NEURO-OPHTHALMOLOGY

Joshua Christy
Windsor School of Medicine, MS-4
May 25, 2018

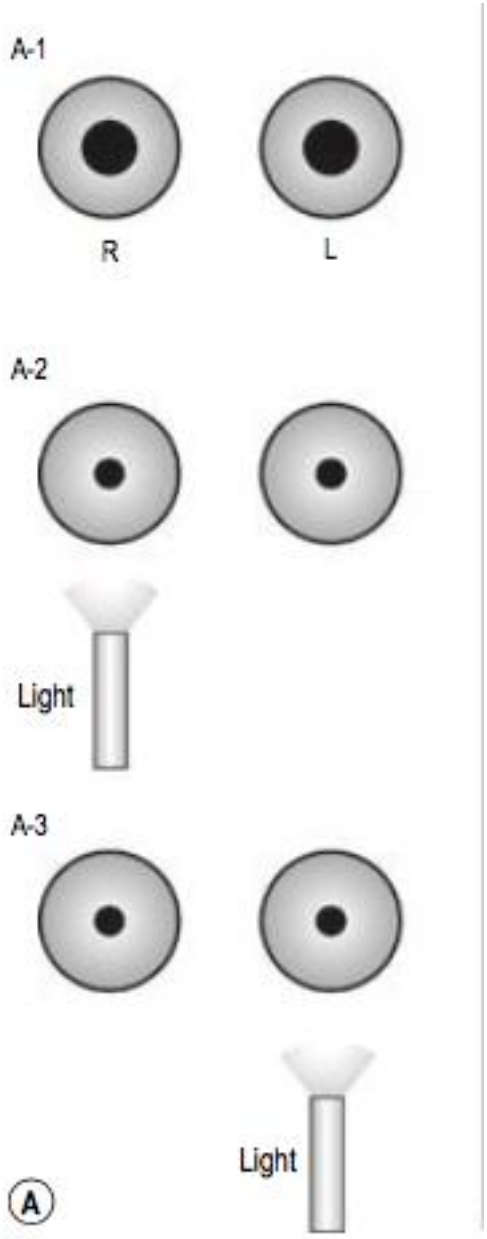
OBJECTIVES AND TOPICS

- Pupillary Light Reflex
  - Marcus Gun Pupil
  - Accommodation Reflex
  - Argyll Robertson Pupil
- Oculomotor Nerve Palsy
- Anisocoria
  - Adie's Tonic Pupil
  - Horner's Syndrome
- Saccadic Eye Movements
- Progressive Supranuclear Palsy
- Nystagmus
  - Central Vs. Peripheral
  - Downbeat
  - Upbeat
  - Torsional
  - Vertigo

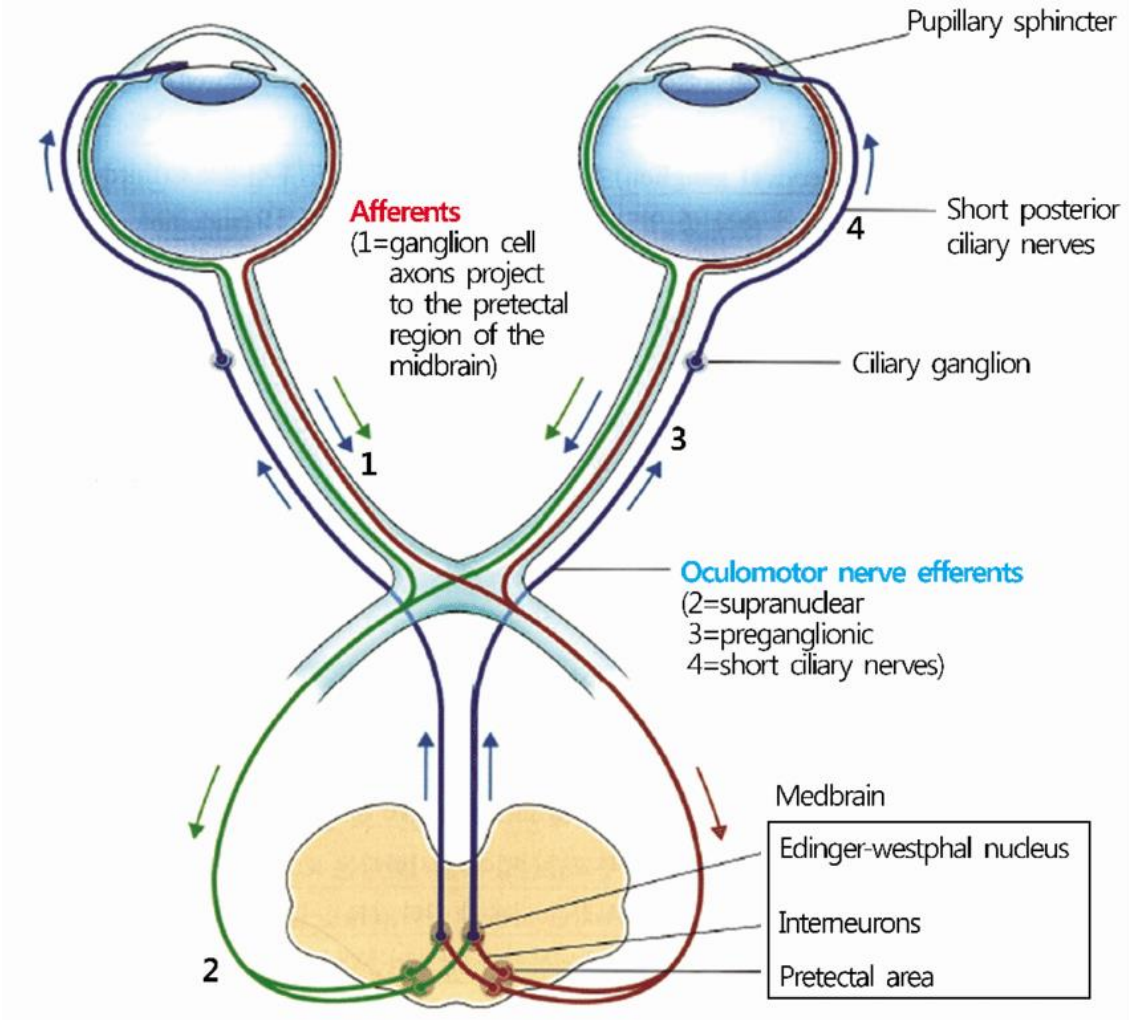
NORMAL PUPILLARY RESPONSE

- Shine light in one eye
  - ipsilateral constriction = direct response
  - contralateral constriction = consensual response

