

Stroke Management

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Learning objectives:

1. Interpret with the clinical signs for stroke patients
2. Know the clinical management for stroke patients
3. Be familiar with the rehabilitation for stroke patients
4. Know the optical treatment considerations for double vision
5. Understand prism prescribing theories for hemianopsias
6. Navigate the interprofessional needs in this case type

Cerebrovascular accident (CVA or Stroke)

Acute neurologic injury from:

- **Ischemic cerebral infarction (80%)**
 - Too little blood to supply oxygen and nutrients
 - Thrombosis, embolism, or systemic hypoperfusion
- **Brain hemorrhage (20%)**
 - Too much blood in a closed cavity
 - Intracerebral hemorrhage (ICH) or subarachnoid hemorrhage (SAH)

Epidemiology

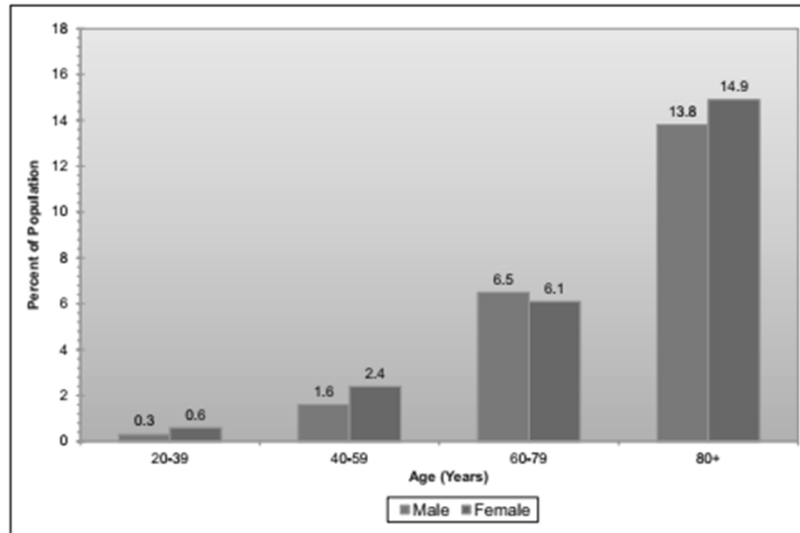
Worldwide:

- 2nd most common cause mortality
- 3rd most common cause disability

US:

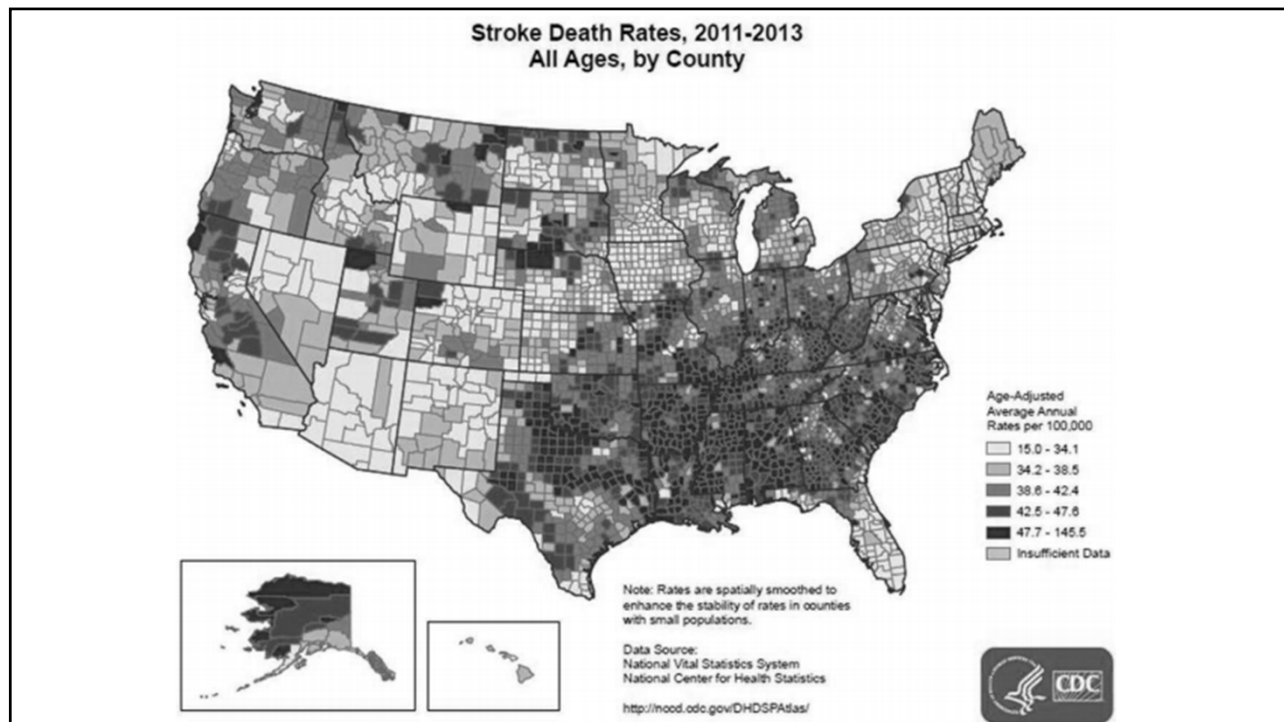
- Annual incidence 795,000
 - 610,000 first-ever strokes
 - 185,000 recurrent strokes
- Men > Women, incidence reverses and higher in women >75yo
- Nearly 7 million stroke survivors in the U.S.
- Stroke is the 5th leading cause of death in the U.S.

Prevalence of stroke by age and sex (NHANES 2011–2014)



Prevalence by area and race

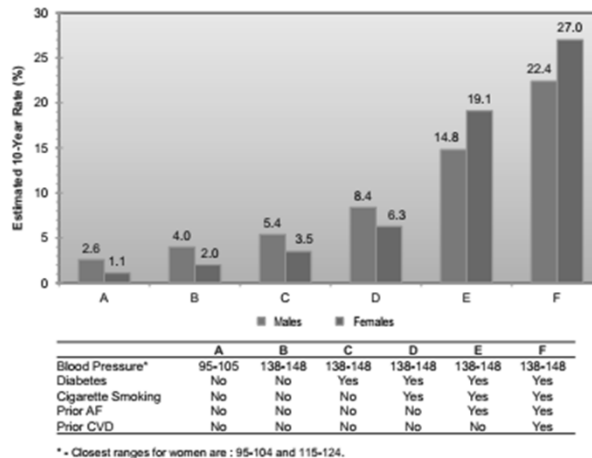
- Stroke belt states: North Carolina, South Carolina, Georgia, Tennessee, Arkansas, Mississippi, Louisiana and Alabama
- Northern Manhattan Study (2005, White et al.)
- Greater Cincinnati/Northern Kentucky Stroke Study (2004, Schneider et al.)
- US Stroke prevalence rates (age 18+) for different ethnic groups:
 - Asian/Pacific Islanders, 1.8 %
 - Hispanics of any race, 2.4 %
 - Non-Hispanic Whites, 2.5 %
 - Non-Hispanic Blacks, 4.5 %
 - American Indian/Alaska natives, 5.4 %



Risk factors

- **Major modifiable risk factors:**
 - Hypertension
 - Diabetes mellitus
 - Smoking
 - Dyslipidemia
 - Physical inactivity
 - (Atrial fibrillation)
 - (Carotid artery stenosis)
- **Unmodifiable risk factors:**
 - Age, ethnicity, sex, family history, and genetics

Heart Disease and Stroke Statistics—2017 Update A Report From the American Heart

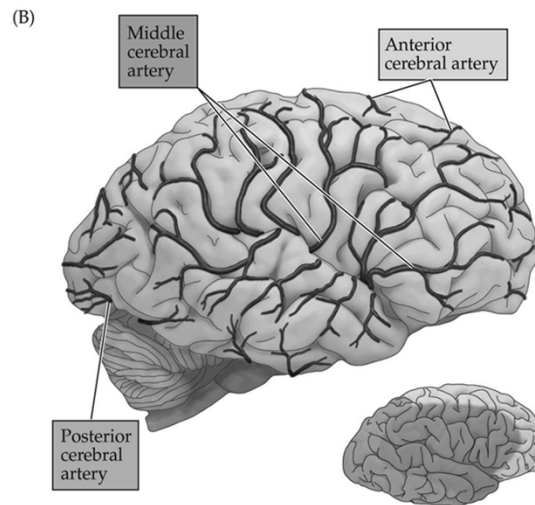


Estimated 10-year stroke risk in adults 55 years of age according to levels of various risk factors (Framingham Study). (1991, Wolf et al.)

