



Neuro Op Grand Rounds: Fields and Diplopia

South Dakota Optometric Association
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Disclosures

- I have received honorarium from the following:
 - Alcon
 - Allergan
 - CE in Italy
 - Heidelberg Engineering
 - Review of Optometry

Course Goals

- Take something back to clinic that you can use
- Inform
- Interesting
- Maybe see something in



Key Areas of Investigation for Field Loss

1. Pre chiasmal
2. Chiasmal
3. Post chiasmal



Pre Chiasmal Field Loss

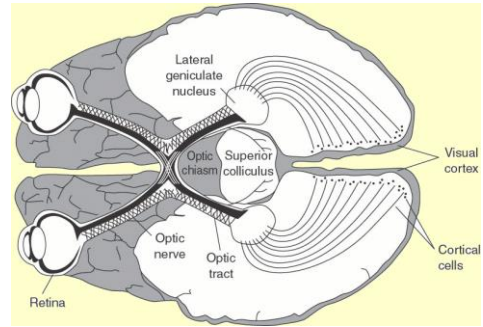
- Is always* unilateral
- Unilateral field loss is restricted to the
 - Globe
 - Retina
 - Optic nerve head
 - Optic nerve to the chiasm
- Exception* is very posterior optic nerve lesion just at anterior chiasm
 - Contralateral nasal fibers after decussation enter the posterior portion of fellow ON

Chiasmal Field Loss

- Is always bilateral
- May be asymmetric
- Is either
 - Bitemporal
 - Binasal
- Medial optic chiasm = pituitary & 3rd vent
- Lateral optic chiasm = carotids and cavernous sinus

Chiasmal Field Loss

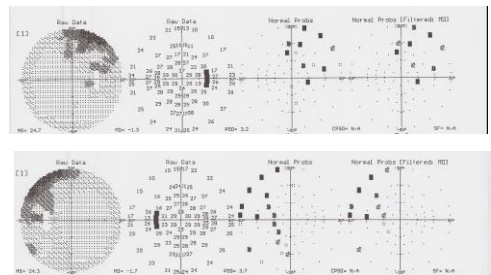
- If medial optic chiasm affected
 - Bitemporal field loss
 - Pituitary most likely, possibly 3rd vent
 - Above/below field defects
- If lateral chiasm affected
 - Binasal field defect
 - Carotid artery, cavernous sinus most likely



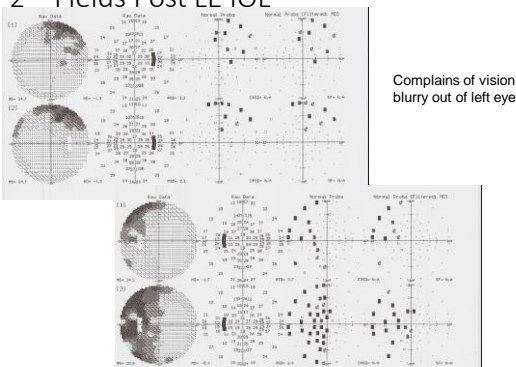
Patient JR Vision Loss OS

- 80 y/o white female
- Post Crystalens OD and OS
- History AMD OU
- Constant complaints of vision OS not as good as expected post implantation
- VA 20/30 20/80
- Fundus unchanged

Fields First Post LE IOL



2nd Fields Post LE IOL

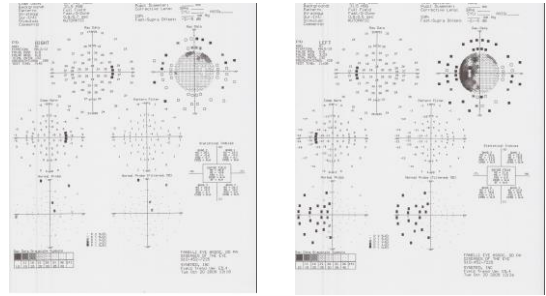


When things just don't add up

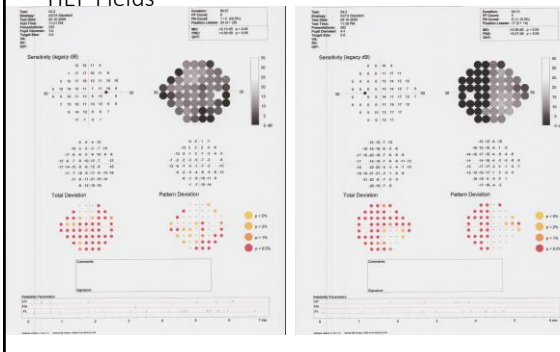
- That is a fact of medicine.
- Sometimes things just don't always add up.
- Patient in no acute distress, nothing imminently going on.
- Repeat studies, but don't wait too long

1 month later

- Complaints of vision out to left side no better, maybe worse
- VA 20/30 20/200 PHNI OD, OS, OU
- Pupils ERRLLA (-) APD
- EOM's intact OU
- AT 16, 18
- Anterior segment: NL OU

3rd Fields Post LE IOL

HEP Fields



Post Chiasmal Field Loss

- Is always bilateral
- Field loss is in left or right hemifield
 - Homonymous
- Field loss is opposite the side of the lesion
- If VF loss more inferior, then parietal lobe
- If VF loss more superior, then temporal lobe

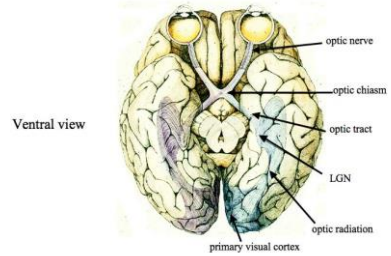
Post Chiasmal Field Loss

- Lesion closer to the chiasm
 - incongruous
- Lesion closer to occipital cortex
 - congruous

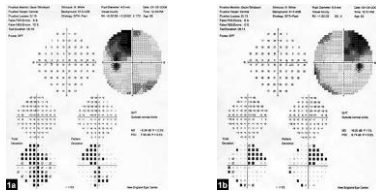
Post Chiasmal Field Loss

- Very congruous above and below, macular sparing
 - Occipital pole
- Cuneus
 - Above calcarine fissure
 - Inferior (L/R) homonymous quadrantanopsia
- Lingula
 - Below calcarine fissure
 - Superior (L/R) Homonymous quadrantanopsia

Retinogeniculate visual pathway

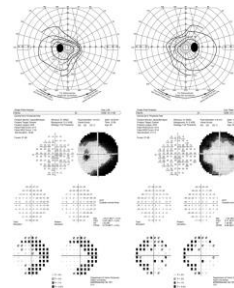


Where's the lesion?