- Why both eyes react?
  - Light in one eye will reach both Edinger-Westphal nuclei



PUPILLARY LIGHT REFLEX



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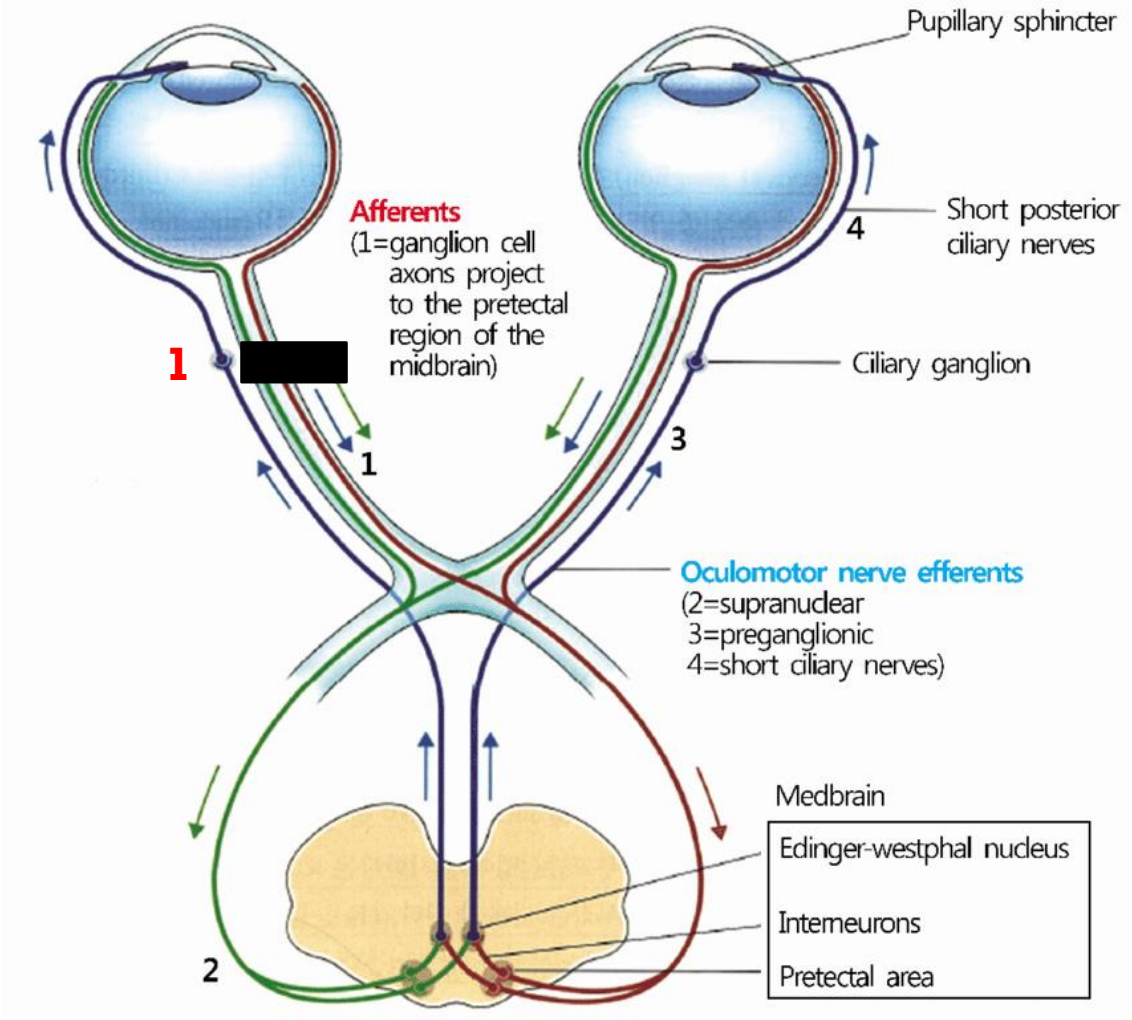
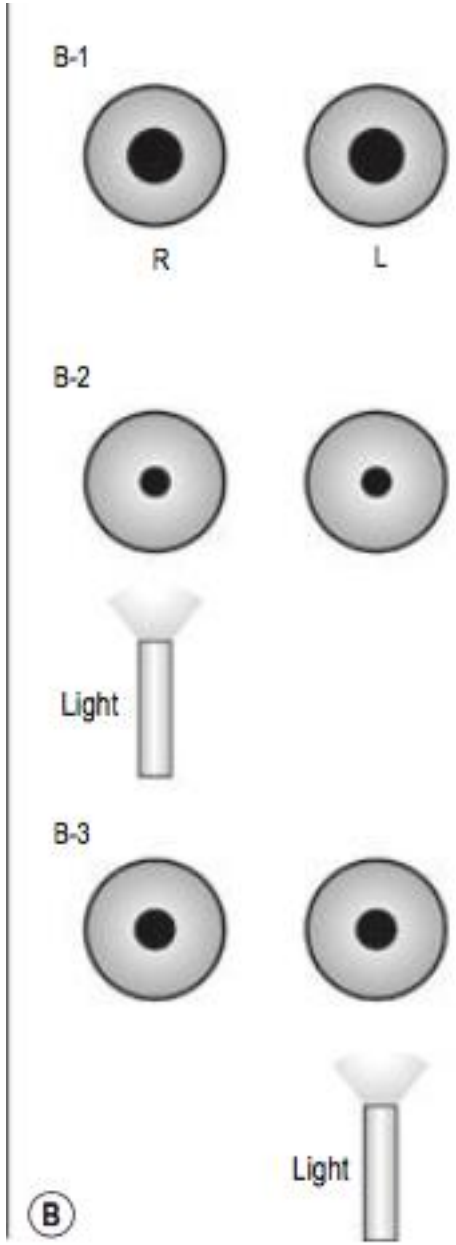
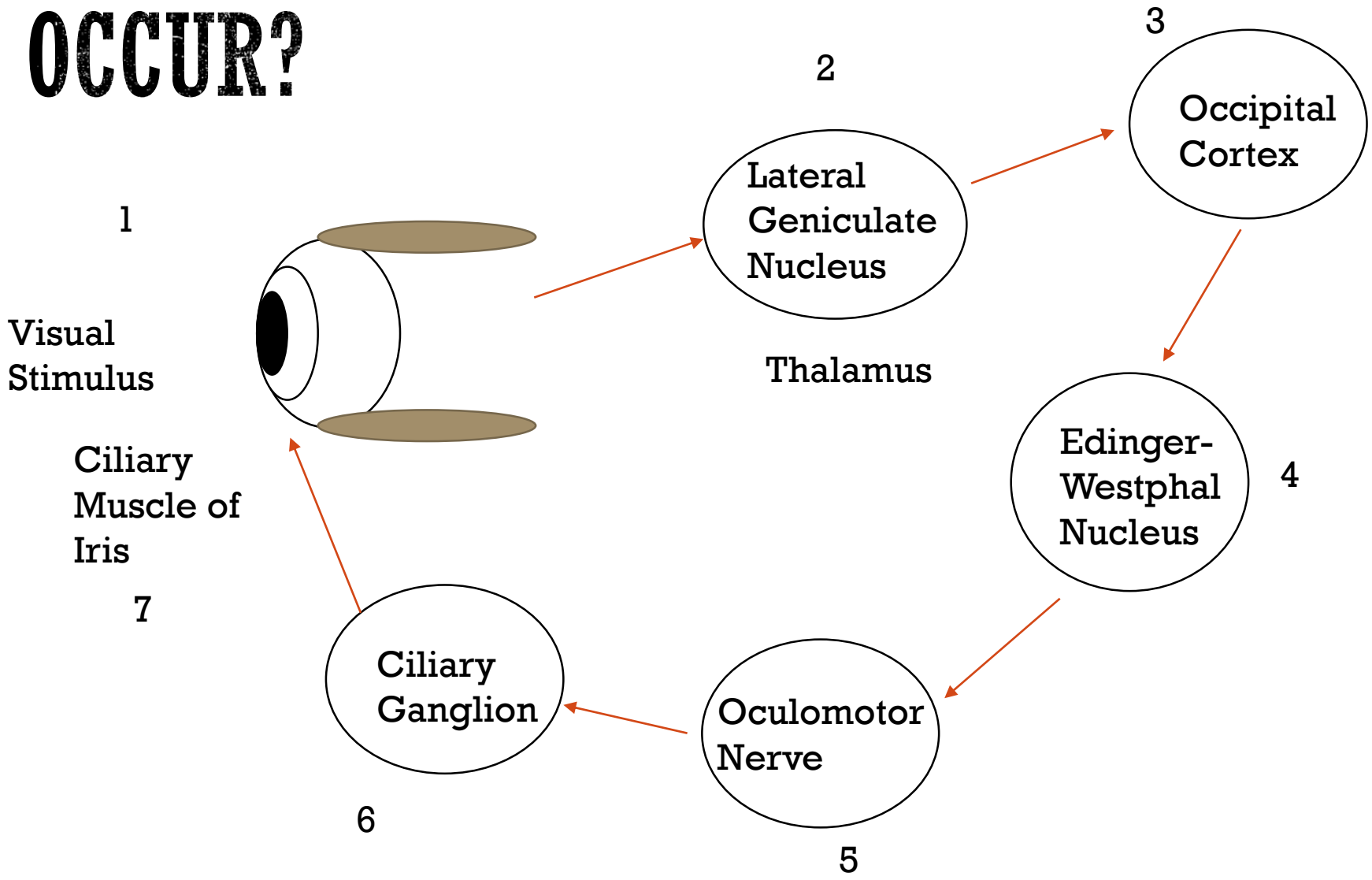