Pathophysiologic processes

1. Intrinsic to the vessel (Ischemic thrombotic)
 - Atherosclerosis, arterial dissection, diabetes, hypertension, AVM
 2. Originate remotely (Ischemic embolic)
 - Embolus from heart, endocarditis
 3. Inadequate cerebral blood flow
 - Decreased perfusion pressure or increased blood viscosity
 4. Rupture of a vessel (Primary hemorrhagic)
 - Subarachnoid hemorrhage (SAH) or intracerebral hemorrhage (ICH)
- 1,2 and 3 cause TIAs and Ischemic strokes

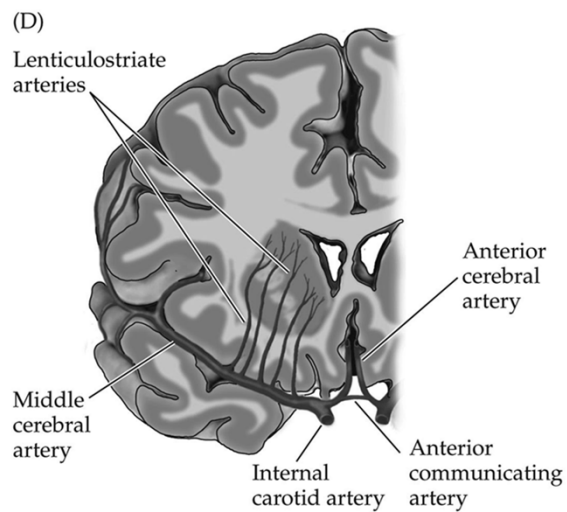
Cerebral blood supply



NEUROSCIENCE, Fourth Edition, Appendix, Figure A16 (Part 2)

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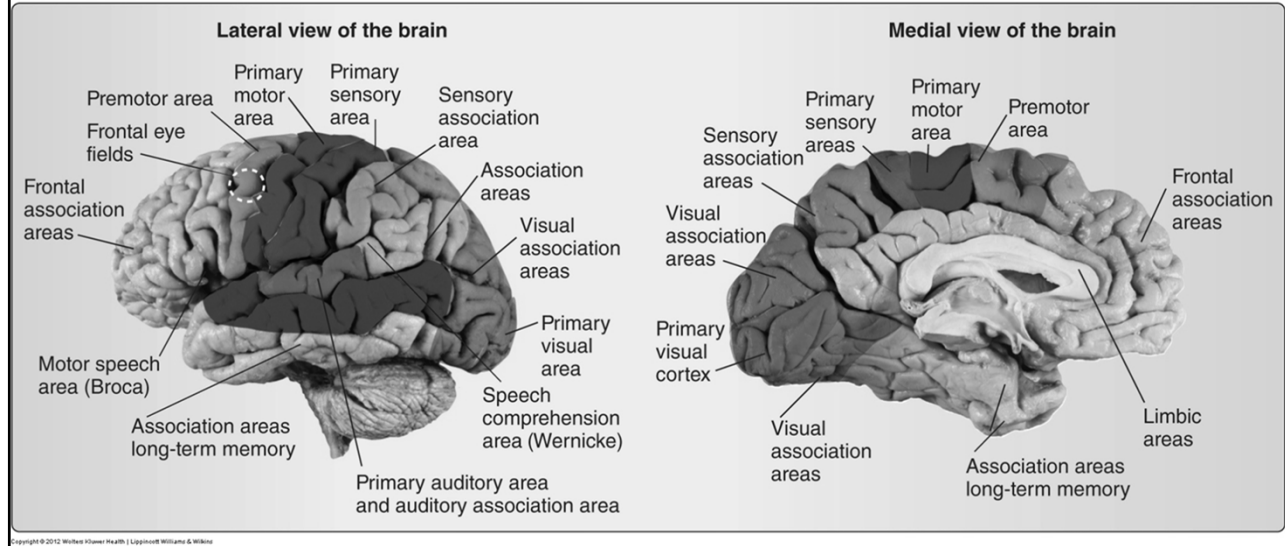
Middle Cerebral Artery (MCA)



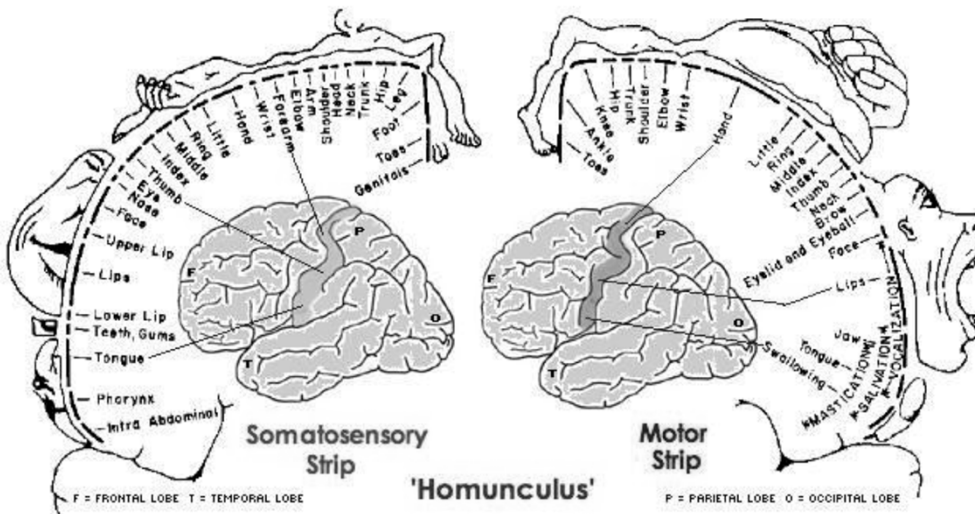
NEUROSCIENCE, Fourth Edition, Appendix, Figure A16 (Part 4)