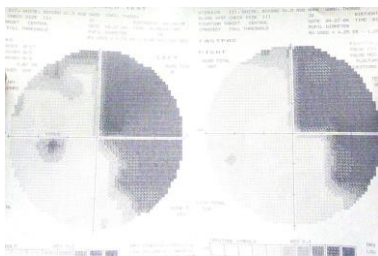
Suspect pituitary origin

Where's the lesion?



Chiasmal likelihood; lateral aspect

Where's the Lesion?



Fixation involved, denser above than below, incongruous right sided defect
Left optic radiations, more temporal lobe than parietal; not at occipital pole

Anatomy

- **CNS / Visual-motor pathways**
- **Appearance of key structures**

Planes of the body ➔

M. Buonarroti

- 1475-1564
- Painter, sculptor, architect, engineer
- An accomplished anatomist, at time when forbidden
- Michelangelo



M's Anatomy Lesson

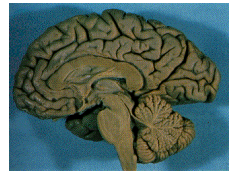


Concealed Neuroanatomy in Michelangelo's Works in the Sistine Chapel. Suk, I, Tamargo, Rafael. Neurosurgery. May 2010 66: 851-61

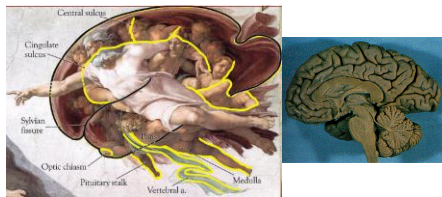
M's Anatomy Lesson



M's Anatomy Lesson



M's Anatomy Lesson



M's Anatomy Lesson

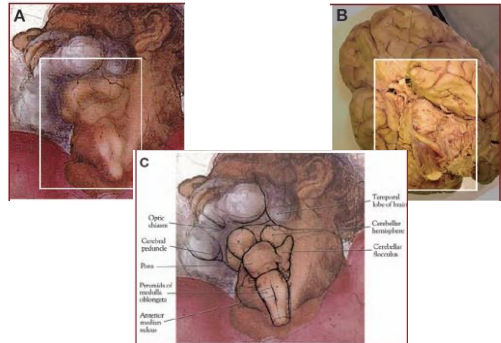


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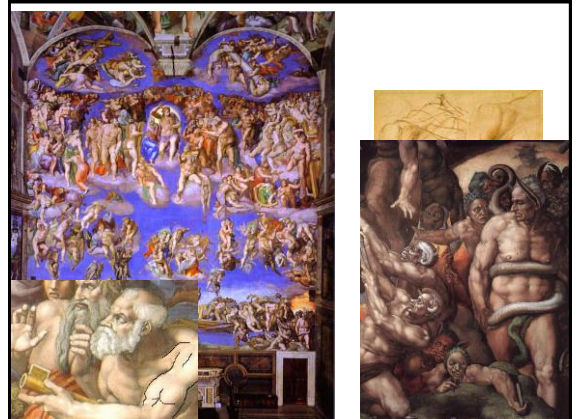
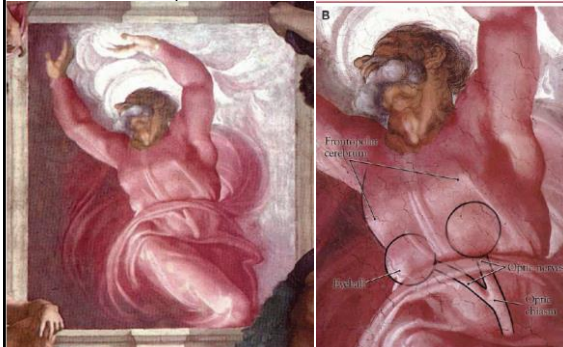


FIGURE 3. Comparative anterolateral oblique views of the human neck depicted by Michelangelo throughout the Sistine Chapel ceiling by Leonardo da Vinci, and by Raffaello Sanzio (Raphael). Some figures are reversed to match the orientation of God's head in the Separation of Light From Darkness. A. Adam (reversed), from the Creation of Adam. B. Eve, from the Sacrifice of Noah. C. Adam (reversed), from the Expulsion From the Garden of Eden. D. Eve (reversed), from the Expulsion From the Garden of Eden. E. Virgin Mary (reversed), from The Virgin and Child With St. Anne (ca. 1508) by Leonardo da Vinci. F. Virgin Mary from Holy Family Before the Oak (1518) by Raffaello Sanzio (Raphael). G. God, from the Separation of Light From Darkness. Note the difference between the normal neck anatomy depicted in A-E compared with that of God's neck in G.