MARCUS GUN PUPIL

- Also known as Relative Afferent Pupillary Defect
- Shine light in affected eye:
  - No direct or consensual response
- Mechanism:
  - Reduction in afferent input reaching the pretectum in the midbrain
- Potential cause:
  - Optic nerve lesion
- https://www.youtube.com/watch?v=ToFIadG5tqM



HOW DOES ACCOMMODATION REFLEX OCCUR?



ARGYLL ROBERTSON PUPIL

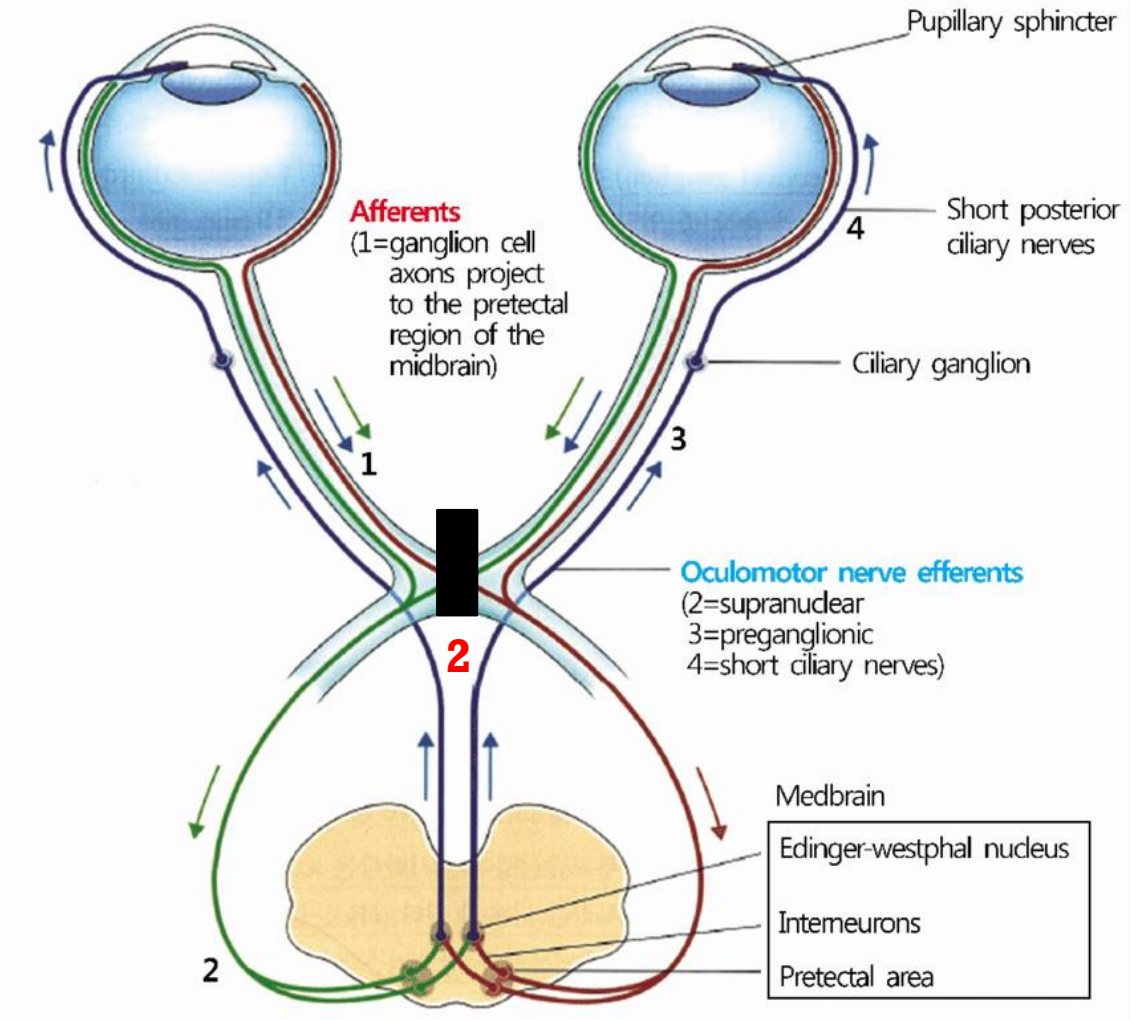
- Seen with syphilis and diabetic neuropathy

- Pathophysiology:
  - lesion of dorsal reflex fibers from the Edinger-Westphal nucleus responsible for the light reflex.

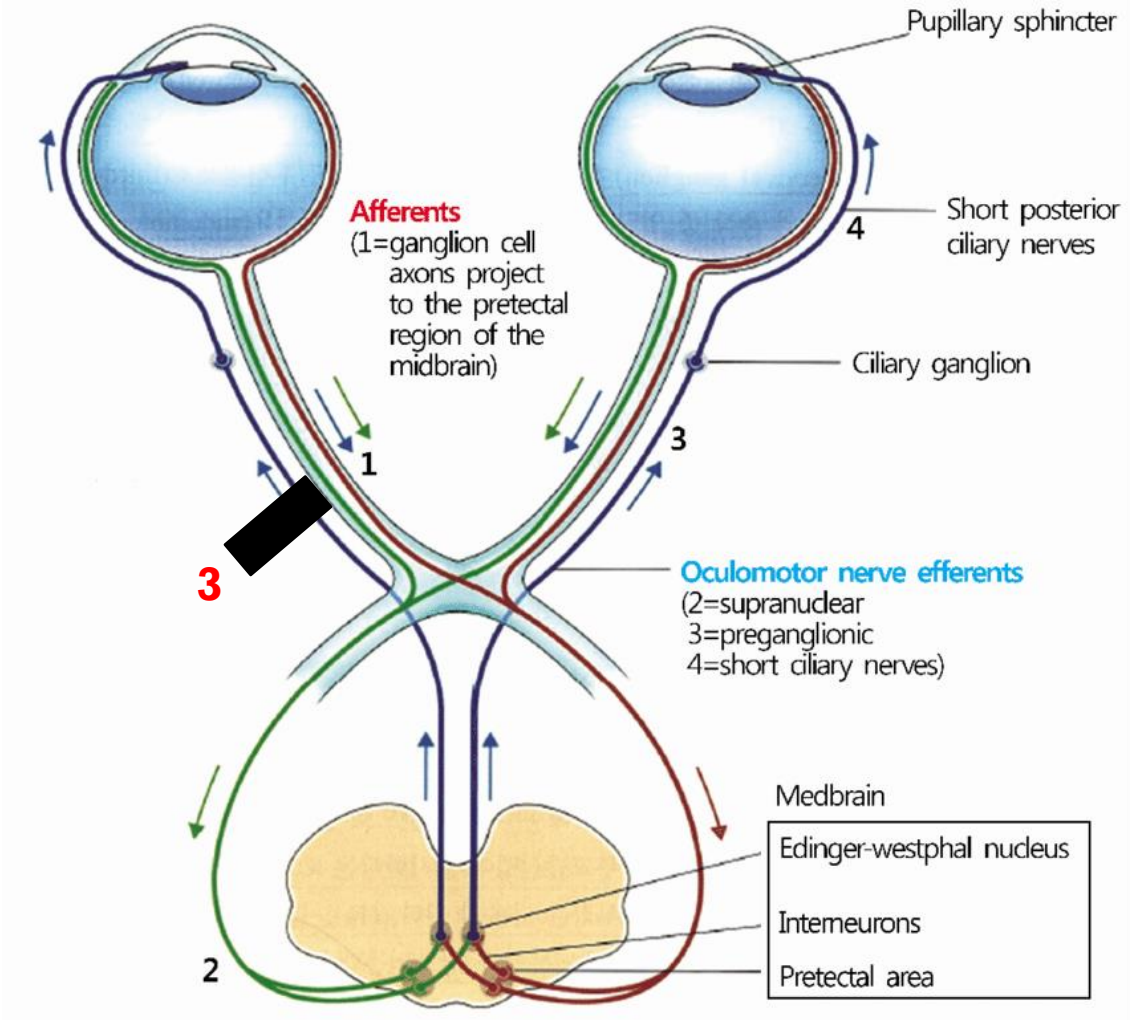
- Signs:
  - Bilateral small pupils
  - Accommodation is normal
    - ventral reflex fibers are unharmed
  - Dilation of pupil immediately after constriction