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Cortical Functions in CVA

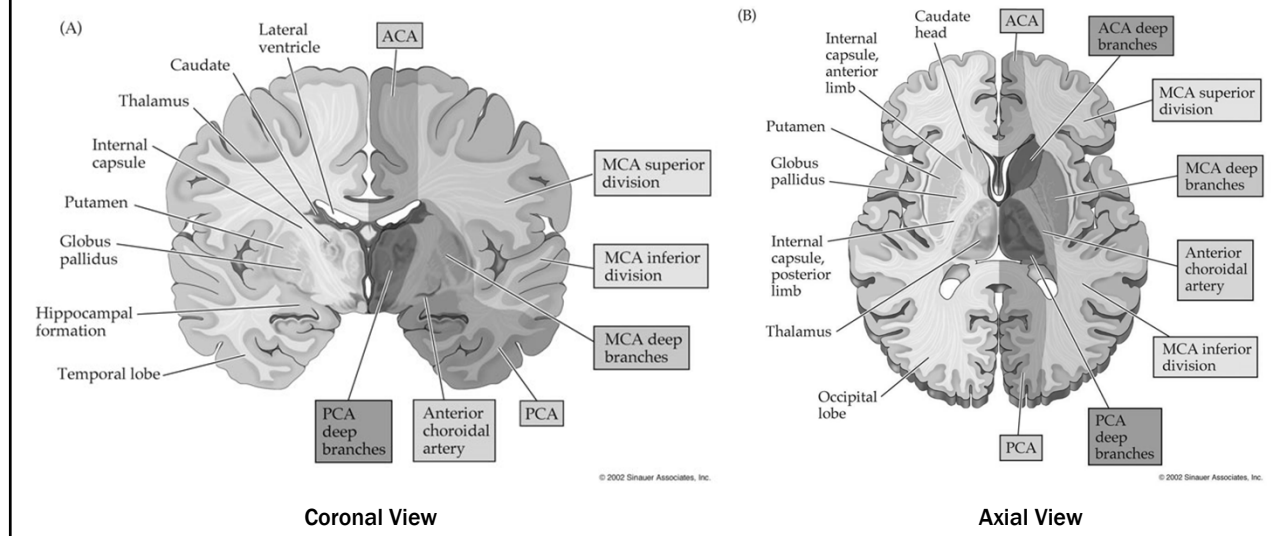


Homunculus



<http://www.emdocs.net/wp-content/uploads/2015/03/homunculus.png>

Acute Ischemic Stroke Syndromes



Anterior cerebral artery

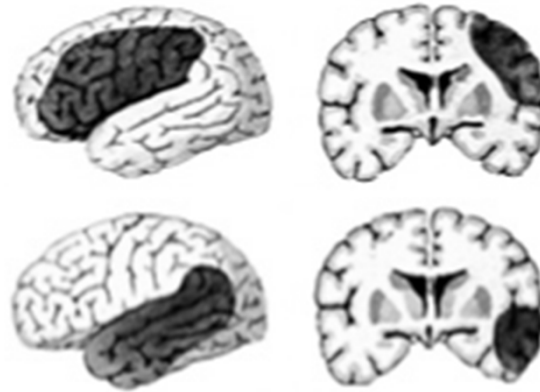
- Mental Status Impairment
- Urinary continence (long duration)
- Contralateral Hemiparesis or Hemiplegia
- Sensory Impairments (contralateral)
- Foot and Leg deficits
- Apraxia on affected side
- Expressive Aphasia (if left hemisphere)
- Deviation of the eyes and head toward the affected side
- Abulia
 - Inability to make decisions or voluntary acts
- Gait dysfunction



<http://www.fpnotebook.com/legacy/Neuro/CV/AntrCrbrlArtryCv.htm>

Middle cerebral artery

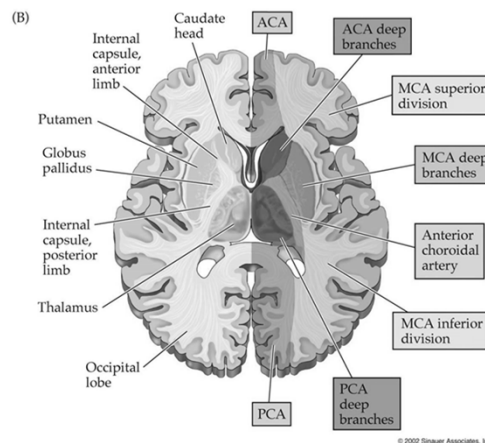
- Dysphagia (if Left hemisphere involvement)
- Dyslexia
- Dysgraphia
- Contralateral Hemiparesis or Hemiplegia
- Contralateral Hemisensory disturbance
- Rapid progression in Decreased Level of Consciousness
- Vomiting
- Homonymous Hemianopia
- Denial or lack of recognition of paralyzed extremity
- Eyes look toward lesion
 - Inability to turn eyes toward the affected side



<http://www.fpnotebook.com/legacy/Neuro/CV/MdICrbrlArtryCv.htm>

Posterior cerebral artery

- Visual Changes
 - Homonymous hemianopia
 - Cortical blindness
 - Lack of depth perception
 - Failure to see objects not centered in visual field
 - Visual Hallucinations
- Memory deficits
- Perseveration
- Dyslexia



<http://www.fpnotebook.com/legacy/Neuro/CV/PstrCrbrlArtryCv.htm>

UpToDate®

Lacunar stroke or internal capsular stroke

- Pure motor hemiparesis (classic lacunar syndromes)
- Pure sensory deficit
- Pure sensory-motor deficit
- Hemiparesis, homolateral ataxia
- Dysarthria/clumsy hand



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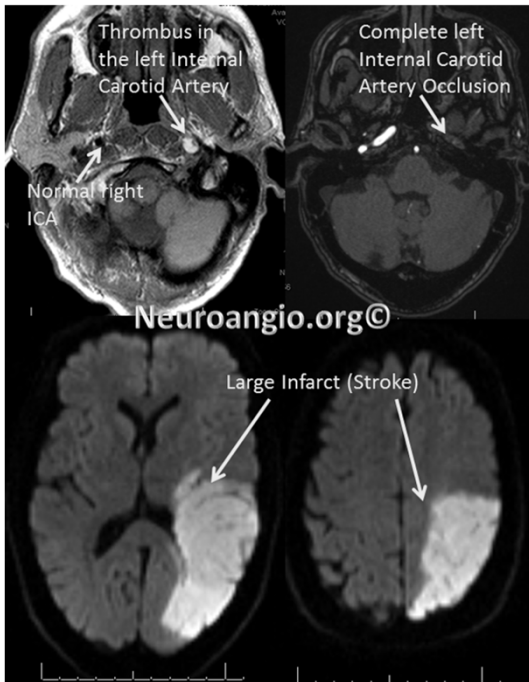
Vertebrobasilar supply

- Cranial nerve palsies
- Crossed sensory deficits
- Diplopia, dizziness, nausea, vomiting, dysarthria, dysphagia, hiccup
- Limb and gait ataxia
- Motor deficit
- Coma
- Bilateral signs suggest basilar artery disease



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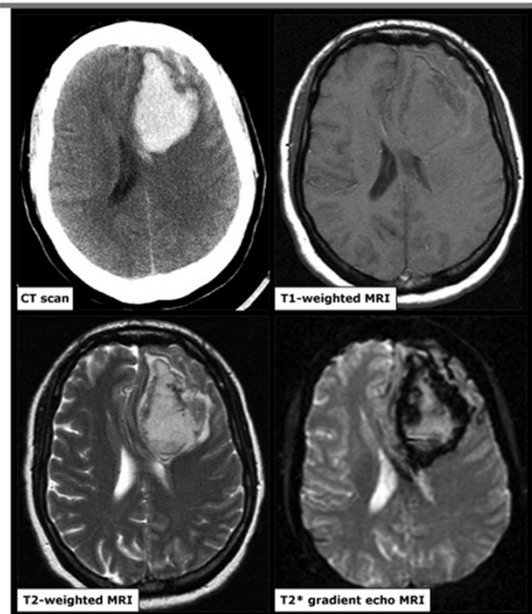
http://www.neuroangio.org/wp-content/uploads/Patient_Information/Dissection/Dissection_20.png

Internal carotid artery

- Progressive or stuttering onset of MCA syndrome
- Occasionally ACA syndrome as well if insufficient collateral flow





Hyperacute intracerebral hemorrhage

UpToDate®



Intracerebral Hemorrhage (ICH)

Signs of stroke

F		F ace is uneven
A		A rm is weak
S		S peech is strange
T		T ime to call an ambulance <small>In the US and Canada, dial 9-1-1</small>

The letters in the word "fast" help you remember the signs of stroke. If a person shows any of these signs, call an ambulance right away. In the US and Canada, dial 9-1-1.

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FAST

Eligibility criteria for the treatment of acute ischemic stroke with recombinant tissue plasminogen activator

- Inclusion criteria
- Clinical diagnosis of ischemic stroke causing measurable neurologic deficit
- Onset of symptoms <4.5 hours before beginning treatment; if the exact time of stroke onset is not known, it is defined as the last time the patient was known to be normal
- Age ≥ 18 years

Artery Involved	CNS Structures Involved	Clinical Syndromes	Etiologies
Carotid Artery Territory			
Anterior choroidal artery	Posterior limb of internal capsule, medial pallidum, head of caudate, lateral geniculate body, optic radiation, medial temporal lobe	Contralateral hemiparesis/hemisensory deficits (face/arm/leg), homonymous hemianopia with sparing of horizontal segment	Focal atherosclerosis Emboli (cardiac, arterial) Aneurysm surgery (ICA)
Anterior cerebral artery	Medial upper frontal and parietal lobes, paramedian hemispheres, anterior corpus callosum, anterior limb of internal capsule, anterior putamen, caudate nucleus	Contralateral weakness (distal leg and shoulder), abulia, mutism, left-hand apraxia (anterior disconnection syndrome), transcortical motor aphasia Frontal release signs, urinary incontinence	Artery-to-artery embolism Cardiac embolism In situ thrombosis (rare) Vasospasm (SAH, drugs) CNS angiitis
Middle cerebral artery Stem: lenticulostriate vessels (M1)	Cortical and subcortical frontoparietal hemisphere Corona radiata, striatum, external and internal capsule (posterior limb), lateral temporal lobe	Contralateral hemisensory/motor syndrome (face/arm/leg), global aphasia with dominant hemisphere involvement, visuospatial neglect when non-dominant hemisphere involvement Contralateral gaze paresis, contralateral homonymous hemianopia Obtundation or agitated delirium	Artery-to-artery emboli Cardiac emboli In-situ thrombosis Focal stenosis Intracranial dissection Vasospasm (SAH, drugs) Moyamoya syndrome
Superior division (M2)	Lateral frontal hemisphere, corona radiata Sparing of structures supplied by lenticulostriate branches (internal capsule, basal ganglia)	Contralateral hemisensory/motor syndrome (face and arm more than leg), motor (Broca's) aphasia with dominant hemisphere involvement, variable visuospatial neglect with nondominant hemisphere involvement	Artery-to-artery emboli Cardiac emboli CNS angiitis Vasospasm (SAH, drugs)
Inferior division (M2)	Lateral temporal lobe, lower parietal lobe, angular gyrus	Contralateral gaze paresis Hemispatial neglect, hemianopia/quadrantanopia, sensory (Wernicke's) aphasia, agitated delirium	Artery-to-artery emboli Cardiac emboli CNS angiitis Vasospasm (SAH, drugs)

