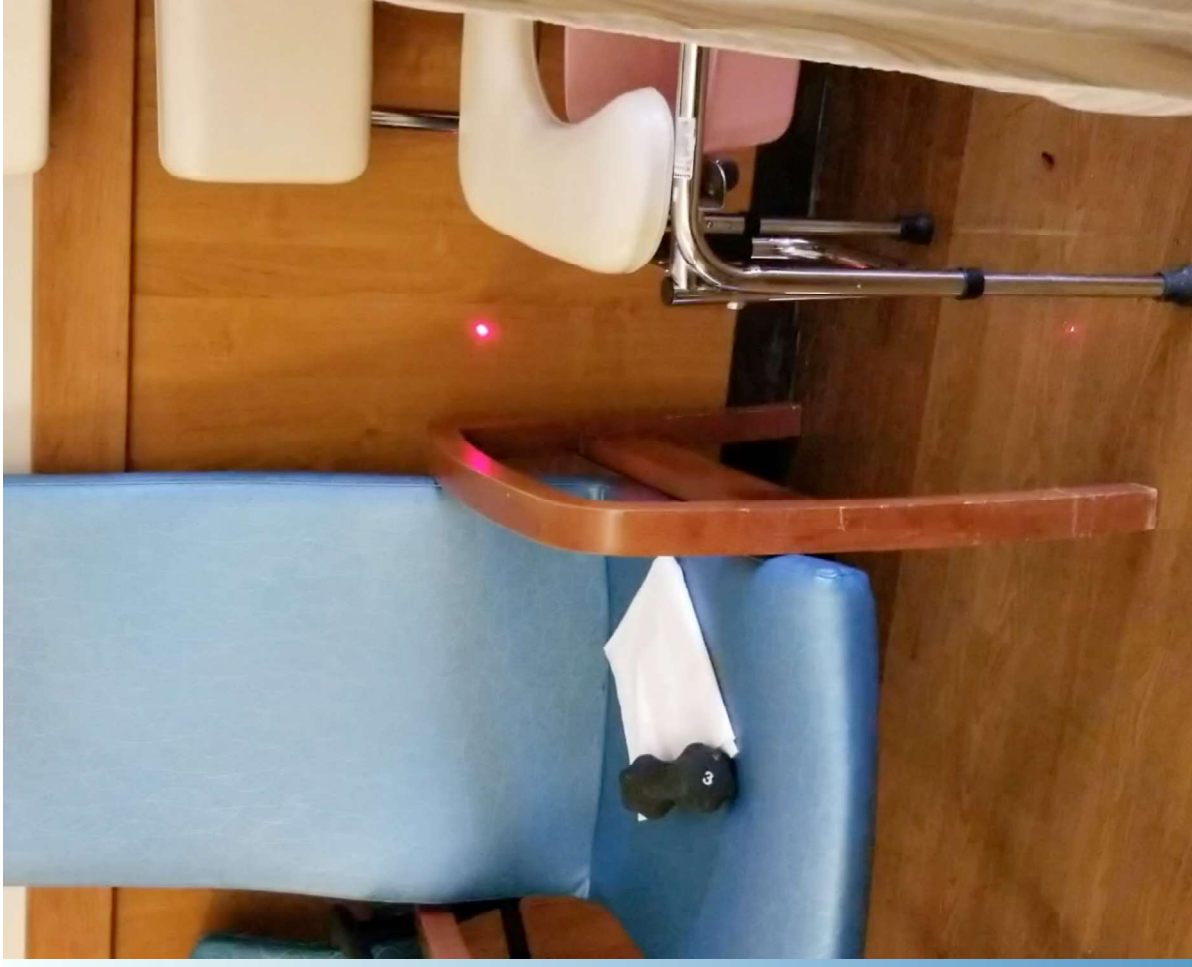
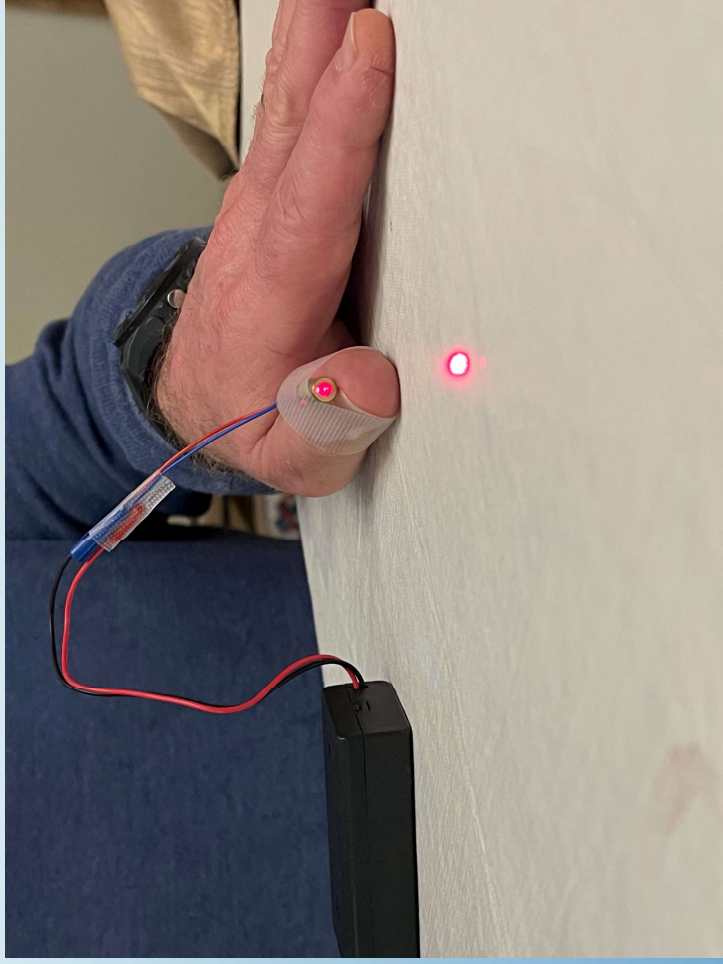
- Use blur patches and bi-nasal occlusion rather than occlusive patches whenever possible.
- Do not assume that any vision disorder will be permanent and unresponsive to treatment.
- Do not assume that the patient will recover without intervention.
- Work bottom up and integrate treatment procedures with other therapies.
- **Teach the patient and caregivers what to practice daily!**