PUPILLARY LIGHT REFLEX

Optic Light Reflex will still be present



PUPILLARY LIGHT REFLEX



OCULOMOTOR NERVE PALSY

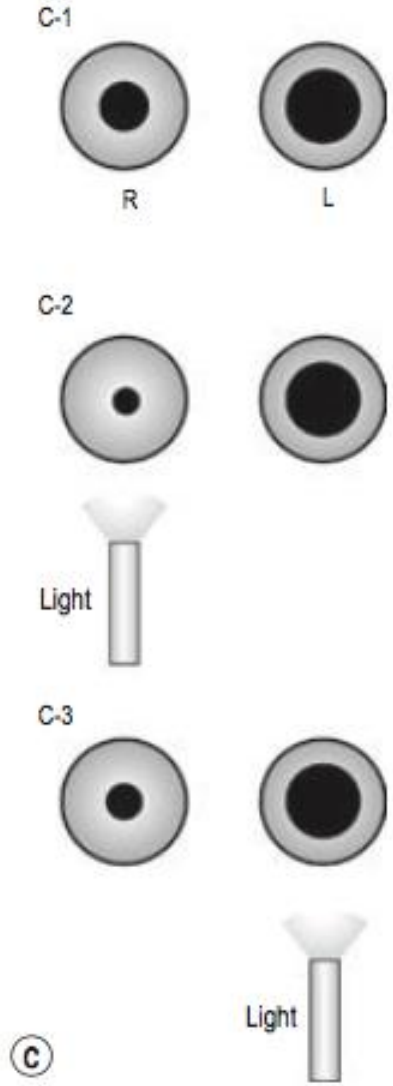
- Pathophysiology: damage to cranial nerve III

- Damages light reflex:
  - Fixed dilated pupil and poor vision in affected eye
  - If shining light in one eye causes contralateral dilation:
    - suggests an optic neuropathy in initial eye

- Causes ptosis:
  - deficit in adduction, depression, or elevation of the eye
  - Cranial nerve III supplies the upper eyelid

- Affects extraocular muscles:
  - Classic position: down and out

- Most common cause of palsy:
  - vascular insufficiency from hypertension or atherosclerosis



ANISOCORIA

- Asymmetric pupil sizes
- Need to compare inequality in light and dark
  - In <u>light</u>
    - LARGER pupil has PARASYMPATHETIC abnormality
    - Causes = Adie's Tonic Pupil, 3rd nerve palsy, cocaine
  - In <u>dark</u>
    - SMALLER pupil has SYMPATHETIC dysfunction
    - Most common cause = Horner's Syndrome

ADIE'S TONIC PUPIL

- Damage to the parasympathetic ciliary ganglion
- No response to light, will have light-near dissociation
- Pupil is initially large, exhibits accommodation
- Redilates slowly after constriction

HORNER'S SYNDROME

- Pathophysiology: Damage to sympathetic trunk
- Signs seen on affected side:
  - Miosis: constricted pupil
  - Ptosis: droopy weak eyelid
  - Anhidrosis: decreased sweating
- Causes:
  - Idiopathic
  - Pancoast tumor (apical lung)
  - Internal carotid dissection
  - Brainstem stroke
  - Neck trauma

SACCADIC EYE MOVEMENTS

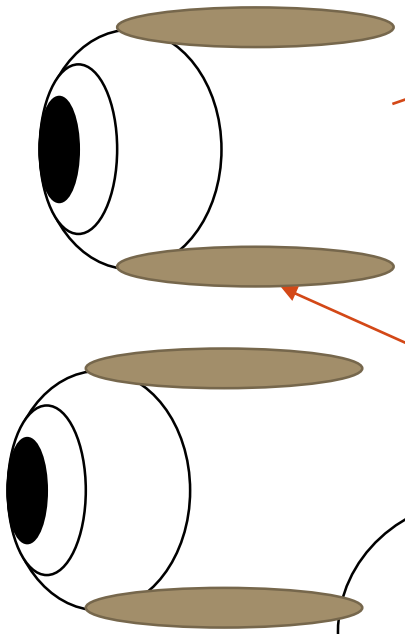
- Quick ballistic movement that allows fixation from one target to another
- Conjugate eye movement:
  - Both eyes move in the same direction
- Once initiated, cannot be stopped