https://clinicalgate.com/wp-content/uploads/2015/04/B9780323033541500468_cetable22.jpg

THREE MOST DEVASTATING AND INTOLERABLE VISUAL PROBLEMS RESULTING FROM STROKE

1. Visual field loss
2. Intractable double vision
3. Visual / balance disorders



Etiology of Hemianopsias

ADULTS

- 42-89% cerebral infarction or intracranial hemorrhage
- More common; middle and posterior cerebral artery territory strokes
- Less common; brain tumor, trauma, surgical, other CNS

CHILDREN

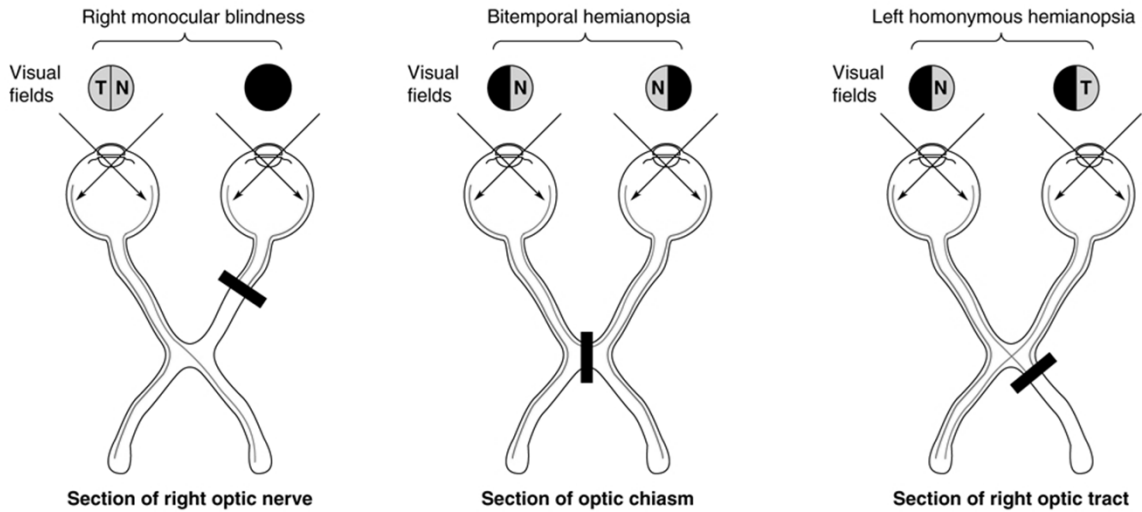
- 39% neoplasms
- 25% cerebrovascular
- 19% trauma

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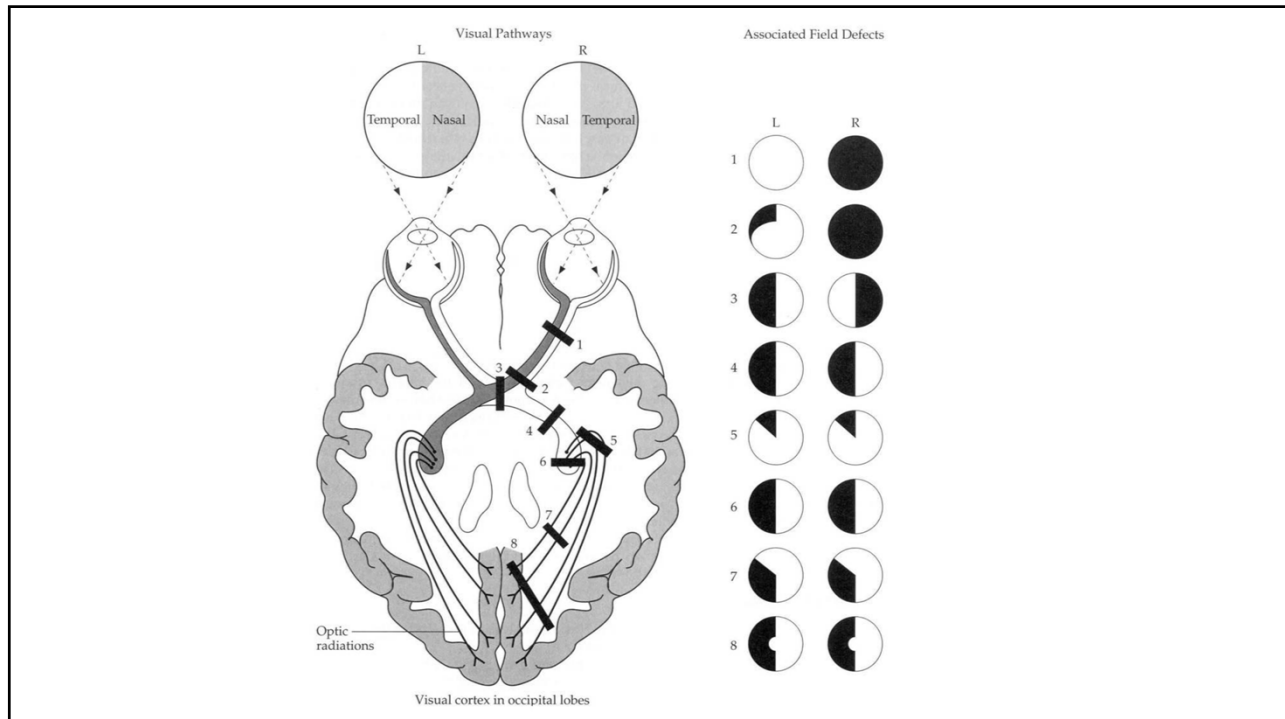
Prognosis

- Spontaneous improvement varies greatly 18-67%
- 46% improved in 3 week from ischemic event (Tiel et al.)
- 67% improved in 1 month from stroke (Gray CS et al.)
- Spontaneous improvement unlikely after 6 months from injury (Levin et al, Bruce et al., Zhang et al)

EXAMPLES of VISUAL FIELD LOSS



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Homonymous Hemianopia Categories

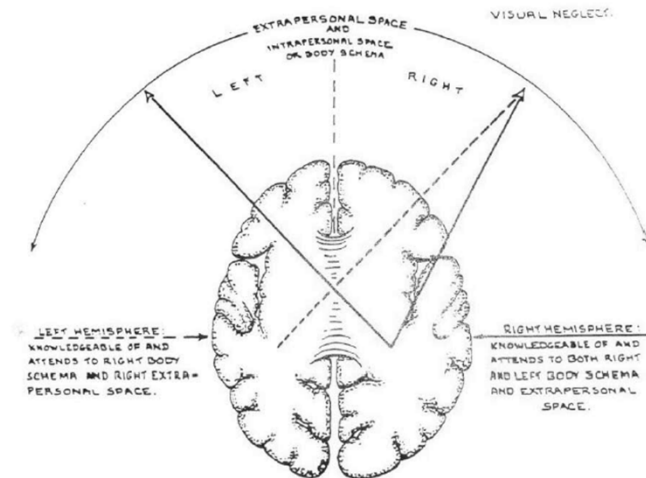
- **Category 1: Hemianopia without Neglect**
- **Category 2: Hemianopia with Neglect**
- **Category 3: Incomplete Hemianopsia with Extinction and mild Neglect behaviors**
- **Category 4: No Hemianopsia, with Extinction and Neglect present**

Ciuffreda K, Suchoff I. A Primer for the Optometric Management of Unilateral Spatial Inattention. Optometry 2004;75:305-317.