M's Anatomy Lesson



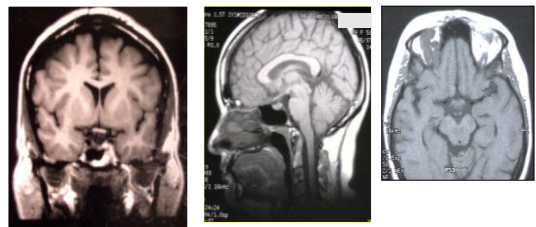
M's Anatomy Lesson



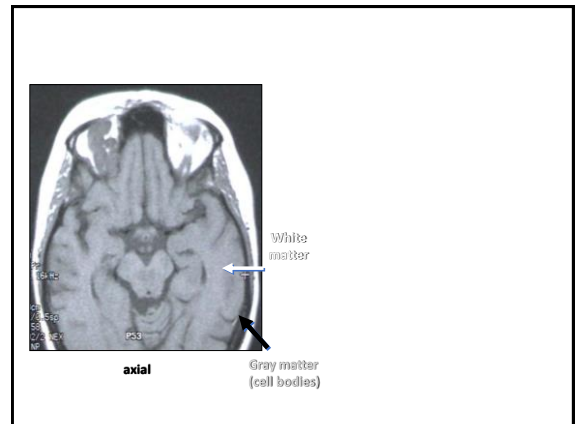
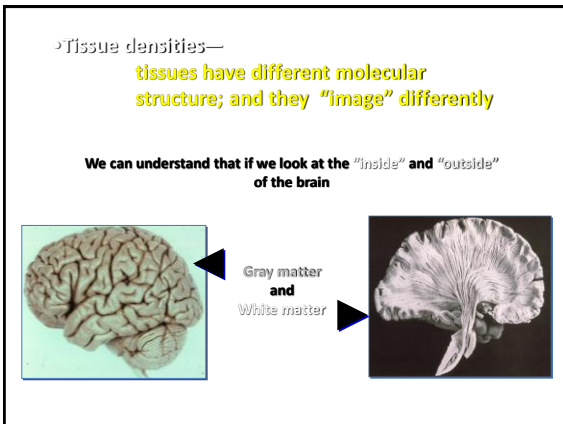
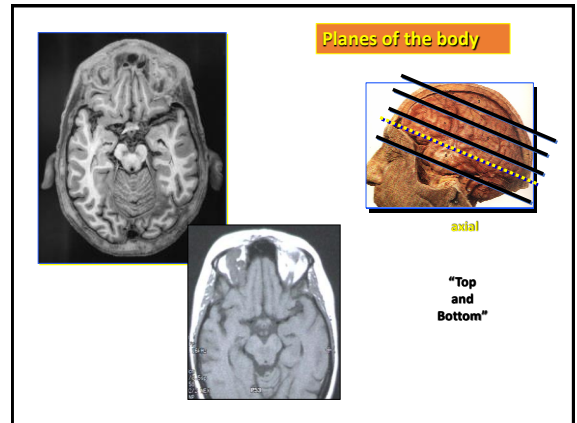
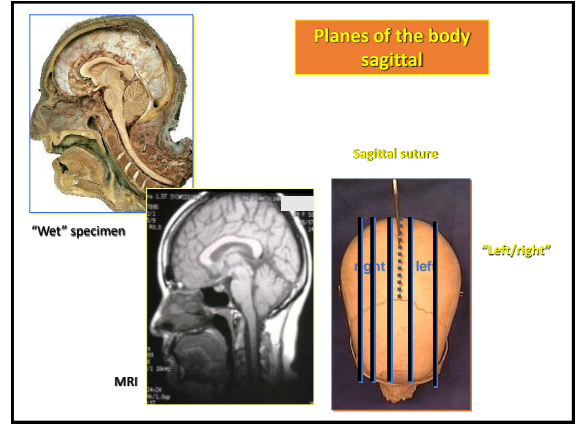
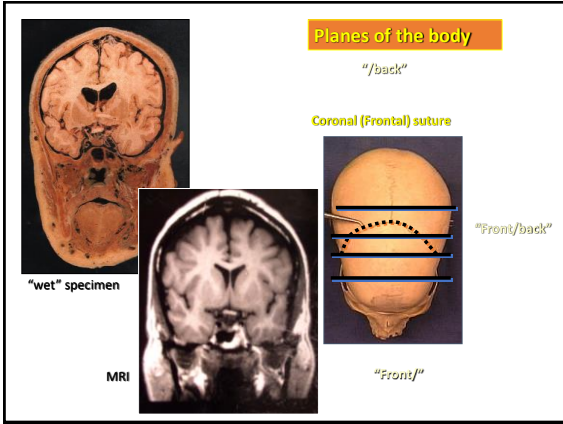
Don't Mess with Mike

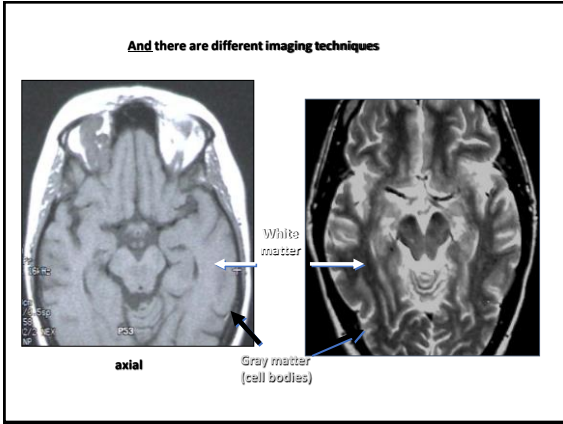
- When the Pope's own Master of Ceremonies Biagio da Cesena said "it was mostly disgraceful that in so sacred a place there should have been depicted all those nude figures, exposing themselves so shamefully, and that it was no work for a papal chapel but rather for the public baths and taverns," Michelangelo worked da Cesena's semblance into the scene as **Minos**, judge of the underworld. It is said that when he complained to the Pope, the pontiff responded that his jurisdiction did not extend to hell, so the portrait would have to remain.

This is a CORONAL MRI This is SAGITTAL This is AXIAL



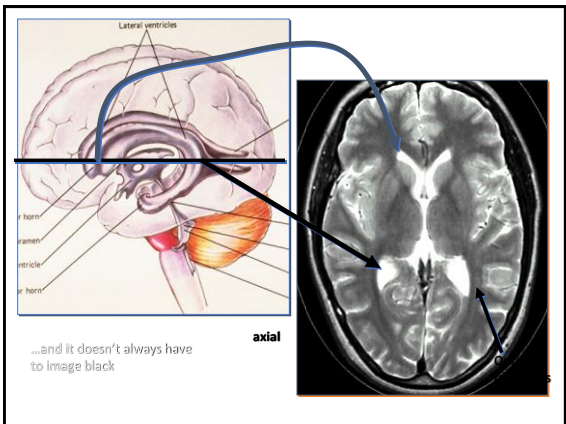
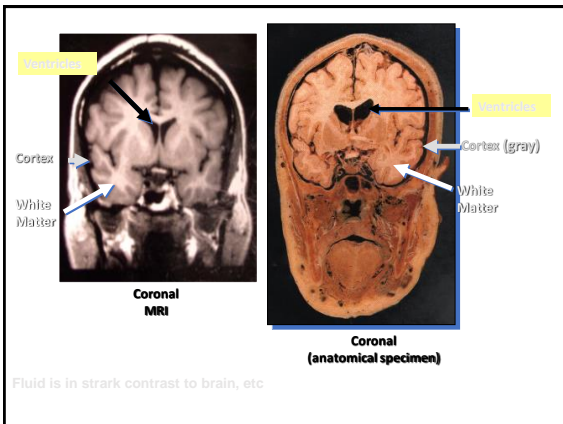
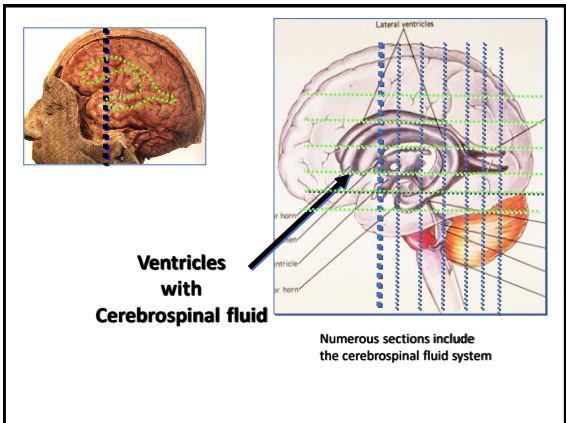
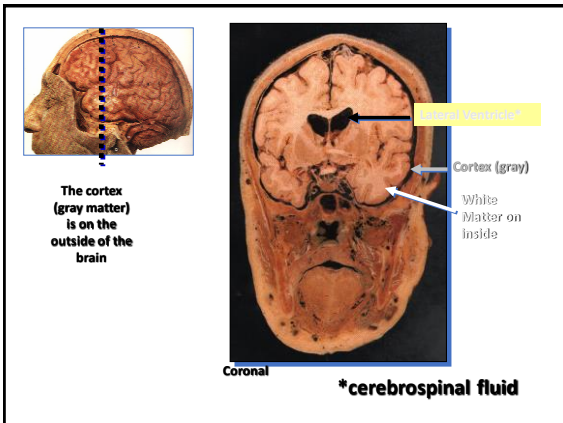
What does that mean?