- https://www.youtube.com/watch?v=TNooKldf-gw

HORIZONTAL SACCADE

1

Visual Stimulus



2

Lateral Geniculate Nucleus

Thalamus

3

Occipital Cortex

4

Frontal Eye Fields

5

Superior Colliculus

Midbrain

6

Burst Cells in PPRF

Burst Cells in riMLF

Pons

Midbrain

7

Omnipause neurons in rip Nucleus

Pons

8

Motor Neurons of VI

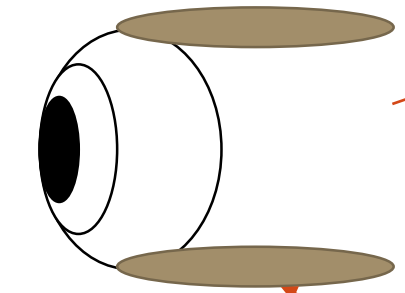
9

MLF & Motor Neuron 3

+

-

VERTICAL SACCADE



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PROGRESSIVE SUPRANUCLEAR PALSY

- Pathophysiology = Lesion of the midbrain
  - Rostral Interstitial Nucleus of the MLF
- Presents with gait disturbance - leads to falls
- Supranuclear Ophthalmoplegia = Weakness in eye muscles over time
- First ocular symptoms = Vertical Saccades
  - Round the House Sign
  - Slow Saccadic Velocity
  - Hypometric- undershoot or do not reach target
  - Square Wave Jerks- Eyes drift off target, and a quick saccade pulls the eyes into neutral position
- Bradykinesia of the neck and upper trunk
- Cognitive impairment

PROGRESSIVE SUPRANUCLEAR PALSY

- Diagnostic Test = CT and MRI
  - generalized and brainstem atrophy especially in midbrain
- Management = Physical therapy for postural instability and falls
  - Mirror prism lenses if severe limitation of extraocular movements
- Pharmacology = Levodopa can be used to diagnose
  - Not enough data to use drugs as treatment
- Prognosis = 6-9 years

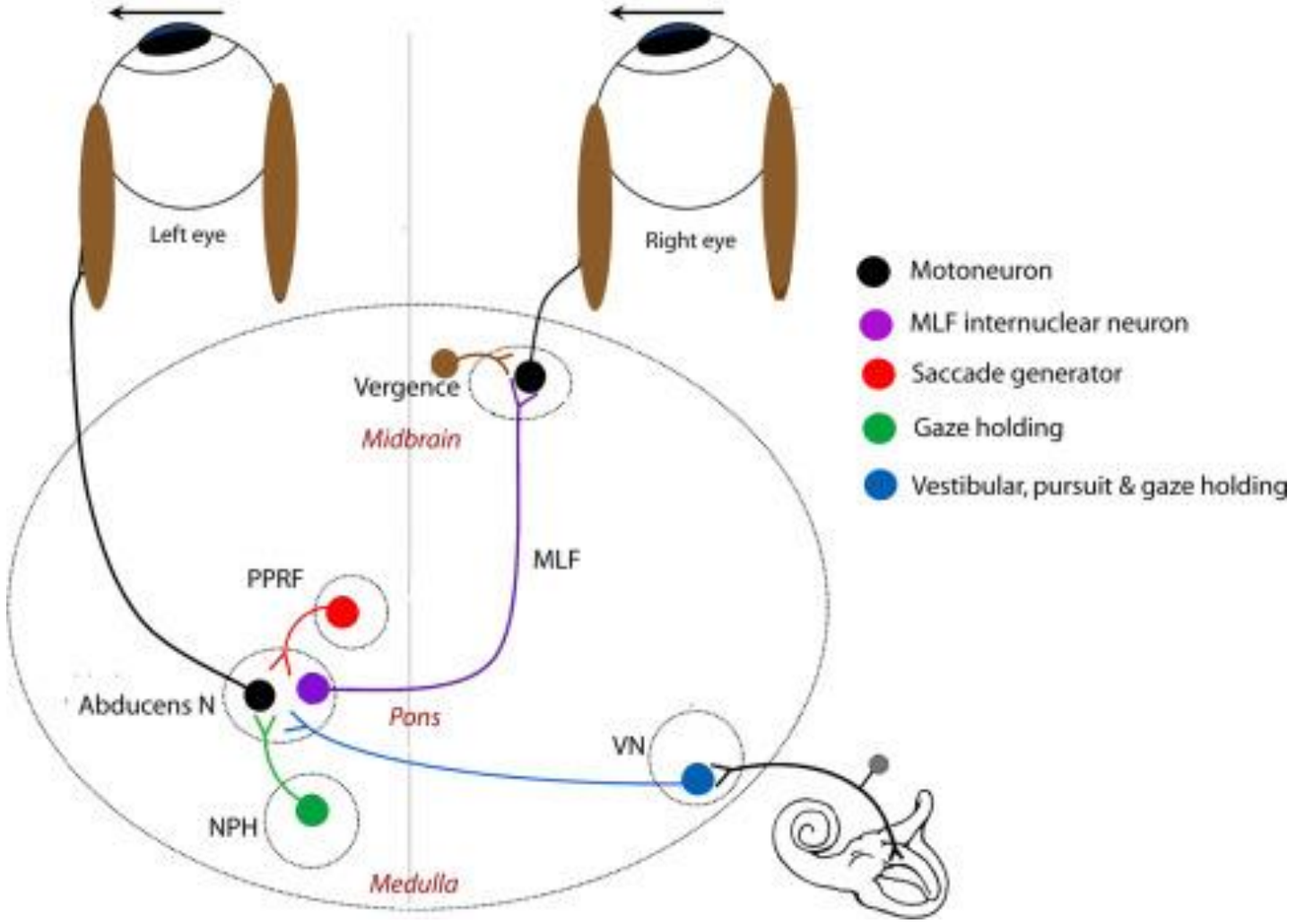
NYSTAGMUS

- Repetitive, uncontrolled eye movements
  - side to side
  - up and down
  - circular pattern