Neglect or Unilateral Spatial Inattention (USI)

- Neglect can be present with or without a VF defect.
- **Hemianopsia involves damage to the primary visual pathway.**
- **Neglect results from damage to the processing areas, right inferior (or posterior) parietal cortex**
- **MCA strokes 12-49% right brain 2-12% left brain**
- **Generally speaking, the right cerebral hemisphere is specialized for spatial perception and the left cerebral hemisphere is specialized for language.**

Redundancy on the Right



Suter, P. Peripheral visual field loss and visual neglect. J Behavioral Optometry Vol 18 (2007) page 79.

Extinction similar to neglect?

Incidence of visual extinction after left versus right hemisphere stroke.
Becker E¹, Karnath HO.

- The incidence of visual extinction and of spatial neglect was not significantly different, neither after left hemisphere (2.4% neglect; 4.9% extinction) nor after right hemisphere (26.2% neglect; 24.3% extinction) stroke.
- Visual extinction seems to be as asymmetrically associated with the human right hemisphere as is spatial neglect.

Stroke. 2007 Dec;38(12):3172-4. Epub 2007 Oct 25.

Patient complaints



- Blurred vision in eye same side as field loss
- Some patients are unaware of deficits and continue to drive or want to drive
- Difficulty reading
- Reduced iADLs: dressing, eating, cosmesis
- Ambulation on one side more than the other
- Seeing only parts, not the whole
- Social concerns

Safety Concerns

- Increased fall risk
- Poor path planning
- Bumping into obstacles
- Driving
- Potentially being struck by a motor vehicle when crossing the street
- Strike one's head on a cupboard door
- Shaving resulting in cuts

Basic Protocol

Inpatient setting

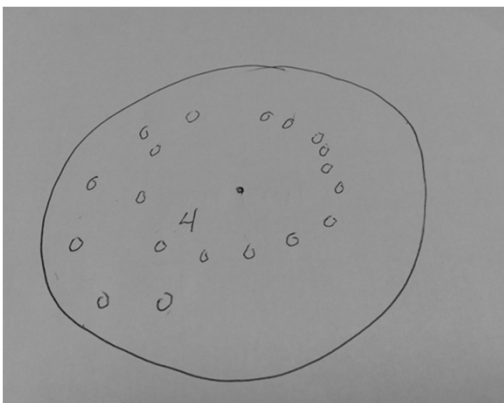
- Confrontations: Single and Simultaneous, Facial Amsler, Red cap comparison
- Observe eye movements, R/L gaze preference, head turn, neglect behaviors
- Clock draw, line bisection, visual perceptual midline, pointing skill
- Blink to threat, Wernicke's pupil, Yes/No

Outpatient setting

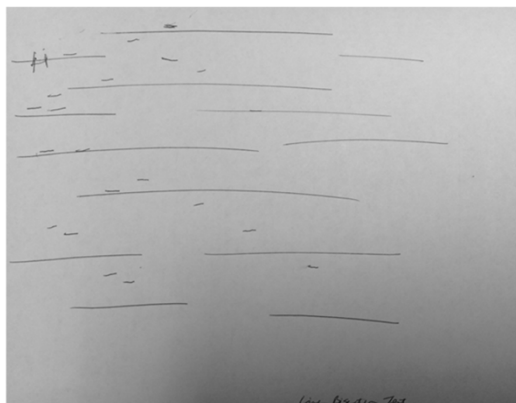
- Confrontations: Single and Simultaneous, Amsler Grid
- Observe eye movements, R/L gaze preference, head turn, neglect behaviors
- Humphrey Sita-Fast 30-2
- Gait observation (DGI)

Behavioral assessment

Clock Draw



Line Bisection



Compensatory and Adaptive Treatment

- Compensation (use intact function):
 - scanning strategies (ODs and OTs)
 - computerized training ie. *Dynavision*
 - head turn towards field loss, tactile/visual 'anchors'
- Field expansion lenses:
 - with inattention:
 - Yoked prisms
 - Mirrors (ambulation)
 - without inattention:
 - Sector/Peli prisms
 - Spotting prisms/InWave prisms

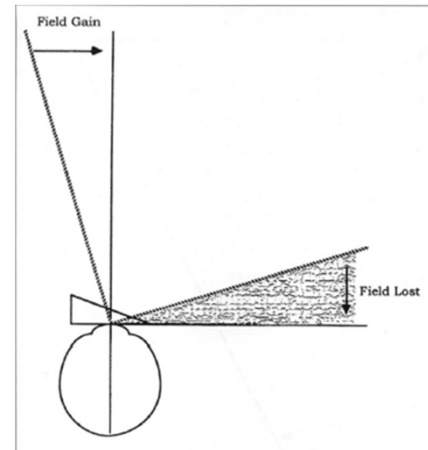


Figure 3 As a result of the yoked prisms, targets in the left compromised field are moved more toward the right uncompromised field. However, there is a corresponding loss of the peripheral right field. The extent of the loss depends on the strength of the yoked prisms. (After Cohen & Weiss.²⁹)

Yoked prisms (for neglect) – Ground In

- 1 degree shift is achieved with approximately 2[^]prism diopters
- Base is towards field loss ie. Base Left for Left Hemianopsia
- Chromatic aberration and non-uniform magnification
- 6 to 8 prism diopters for each eye is a good starting point (up to 10)
- Base is written relative to the patient, use 'In/Out' to avoid lab errors
- Reserve larger prism amounts for therapy or sitting task, also heavy
- Gait testing, caution with ambulation until habituation
- Add 10% grey/brown tint to reduce reflection related symptoms

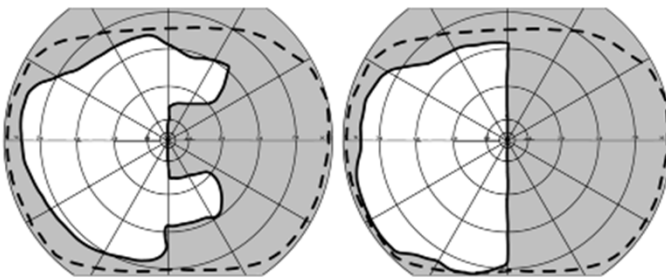
Sector (Fresnel or Chadwick) Prism

- Sector prisms are typically 12Δ (6°)
- Patient needs to scan into prism
- Not ideal for neglect
- Diplopia when scanning; should be brief
- Once object is spotted, pt turns head



Peli Prism System (mounted or clip-on)

- Improves patient-reported detection and mobility
- 2 year multicenter, placebo-controlled trial
- Peripheral prism segments (40D or 57D, oblique or horizontal) fit above and below the line of sight expand the blind field 20° to 30° in all horizontal positions of gaze



Spotting (Gottlieb) prism

- Small round wafer of base out prism on the blind side of the visual field loss
- Shift the image into the patient's still functional field as the patient makes natural scanning movements
- Gottlieb VFAS are 18.5Δ (10°)
- Amplifying the effect of scanning to the blind field

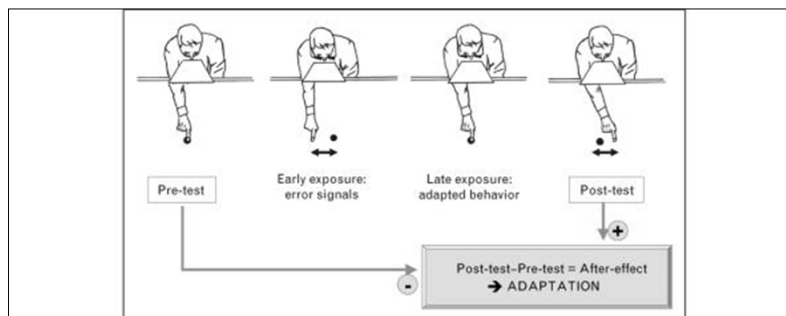


Patient fit with a Gottlieb VFAS on the right lens to treat a right homonymous hemianopsia