Fluid

- The cerebrospinal fluid system



... there are different imaging techniques
 -not only can **gray/white matter** "image" differently
 -so can **cerebrospinal fluid**

midsagittal

Cerebrospinal fluid is also found **OUTSIDE** the brain

Cerebrospinal Fluid (CSF)

inside the CNS and outside the CNS (subarachnoid space)

Pia and Arachnoid **dura**

Pia/arachnoid Removed

cerebrospinal fluid fills subarachnoid space — can see it on imaging — one of the reasons that MRI images brain so well

Ex: Calcarine fissure

midsagittal

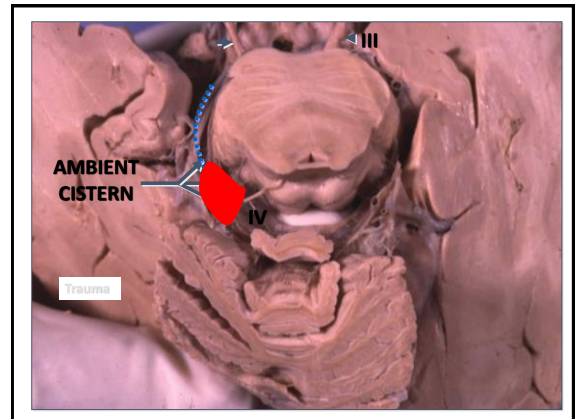
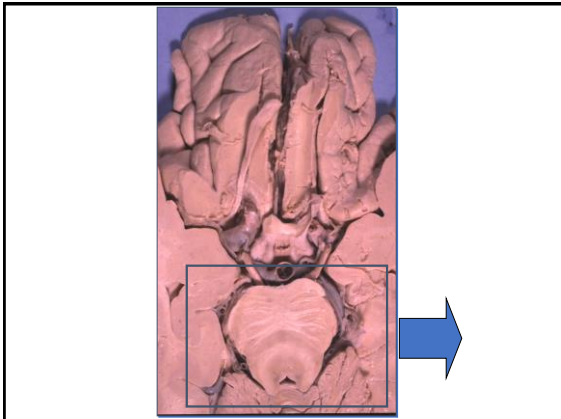
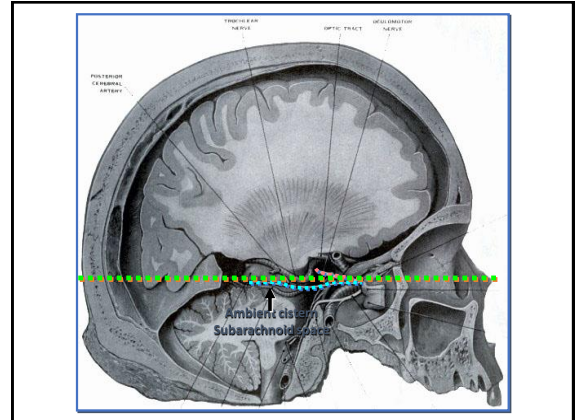
Calcarine fissure

Midsagittal Anatomical wet specimen

midsagittal

**All cranial nerves traverse the
subarachnoid space
(Cerebrospinal Fluid)
and can be damaged there**

For example,
Cranial nerve IV (superior oblique)
is especially at risk in the
ambient cistern
(subarachnoid space)



"THE FIRST 4 QUESTIONS"

- 1. WHO IS THE NEURO-OP ON CALL?
- 2. WHAT IS THEIR NUMBER?
- 3. HOW SOON CAN THE PATIENT BE SEEN?
- 4. WHAT DID THEY HAVE?

“THE FOUR QUESTIONS”

1. DOUBLE VISION WHEN COVER EITHER EYE?
2. “UP & DOWN” OR “SIDE BY SIDE”?
3. WORSE IN WHICH DIRECTION?
4. GREATER AT DISTANCE OR NEAR?

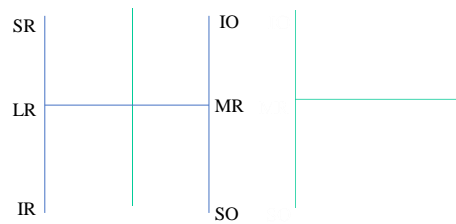
4 Questions We Should Ask

- 1-Is Double Vision Present with one eye covered?
 - “Yes” eliminates neurologic etiologies
- Usually a ‘windows’ problem
 - Media opacities
 - Monocular diplopia

4 Questions We Should Ask

- 2-Does the Diplopia have a vertical component or a horizontal component

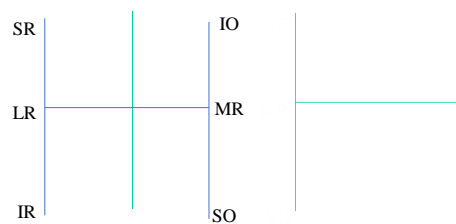
EOM ACTIONS



4 Questions We Should Ask

- 3-In which direction (R or L) does the diplopia worsen?