- Semicircular canal = push-pull mechanism
  - Angular movement of the head:
    - maximally activate one canal
    - maximally inhibit the other canal

- Canal is excited by head motion towards the canal, in the appropriate plane
  - Posterior canal = excited with neck EXTENSION
  - Anterior canal = excited with neck FLEXION

VESTIBULAR PATHWAY



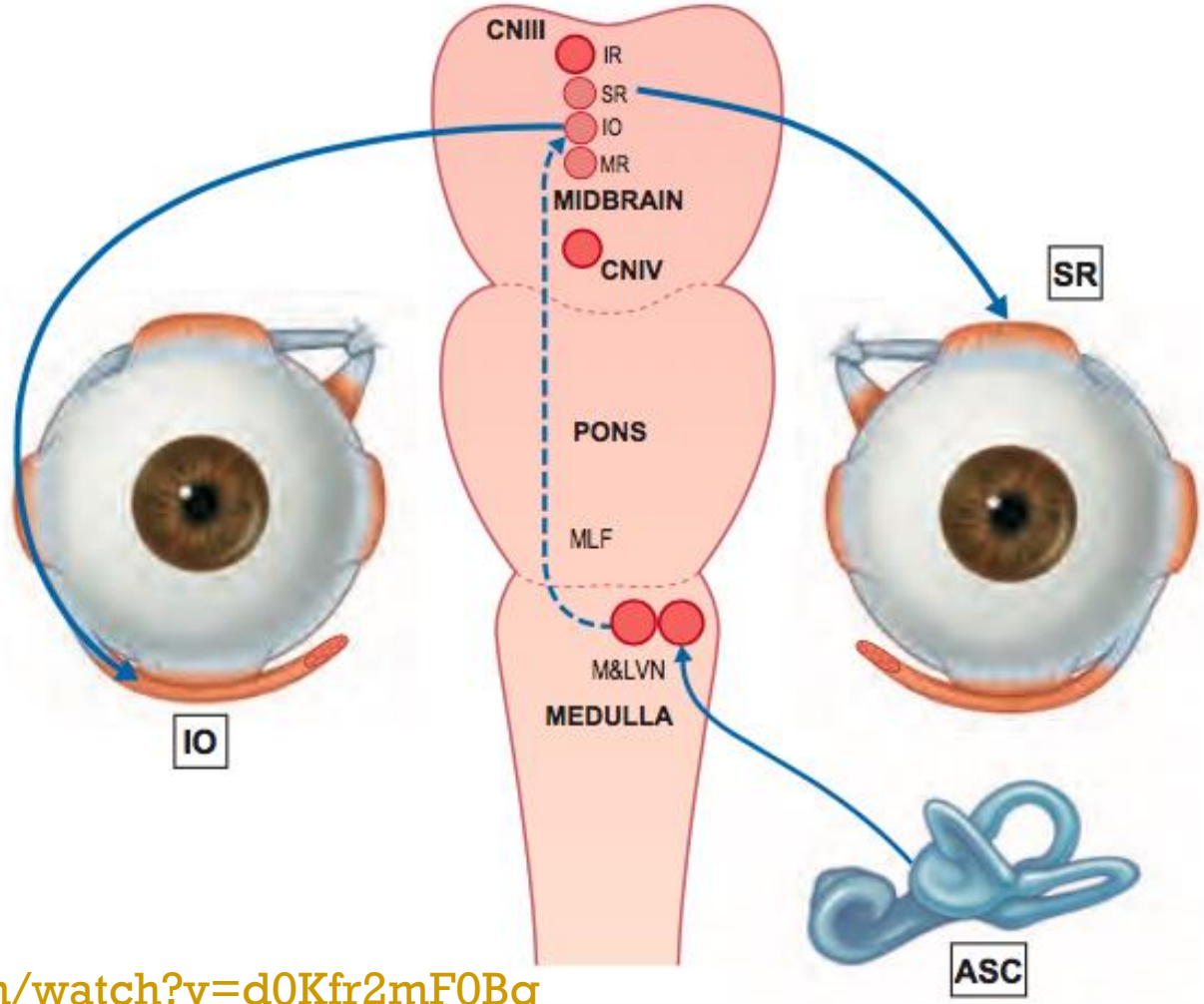
CENTRAL VS. PERIPHERAL NYSTAGMUS

- Central vestibular nystagmus
  - From the vestibular nuclei and neural pathways beyond

- Peripheral vestibular nystagmus
  - labyrinth and semicircular canals of the inner ear

- Nystagmus can present as Downbeat, Upbeat, and/or Torsional

DOWNBEAT NYSTAGMUS



https://www.youtube.com/watch?v=d0Kfr2mF0Bg

DOWNBEAT NYSTAGMUS

- Unopposed action from ANTERIOR semicircular canal
- Pathophysiology:
  - lesion in the medulla = where posterior semicircular canal tracts run
  - cerebellar flocculus lesion = removes a tonic inhibition of upward vestibular eye movements
- Downbeat = due to saccade that tries to correct it
- Causes:
  - Chiari Type 1 = cerebellar tonsils below the level of foramen magnum
  - Demyelinating Multiple Sclerosis.
  - Drugs = lithium and anticonvulsants (phenytoin or carbamazepine)