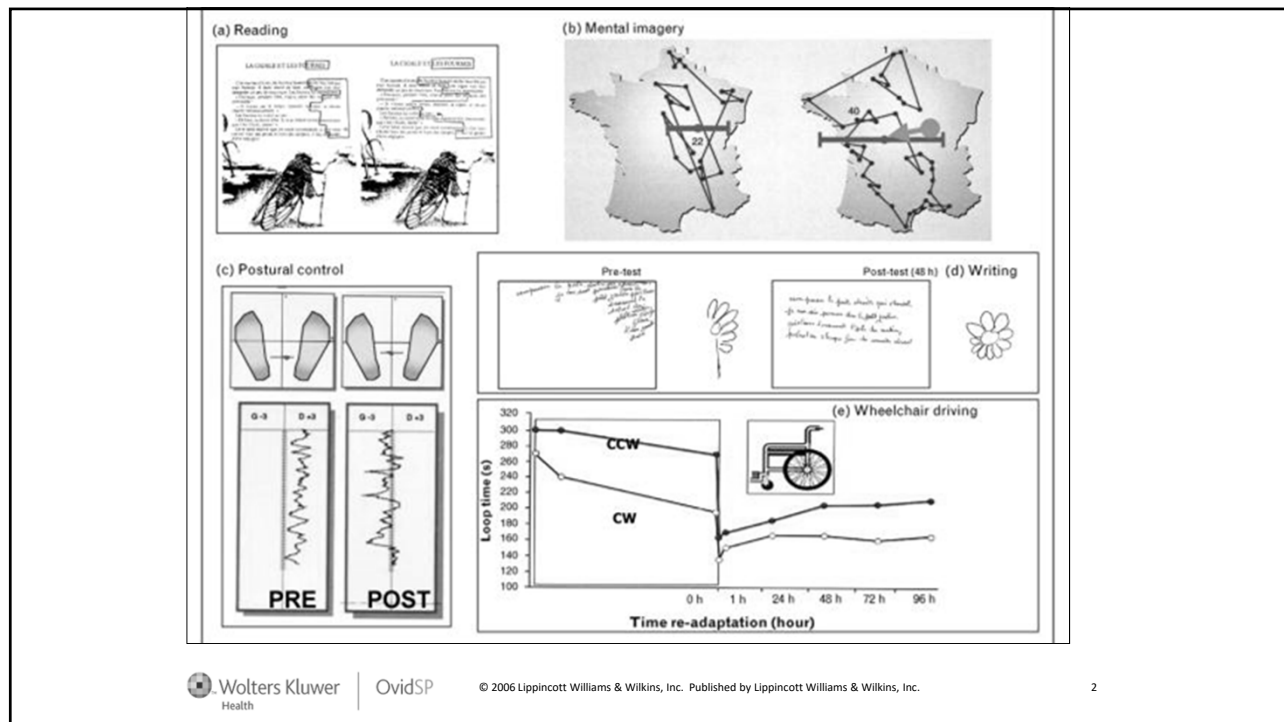
Yoked prism adaptation for neglect

“Prism adaptation can be considered the most-promising rehabilitation method for unilateral neglect to date, especially in light of the fact that spontaneous recovery from neglect is very limited.”

Pisella et al., 2006 “Prism adaptation in the rehabilitation of patients with visuospatial cognitive disorders”, *Current Opinion in Neurology*



A proper prism adaptation session should include three periods: pre-tests, prism exposure and post-tests. During the early phase of the exposure, error reduction (mainly accounted for by the strategic component) does not imply that prism adaptation is already effective. The post and pre-tests, optimally performed with nonexposed targets, are used to compute the amount of after-effect, i.e. proper adaptation.



Driving (OT/CDRS)

- Some patients are unaware and continue to drive
- DL requirements vary by state
- Binocular field of at least 120° horizontal and 40° vertical is suggested. (Intl Council Ophthalmology)
- Refer for driving eval (CDRS)
- Patient will need report to reinstate license
- Binocular visual fields



Various restrictions could be imposed...

1. Limitation to daylight driving
2. Restriction to a radius of miles from home
3. Restriction to familiar areas
4. Speed limitation
5. No highway driving
6. Requirement of more frequent testing, based on the prognosis of the condition

Cases

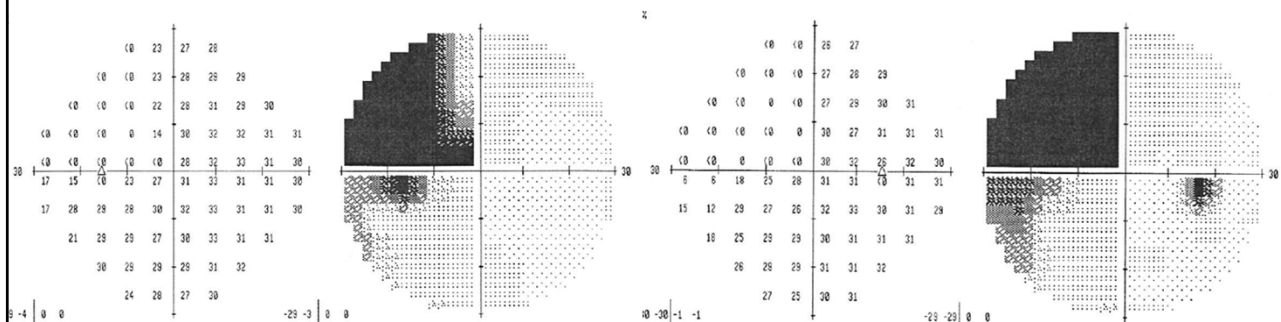
Case 1 – History

- 23 yo HM AVM rupture temporal lobe with hematoma s/p evacuation 1/8/15, R frontal lobe craniotomy 2/27/15, subacute infarction of the R internal capsule and L thalamus with L hemiparesis.
- CC: Blurry vision OS > OD
- HPI: Left parieto-occipital hemorrhagic stroke 10/13, Treated at Keck USC Med Ctr.
- OH/MH: Seizures, dysphagia, L-sided weakness
- Meds: Claritin, Keppra
- Alls: NKDA

Case 1 – Pertinent Findings

- DVA cc 20/20 right eye 20/40 left eye
 - OD plano
 - OS +2.25-5.25 x 172
- No ophthalmoplegia
- Eye movements were jerky and dysmetric on L gaze
- Superior left quadrantanopsia
- Low left facial weakness

Automated Visual fields (HVF 30-2 Sita Std)



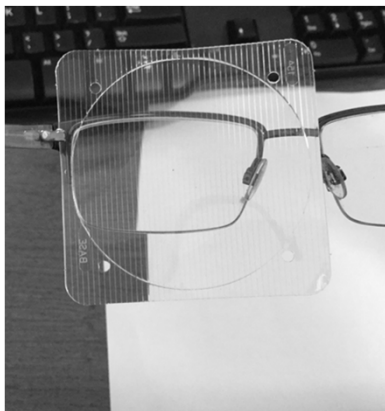
**Case 1 - Yoked prism trial
(6[^]Base In OD, 6[^]Base Out OS)**



**6 prism
base left**

**Shifts vision ~
3 degrees**

**Case 1 - Sector Prism trial
(15[^] Base Left OS)**



**1 line VA loss
per 5[^]Prism
Diopters**

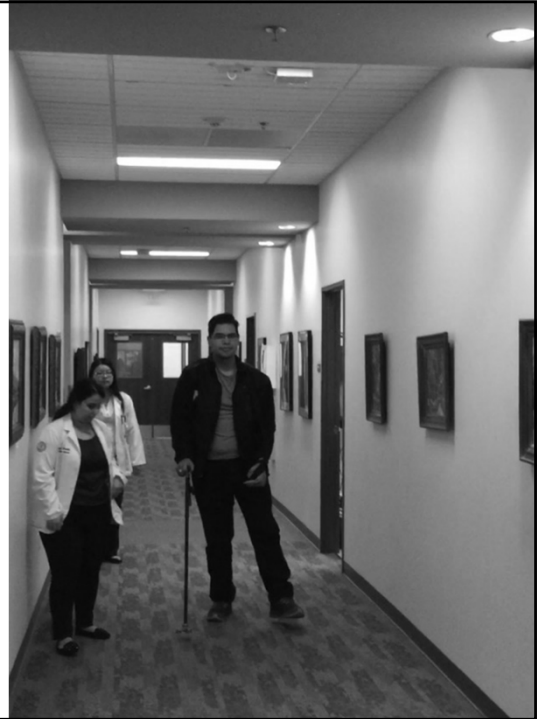
Observe ambulation

Dynamic Gait Index (DGI)