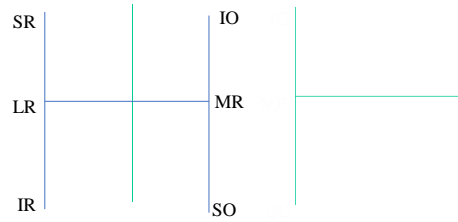
EOM ACTIONS



4 Questions We Should Ask

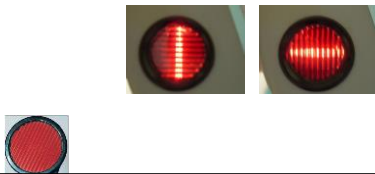
- 4-Is the diplopia greater at distance or near?

EOM ACTIONS

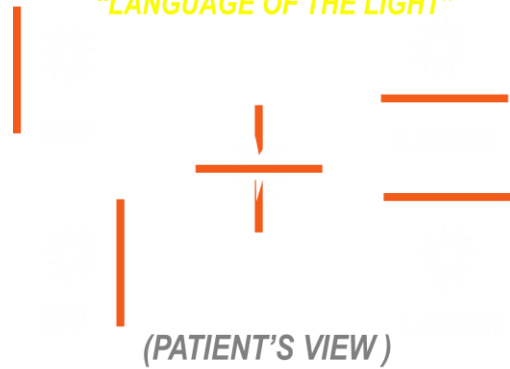


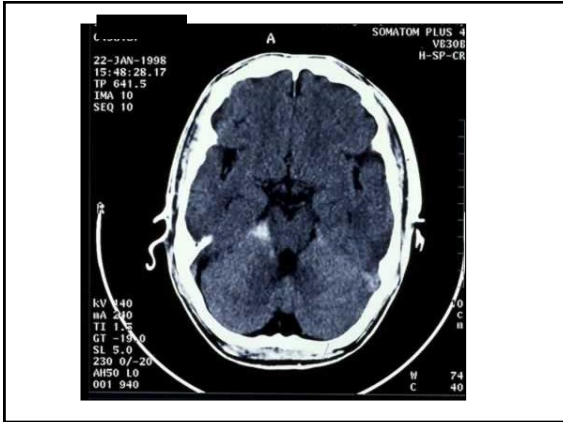
Clinical Assessment of Diplopia

- Begins with dissociating the presenting images before each eye
- Maddox Rod



"LANGUAGE OF THE LIGHT"

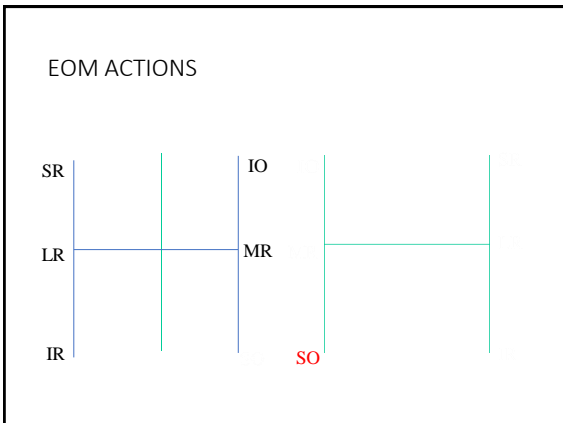
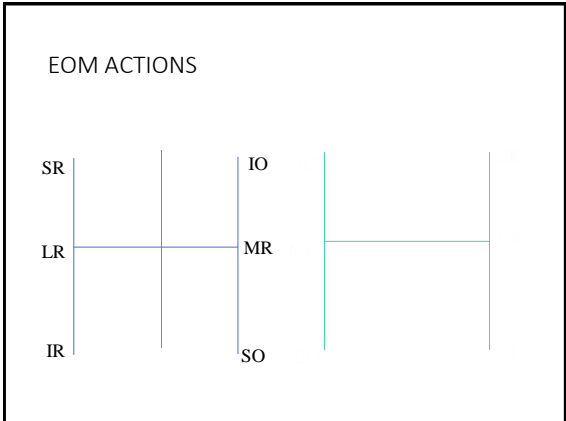




Fourth Nerve Palsies

4th N Innervation & Motility

- Innervation is easy:
 - Superior Oblique
- Motility is more complex
 - Both a horizontal AND vertical component
 - AND.....a TORSIONAL component

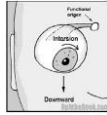


4th N Palsy

- The paretic eye is hyper in primary gaze
- The diplopia decreases on same gaze; increases on opposite gaze
- But.....

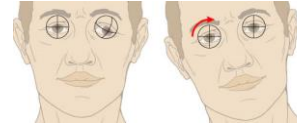
Torsional Obliques

- Remember this:
- SUPERIOR muscles INTORT
- INFERIOR muscles EXTORT



4th N and SO Muscle

- The SO is primarily an INTORTER
 - Compensating for a faulty intorter, one would TILT your head in the opposite direction



4th Nerve Palsies

- 4th N innervates only the superior oblique
- Only CN to exit brain dorsally
- Diplopia will then be both horizontal and vertical
 - Dinner diplopia
- Head tilt to the opposite side
- Congenital or acquired
 - Acquired adults: trauma
 - Acquired children: ominous sign if no trauma
- May be unilateral or bilateral

Etiology of Adult Superior Oblique Palsies (Mollan SP, et al. Eye 2009)

• **N = 150**

• **133 unilateral-isolated:**

- 38% congenital
- 29% trauma
- 23% vasculopathic
- 7% undetermined

• **10 bilateral:**

- 50% trauma
- 20% tumor
- 20% undetermined

• **7 unilateral – complicated**

- 71% trauma
- 14% tumor
- 14% undetermined

4th nerve palsies

- 40, 30, 20, 10 rule of ADULT 4th N palsy
 - 40% Trauma
 - 30% Idiopathic
 - 20% Vasculopathic
 - 10% Tumor / Aneurysm
- Due to congestion at the orbital apex, very unusual location to have an isolated 4th N palsy

Third Nerve Palsies

THIRD NERVE PALSIES KEY POINTS

- MOTILITY SIGNATURE
- ANATOMICAL "ROADMAP"
- ABERRANT REGENERATION
- PUPIL, PAIN, PARESIS

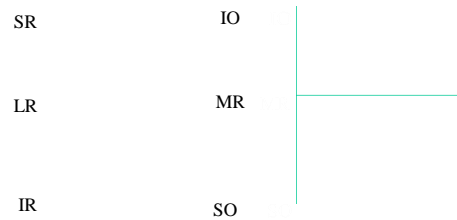
Third Nerve Palsies

- CN III Innervates:
 - SR
 - IR
 - MR
 - IO
 - Levator
 - Parasympathetic Iris (constrictor)