# Therapy Tricks

- Use the Optokinetic Drum for motion detection acuity. And field stimulation.
- Use of backgrounds to stimulate ambient processing will also stimulate visual field recovery.
- Use flashing rings and finger lights to stimulate attention.
- Use mirrors to fill in missing field, establish midline, and regain spatial awareness.
- Use head mounted laser for ocular motor stimulation and localization.
- Use finger laser to stimulate motor recovery.

# Finger Laser



# Mirror Therapy



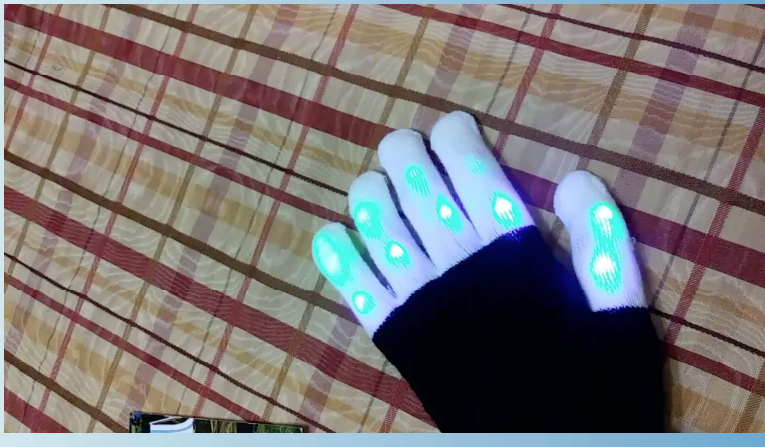
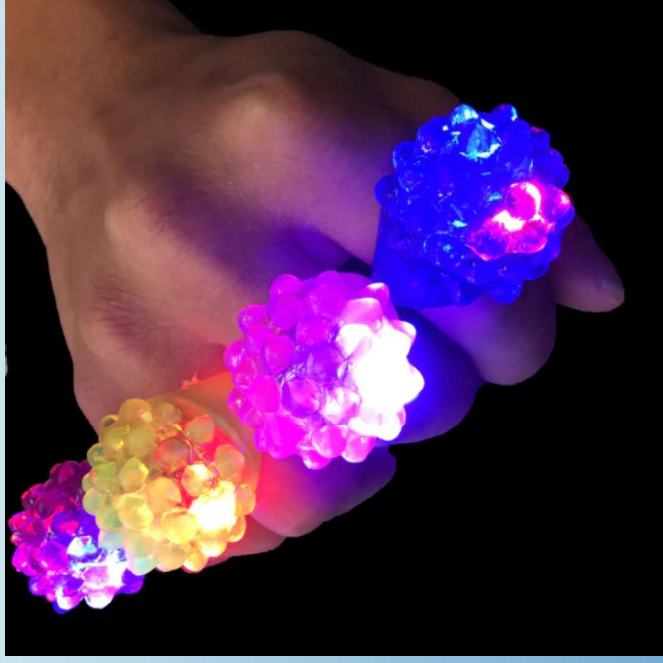
# Rolling Pin