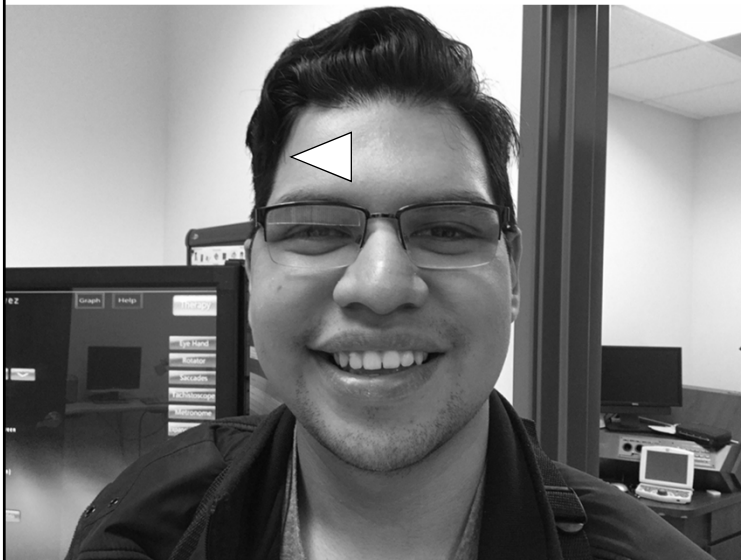
Validated tool to assess fall risk

Abbreviated version is 4 items:

1. Walk 20 feet
2. Change speed
3. Walk with H head turns
4. Walk with V head turns



Case 1 – Peli style Fresnel prisms (25° Base Left OD)



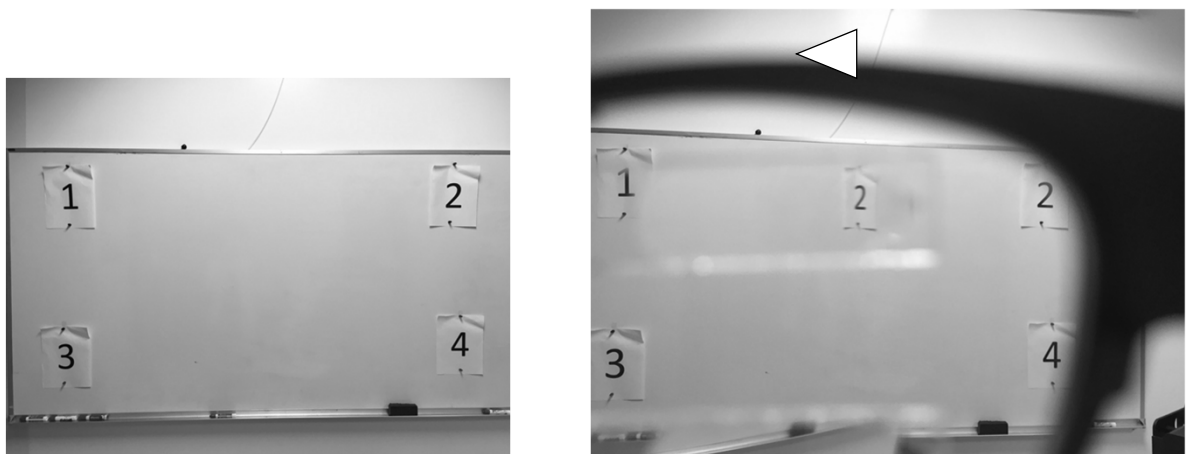
Applied to the top portion only because he could not tolerate walking with the bottom portion

The patient preferred the spotting prism over his dominant eye (OD)

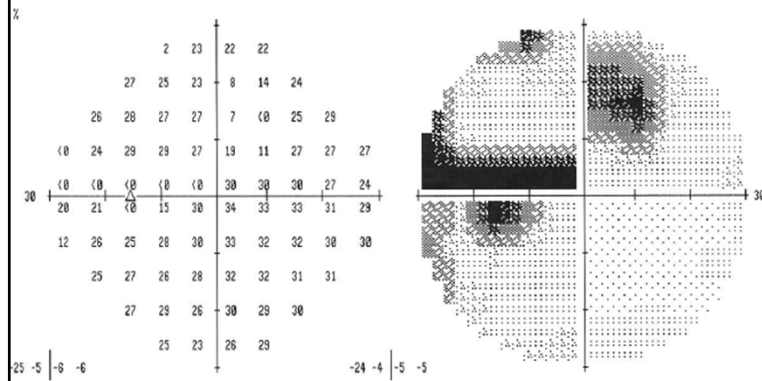
Case 1 - Peli clip-on (40^ Base Left OS)



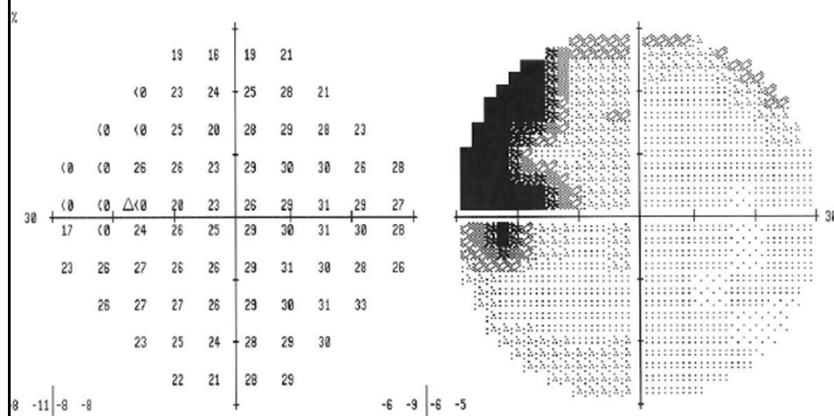
Patient's view through the Peli Prism



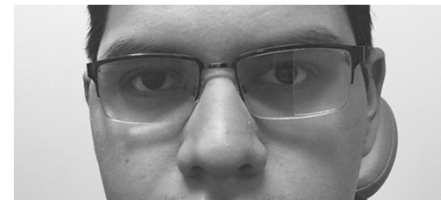
(HVF 30-2 Sita Fast OS)



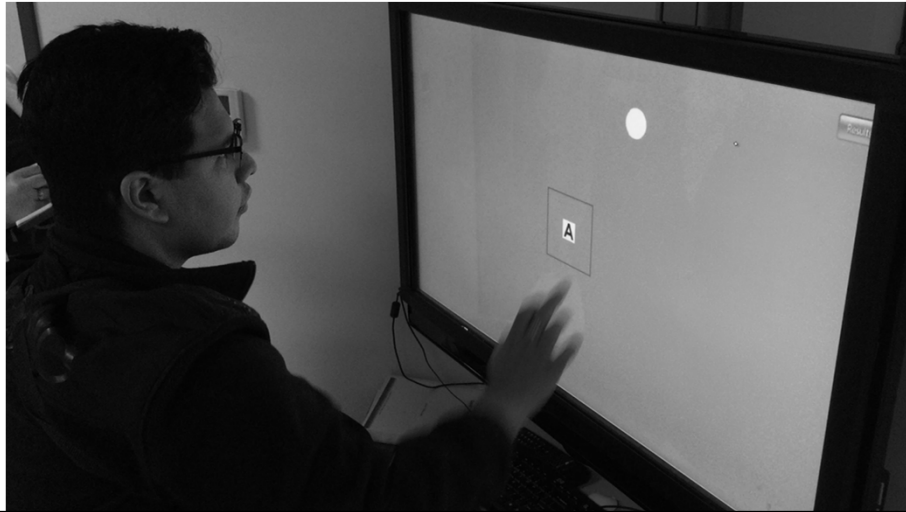
(HVF 30-2 Sita Fast OS)