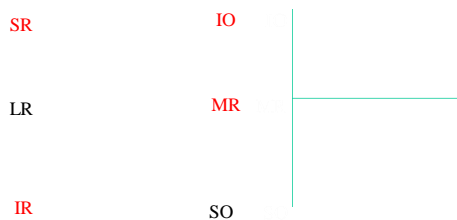
So What is Presentation

- Go back to the Physiological H
- Assuming a RIGHT CN III Palsy:

EOM ACTIONS



EOM ACTIONS

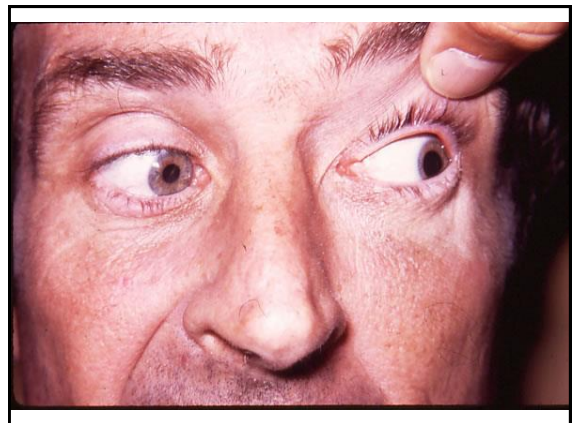
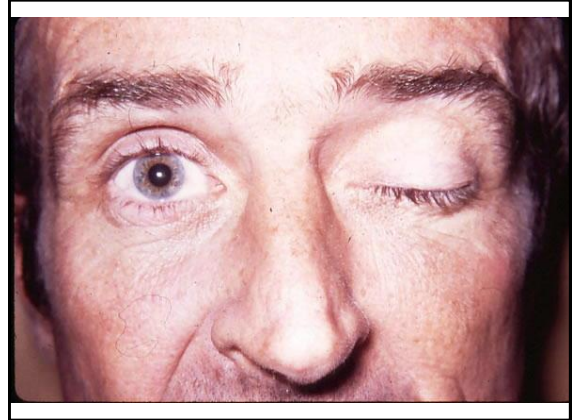


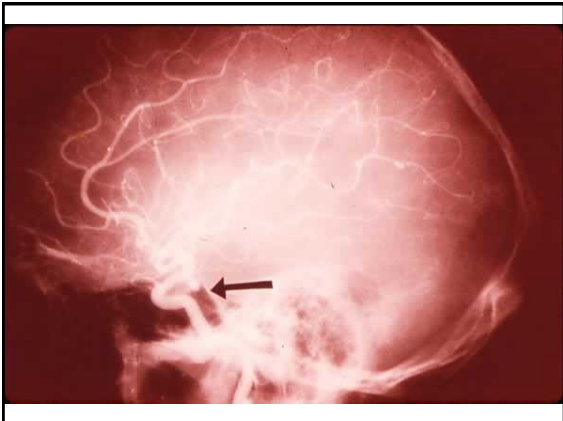
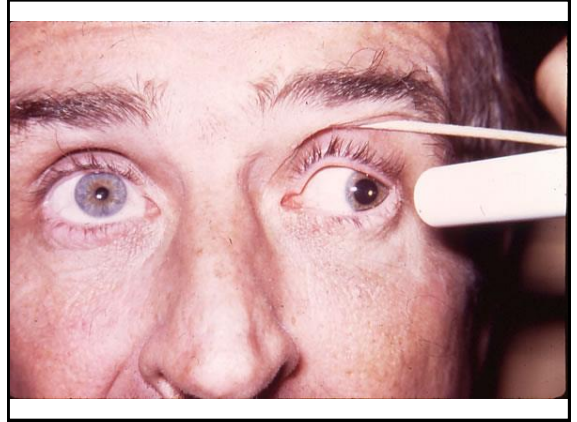
IS THIS REALLY A CNIIIrd? ANSWER BY DIPLOPIA

1. HORIZONTAL & VERTICAL
2. > ACROSS FROM VERTICALLY LIMITED EYE
3. DISTANCE & NEAR

THE SIGNATURE OF CN III PARESIS

- HYPER DEVIATION WHICH INCREASES IN UPGAZE AND REVERSES IN DOWNGAZE
- EXO WHICH INCREASES ACROSS FROM THE VERTICALLY LIMITED EYE





CN III Palsies

- Damage in subarachnoid space results in isolated CN 3 palsy that manifests as:
 - Diplopia
 - Ptosis
 - Dilated pupil
- Usually caused by aneurysm at junction of posterior communicating artery and ICA
- Vascular CN III are pupil sparing..usually

CN III Palsies

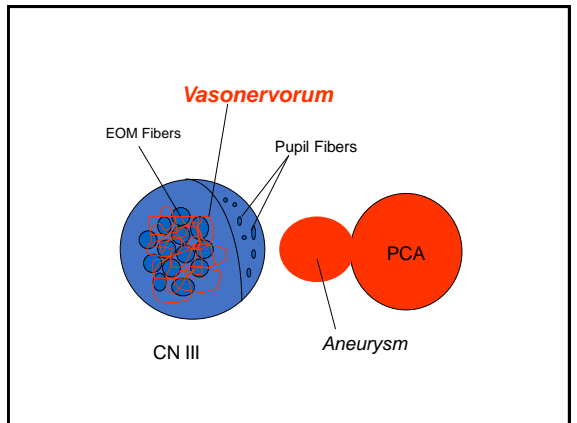
3RD N. PUPILS

(Of the fibers entering posterior eye)
 (Damaged by compressive lesions)

Vasa nervorum supply part of motor and pupillary fibers (damaged by medical aneurysm)