# Can Roll

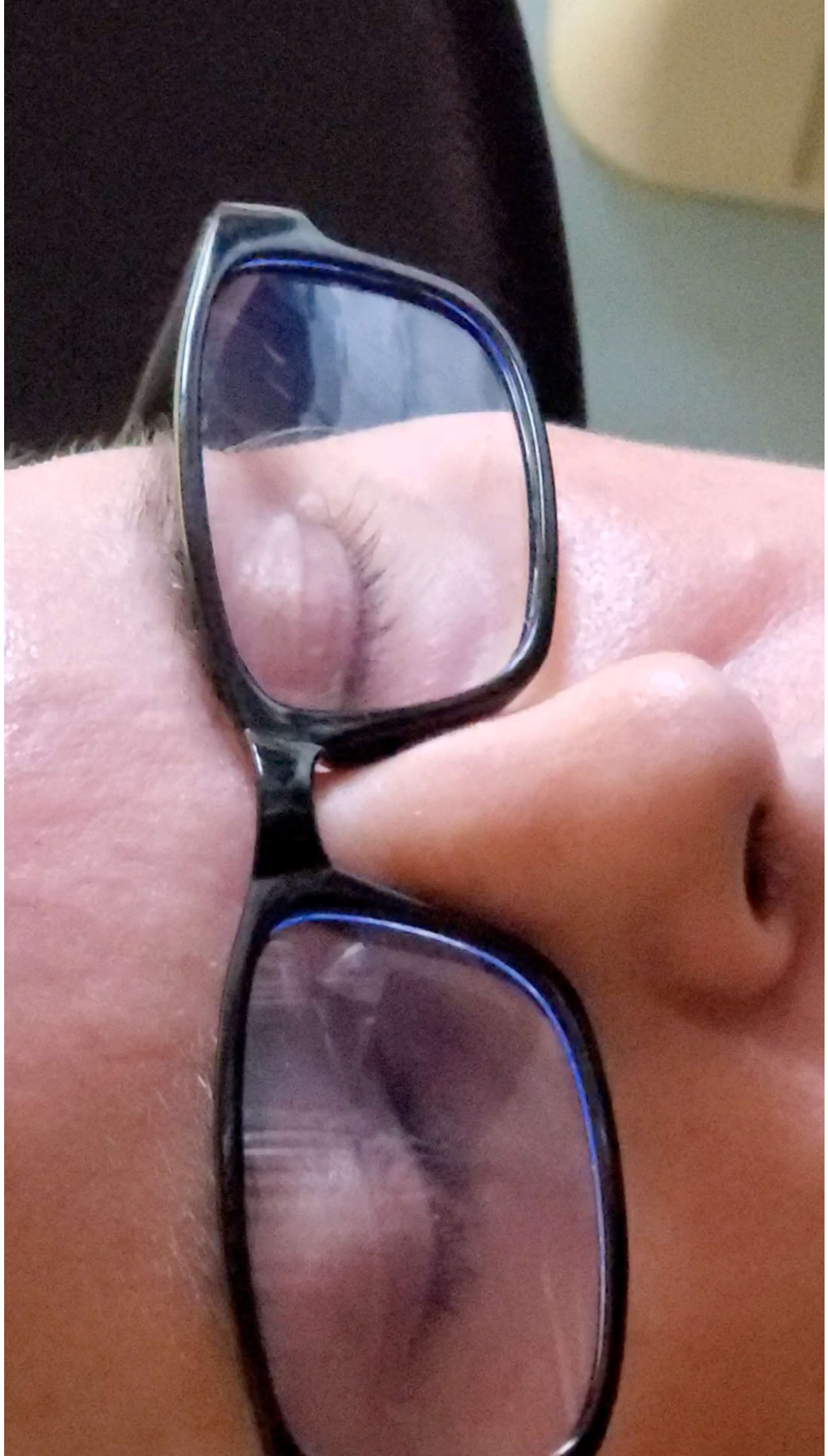


# Finger lights, glow rings, flashing glove



## CASE REPORT - OPTOKINETIC DRUM

- 55 yr F PMH L BG ICH 2/2 sylvian AVM s/p L decompressive hemicraniectomy (8/14), s/p AVM Resection (9/5), s/p cranial debridement and partial closure with PRS (11/22) admitted to NRH on 12/5 presented to WHC ED following a CT head concerning for hydrocephalus.
- Current baseline she is nonverbal but able to follow commands. S/p surgery become progressively less responsive to commands and was transferred back to WHC with CT Head findings for communicating hydrocephalus. Admitted to Neuro ICU.
- On 12/08 R frontal EVD placement @ 5mH20, CTH s/p EVD w R IVH. On 12/13 EVD clamped. On 12/18 IR for DSA, that revealed a small residual nidus. On 12/19 CTH completed ->slight increase in hydro; ICPs 1-2; EVD removed. Admission significant for hypernatremia for which she was given Bolus LR, increased TF FWF due to hypernatremia.
- She gets yearly eye exams and recently started using OTC readers.
- **Presents with dense right inattention.**







# Optokinetic Drum

Tilts, rotates vertically and laterally.

Stripes, checks, picture targets,  
anaglyph. Stimulates form perception,  
binocular vision, ocular motility and  
Peripheral vision.



# Case Report

- 24 y.o. male suffered an hypoxic brain injury with cognitive and cortical visual impairment. Wears +2.00 to “practice reading” on his PC.
- He could not identify any letters, numbers or shapes on a distance acuity chart.
- He had 15 minutes of stimulation with illuminated OK drum using B/W stripes, R/G stripes, checks. Rotation displayed in all directions at eye level, 16 inches from the patient.
- Post-stimulation he was able to identify single LEA symbols down to 20/60.

## Rules for Rehab - FSB

- \*Think about vision loss from stroke like you would for amblyopia and strabismus: **F**orm perception, **S**patial awareness, **B**inocularity.
- \*Your patients have to know what things are and where things are in order to participate actively in their rehabilitation.
- \*They have to remember what they see in order to learn.