With Sector prism



Final Selection



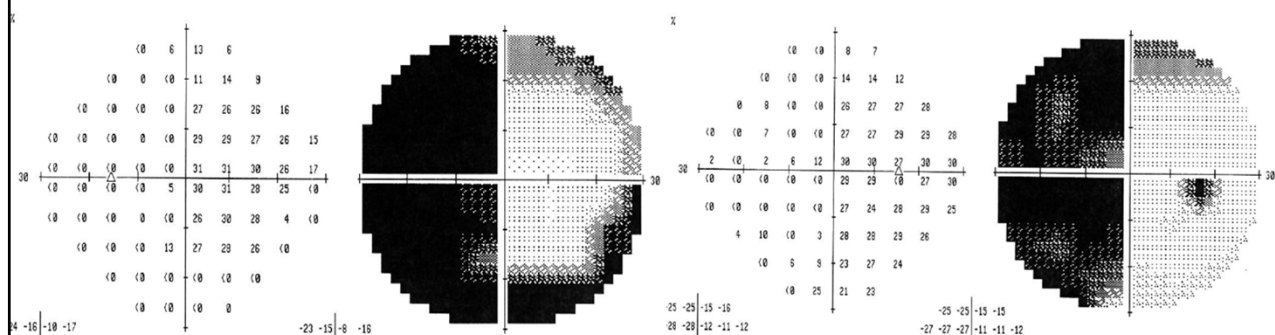
Case 2 – History

- 79 yo WF Previous R occipital stroke 10/15 and recent R MCA territory infarct 2/16 with L hemianopsia and L hemiparesis,
- CC: Eyestrain, intermittent diplopia and dizziness
- OH/MH: POAG, Pseudophakia, HTN, T2DM, Hyperlipidemia, Parkinsonism
- Meds: ASA 81mg, Atenolol, Cozaar, Glipizide, Levodopa, Losartan, Plavix
- Alls: Codeine

Case 2 – Pertinent Assessments

1. Left homonymous hemianopsia with macular sparing
2. Primary open-angle glaucoma OU
3. Type 2 diabetes without retinopathy OU
4. Pseudophakia OU
5. Intermittent double vision due to convergence palsy
6. Parkinsonism with intact supraversions and saccadic eye movements

Automated Visual fields (HVF 30-2 Sita Fast)



Homonymous Left Hemianopsia without neglect

Prism trial protocol

1. Yoked prisms (6-8[^]) better for neglect and perceptual shifts
2. Sector prisms (Fresnel) not good for neglect
3. Peli Prisms (Fresnel or clip-on) nonspecific

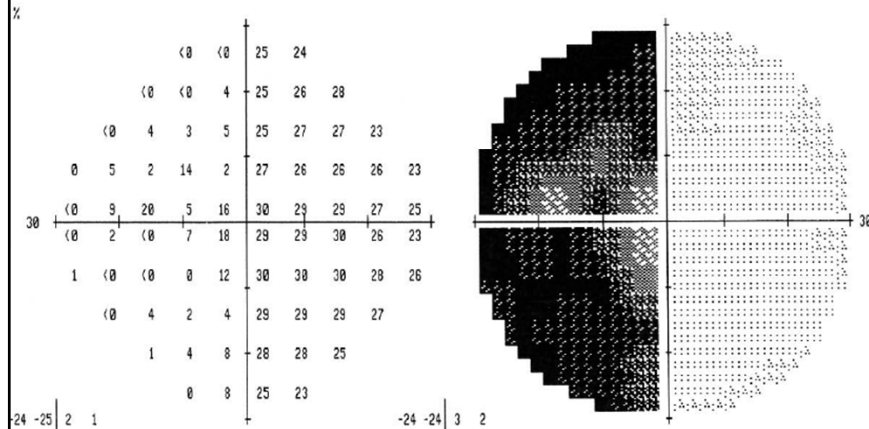
40[^] Peli



15[^] Sector



(HVF 30-2 Sita Fast OS)

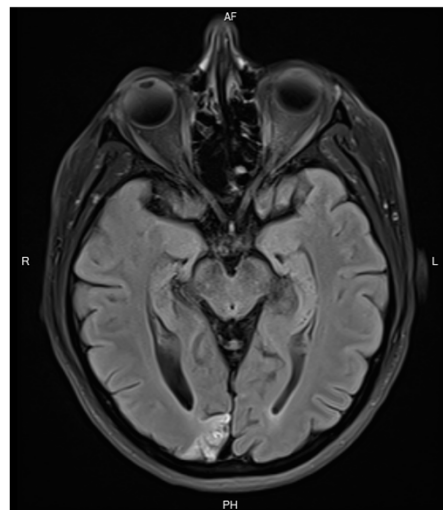


VFI 48% to 65%
MD -16.84 to -11.25 (5.6 dB improvement)

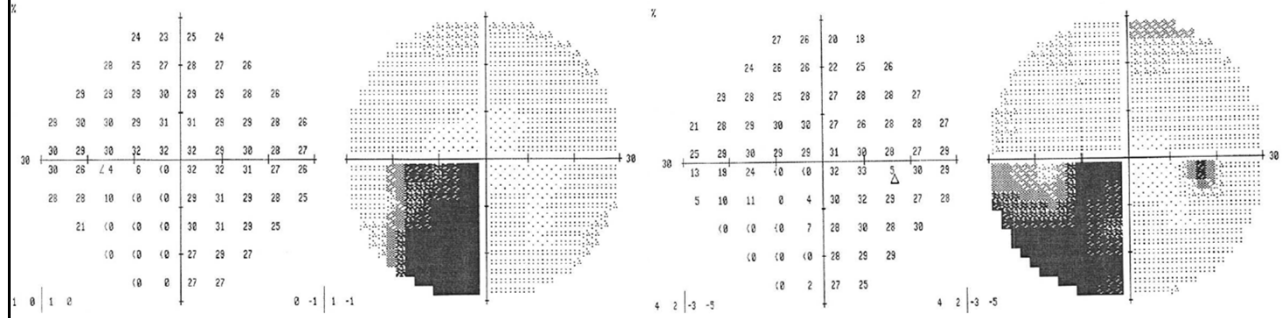


Case 3: Background

- 71 yo WF h/o HTN and hyperlipidemia
- R occipital infarction 8/2015
- Treated with tPA within 1 hour with inferior L quadransopia and L-sided numbness

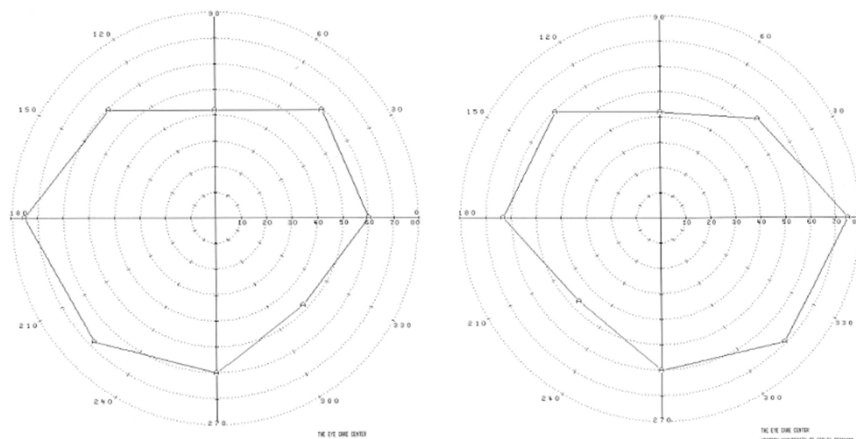


Case 3: 6 mos post CVA (minimal change)



Inferior Left Quadrantanopia without neglect

SSA Kinetic Fields



SSA
Efficiency
Score 94%
OD and OS

Charles Bonnet Syndrome (CBS) and hemianopsias

- One study found 16 of 120 patients had complex visual hallucinations in the hemianopic field (Kolmel et al.)
- Can be static, moving, formed
- Usually not associated with auditory
- Diagnosis of exclusion, in absence of psychoses

Learning objectives recap

- ✓ 1. Interpret with the clinical signs for stroke patients
- ✓ 2. Know the clinical management for stroke patients
- ✓ 3. Be familiar with the rehabilitation for stroke patients
- ✓ 4. Know the optical treatment considerations for double vision
- ✓ 5. Understand prism prescribing theories for hemianopsias
- ✓ 6. Navigate the interprofessional needs in this case type

Summary

- Categorized hemi defects with neglect and extinction
- Reviewed protocols to evaluate field loss and neglect
- Calculated prism magnitude and direction
- Fitting system: Yoked, sector Fresnel and Peli
- Rehabilitation options for safety and function

THANK YOU

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