Pupillary fibers to iris and ciliary muscles

EDUCATIONAL EYE CONSULTANTS OF NORTH CAROLINA

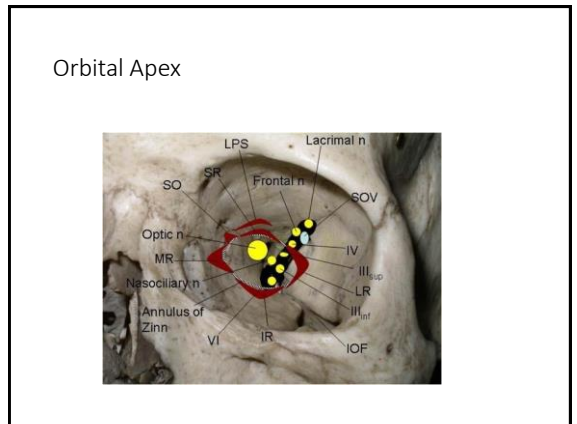
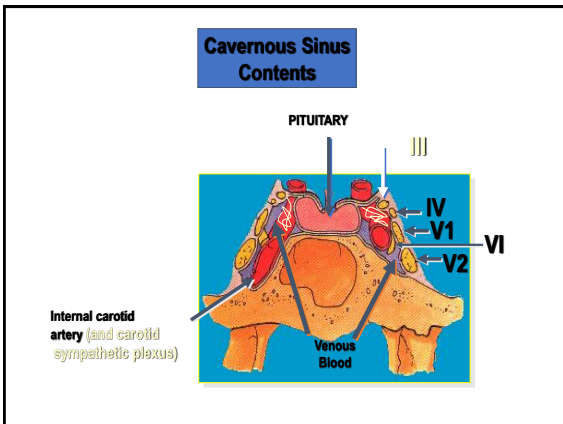
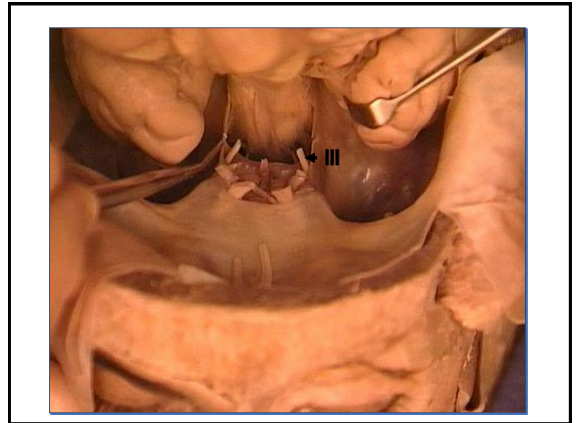
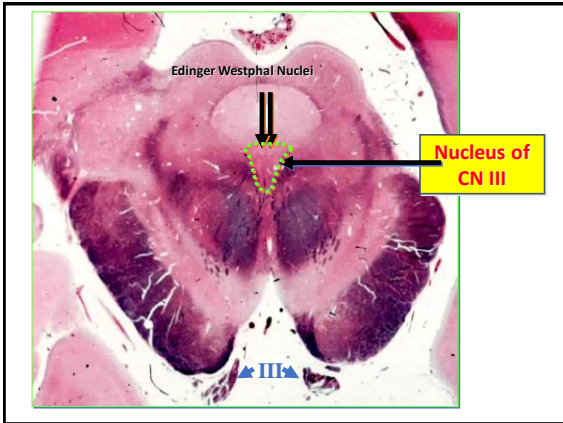


“Rule of the Pupil”

Kissel JT, et al. *Ann Neurol* 1983
 Goldstein JE, et al. *Arch Ophthalmol* 1960

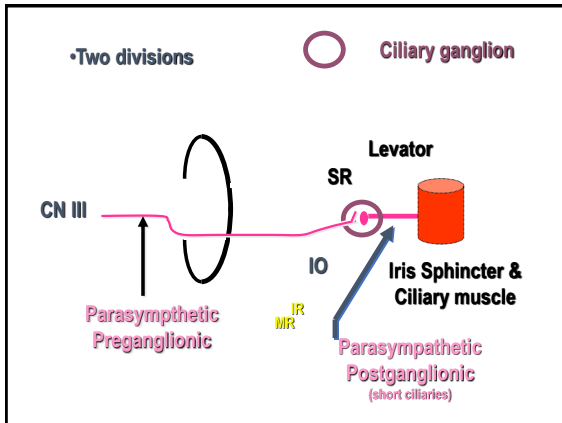
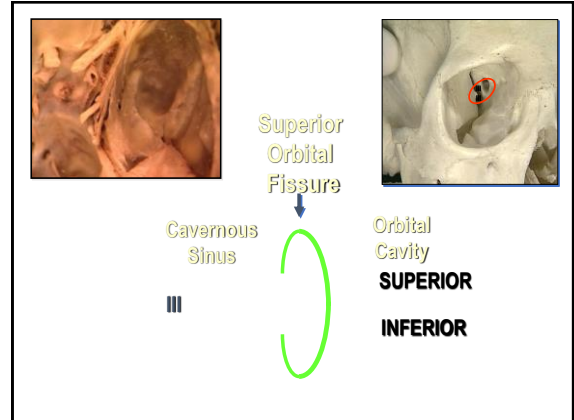
THREE QUESTIONS
 CN III PALSY

- IS THIS A CNIII PALSY?
- IS IT AN ISOLATED CNIIIrd?
- IF IT IS AN ISOLATED CNIIIrd,
 WHAT DO I DO?



Non Isolated CN III Palsies

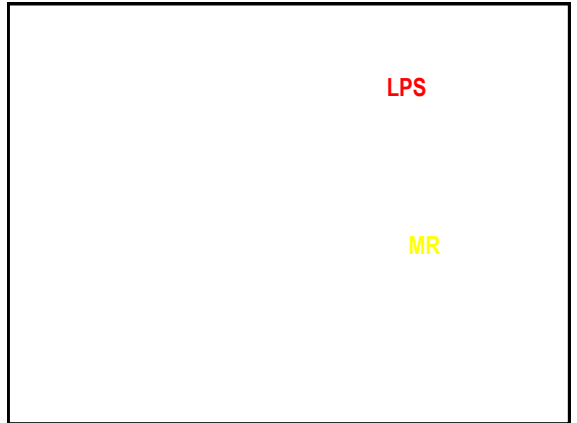
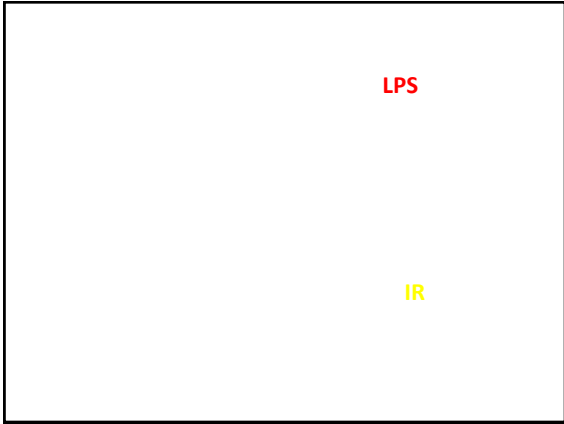
- Damage to CN III in the orbital apex, superior orbital fissure, or cavernous sinus result in unilateral CN III paresis, but often with ipsilateral CN 4 or 6 involvement
- Etiology in these cases is:
 - Metastatic Dz
 - Sphenoid wing meningioma
 - Pituitary abnormalities
 - Zoster
 - Carotid A aneurysm in Cavernous sinus