DOWNBEAT NYSTAGMUS

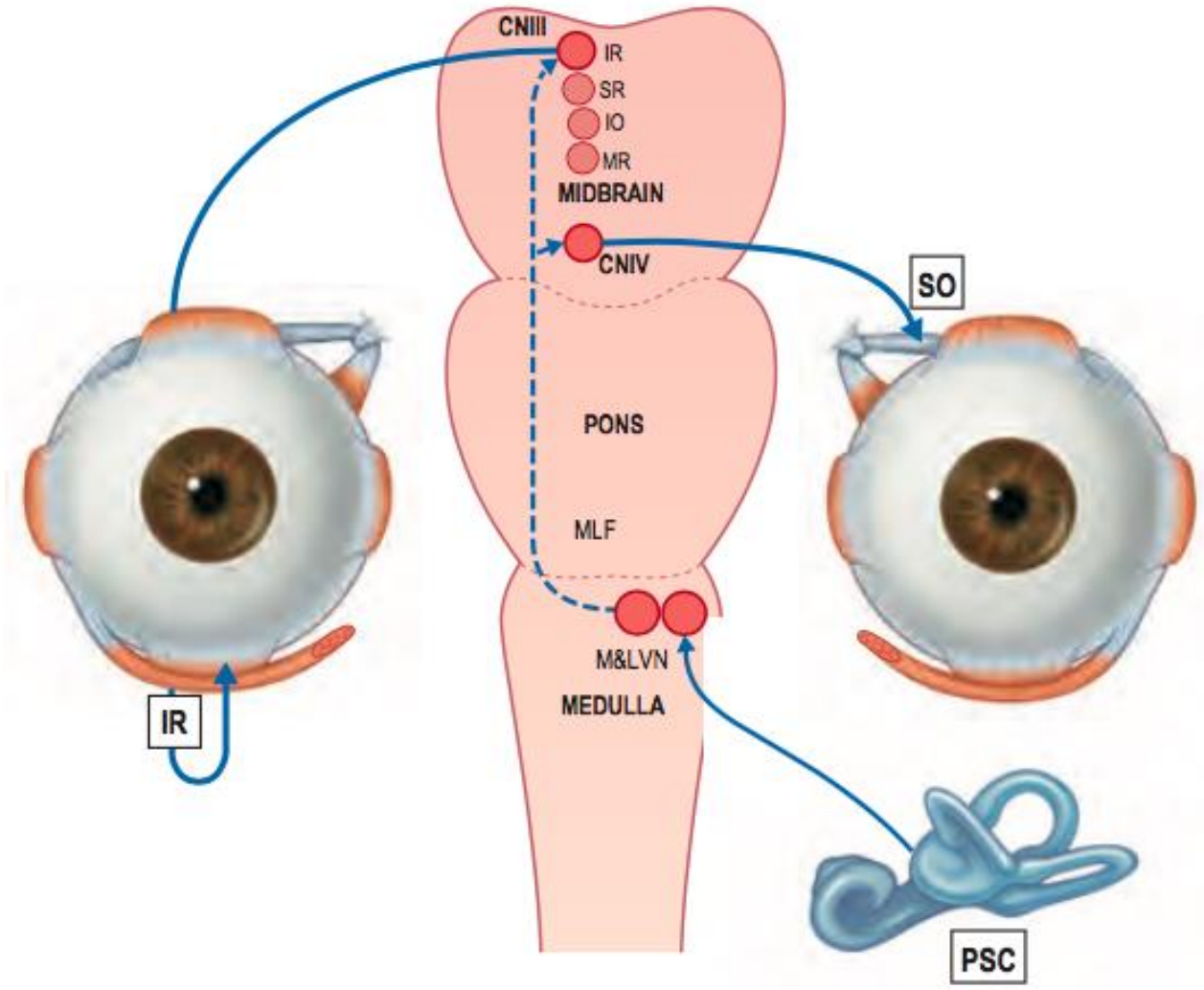
- Presents with:
  - blurred vision
  - oscillopsia = illusion that the environment is moving while moving head

- If oscillopsia is provoked by neck extension or rotation:
  - Consider Arnold Chiari
  - Otherwise, consider MS or drug induced nystagmus

- Ask patient to gaze downward will increase nystagmus

- Treatment = dalfampyridine
  - K+ channel blocker which increases action potential

UPBEAT NYSTAGMUS



https://www.youtube.com/watch?v=7MqyHgozqH0

UPBEAT NYSTAGMUS

- Pathophysiology:
  - Unopposed action of POSTERIOR semicircular canals

- Most common causes:
  - strokes to the medial brainstem
  - degeneration to the cerebellum
  - Why = projections of anterior semicircular canals travel through cerebellum and medial brainstem

UPBEAT NYSTAGMUS

- Presents with possible blurred vision
- Ask patient to look upward, will increase upward nystagmus
- No proven treatment
  - some benefit with dalfampyridine

TORSIONAL NYSTAGMUS

- Fast phase intorsion or extorsion that is conjugate and symmetric
- If purely torsional:
  - Localized to the brainstem
  - Contralateral to the fast phase
  - Ocular tilt reaction direction = ipsi-lesional
- If torsional with a downward or an upward component:
  - Localized to the midbrain
  - Ocular tilt reaction direction = contralateral to lesion
- Causes:
  - Stroke
  - Demyelinating disease
  - Chiari malformation
- https://www.youtube.com/watch?v=Av8nifL5XDg

BENIGN PAROXYSMAL POSITIONAL VERTIGO

- Symptoms:
  - Severe vertigo
  - Tinnitus
  - hearing loss
- Clinical Exam = fixation of vision, will decrease nystagmus.
- Diagnosis = Dix-Halpike
- Treatment = Epley Maneuver

DIX-HALLPIKE MANEUVER

- Dependent ear is facedown
- Develop a torsional upbeating nystagmus

EPLEY MANEUVER

DIFFERENCES BETWEEN CENTRAL AND PERIPHERAL NYSTAGMUS

Central	Peripheral
Purely, vertical, horizontal or torsional	Combined horizontal and torsional or vertical and torsional
Fast beat towards side of lesion	Fast beat away from lesion
Not relieved by gaze fixation	Relieved by gaze fixation

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