- \*They have to be able to use their vision to guide motor function.
- \*They have to be able to integrate vision with auditory and vestibular functions.

## Basic Concepts for Vision Recovery

- \*Research by Dr. Edward Taub provides the foundation for vision recovery after stroke.
- \*Afferent feedback is needed to recover motor function.
- \*Using the patient's own body or their perceptions of themselves is an excellent tool for re-establishing laterality and directionality.
- \*Breaking down visual neglect is important for field and motor recovery.
- \*Use movement or moving targets as much as possible.

- \*Acuity is only one part of vision.
- \*Stationary and ambulatory visual skills differ.
- \*Very few ADL (activities of daily living) skills are *not* dependent on vision.
- \*Impaired vision will interfere with most ADLs.
- \*Impaired vision will interfere with memory - if you didn't see it you can't remember it!
- \*REPETITION REPETITION REPETITION!

## OTHER CONSIDERATIONS

- Look for retinal vascular anomalies including arteriolar sclerosis.
- Look for optic nerve anomalies.
- Ask your patients about nutrition, smoking, and alcohol use.
- Dry eyes? Look for exposure and lagophthalmos.
- Ask about their most recent blood work and encourage them to get regular health care management.
- Use a short report form to give the patient or send to their PCP.

# Footnotes

1. <https://www.cdc.gov/tobacco/campaign/tips/diseases/diabetes.html>

2. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5429867/>

3. American Heart Association. Basic Life Support for Healthcare Providers and Advanced Cardiac Life Support.

4. <https://ijhpr.biomedcentral.com/articles/10.1186/s13584-019-0337-1#:~:text=During 2014-2016, the annual, cases per year>

5. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3659508/>

6. <https://www.brainline.org/article/vision-our-dominant-sense>

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***NEURO-OPTOMETRY IS:  
THE DIAGNOSIS AND TREATMENT OF VISION  
DISORDERS SECONDARY TO DEVELOPMENTAL  
SYNDROMES, STROKE, BRAIN INJURY AND  
NEURO-DEGENERATIVE DISORDERS.***

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