ABERRANT REGENERATION OF CN III

1. PSEUDO GRAEFE SIGN
2. EYELID SYNKINESIA
3. LIGHT-GAZE DISASSOCIATED PUPILS





MR

Pup

ABERRANT REGENERATION OF CN III

- **COMMON CAUSES:**
ANEURYSM, TUMOR,
TRAUMA
- **UNUSUAL:**
INFECTION/INFLAMMATION
- **NEVER: DIABETES MELLITUS**

THREE QUESTIONS CN III PALSY

- IS THIS A CNIII PALSY?
- IS IT AN ISOLATED CNIIIrd?
- **IF IT IS AN ISOLATED CNIIIrd,
WHAT DO I DO?**

ISOLATED IIIrd in KIDS

- **CONGENITAL** 44%
- **TRAUMA** 16%
- **INFLAMMATION** 11%
- **MISCELLANEOUS** 11%
 - NEOPLASM 10%
 - ANEURYSM 3%
 - ISCHEMIA 3%

LOOK FOR ABERRANT REGENERATION!

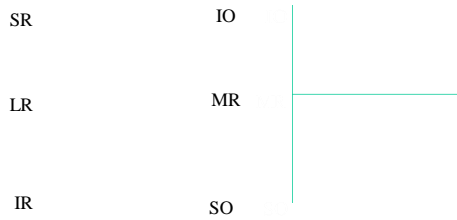
Neuroimaging for CNIII Palsy

- Intra-arterial DSA
- CT Angiography
- MR Angiography

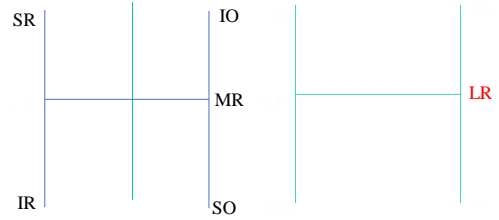
CN VI Palsies

- CN VI innervates only the lateral rectus
 - Diplopia is strictly horizontal and patient has esotropia
 - Diplopia increases in horizontal gaze toward the paralytic muscle
- Often associated with HTN or DM

EOM ACTIONS



EOM ACTIONS



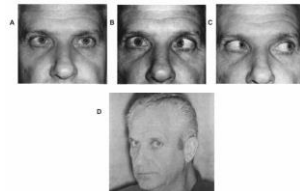
Motility Pattern

- Inability to Abduct, therefore paretic eye has eso posture IN PRIMARY GAZE
- Eso increases on gaze TOWARD paretic eye



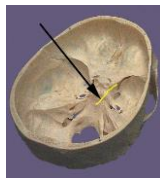
Compensation for CN VI Palsy

- Since the paretic eye cannot Abduct and is eso, the patient will TURN THEIR HEAD to the SAME side



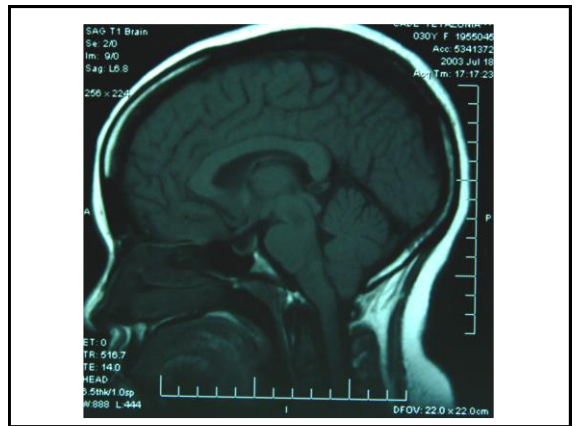
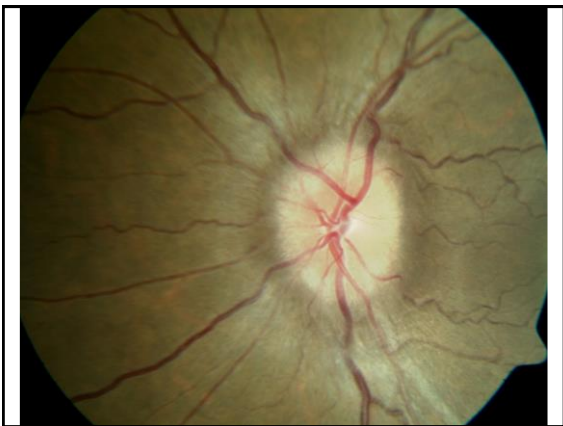
CN VI Palsies

- CN VI has a long climb up the clivus and is prone to compression here.
- Increased ICP will compress both CN VI's in the sub arachnoid space and result in bilateral VI paresis
 - These folks need imaging
 - Often have bilateral papilledema



27 y/o AA Woman

- c/o horizontal diplopia (right gaze > left)
- h/o recurrent headaches (am > pm)
- BVA:
 - 20/20 OD
 - 20/20 OS



S/P Surgical Decompression



Etiology of CN VI Palsy

Mayo Clinic Study of Olmstead Co. MN USA from 1978-1992 (n = 137)

- Undetermined: 26%
- Hypertension: 19%
- HTN & diabetes: 12%
- Trauma: 12%
- MS: 7%
- Neoplasm: 5% (complicated)
- Diabetes (alone): 4%
- CVA: 4%
- s/p neurosurgery: 3%
- Aneurysm: 2% (complicated)
- Other: 8%

Patel SV, et al. *Ophthalmology* 2004

Non Isolated CN VI Palsies

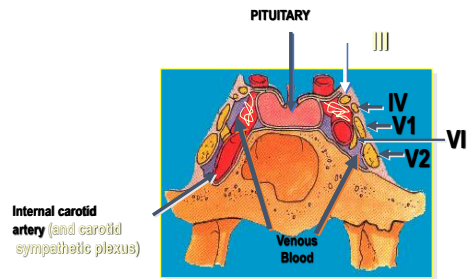
- If CN VII involved with a VI palsy, lesion is in brainstem at pons as VI and VII nuclei are next door neighbors
 - Stroke in adults
 - Demyelination in 20-40 year olds



Non Isolated CN VI Palsies

- If CN IV and or III involved, lesion in cavernous sinus
 - Metastasis, aneurysm, CCF, zoster

Cavernous Sinus Contents



Thank You!