

# 430 Ophthalmology Team

## Neuro Ophthalmology

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The slides were not provided by the doctor  
Sources :- notes taking during lecture + 429 teamwork  
Important Notes in red  
Things doctor said blue  
Notes in Green

## Consists of :-

- Afferent (vision sense "How do you see? How do you test the vision ? and how can you examine the optic nerve and pupils?")
- Efferent ( You are mainly talking about ocular motility as well as abnormality in the pupils size)
- Other

## Afferent System:-

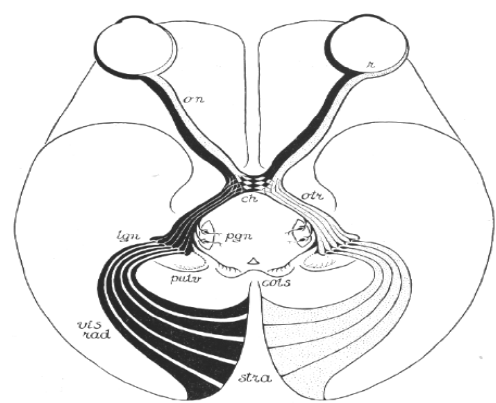
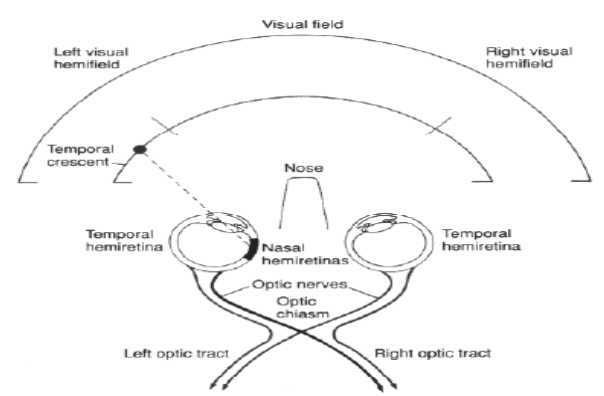
- Anatomy
- Examination
- Diagnoses
- Tests

## Anatomy:-

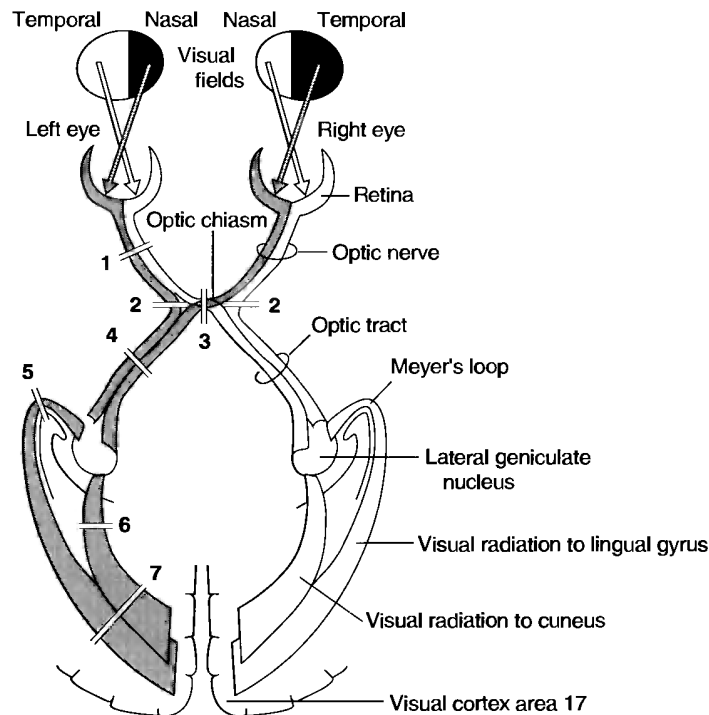
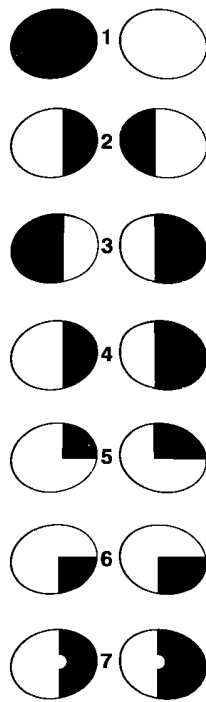
- Vision is generated by photoreceptors in the **retina**, a layer of cells at the back of the eye. The information leaves the eye by the optic nerve, in the chiasm partial axon crossing occurs. After the chiasm the axons are called the **optic tract**. The optic tract wraps around the midbrain to get to the lateral geniculate nucleus (LGN) where all the axons synapse. From there the LGN axons fan out through the deep white matter of the brain as the **optic radiation**, which will ultimately travel to the **primary visual cortex** in the occipital lobe. From there, there is further processing with projections to other cells in the visual cortex and elsewhere resulting in conscious visual perception.

## Blood supply:-

- Inner surface of the retina → Central retinal Artery “ branch of ophthalmic artery “
- Outer Retina → Choroid arteries
- Optic Nerve → Penetrating vessels of the ophthalmic artery running in the optic sheath ( if you remove the sheath, optic nerve will get atrophied).



- Temporal fibers are responsible about the nasal field while nasal fibers are responsible about the temporal field.
- 53% of fibers will decussate and the remaining 47% will remain in the same side.
- If one eye is damaged you will lose one fifth of your field (MCQ).
- Any injury before LGN will make the optic disk pale. If the injury is in the LGN or the optic radiation as in MCA stroke, the optic disc will appear normal.
- Stroke in the occipital lobe will cause visual field defects only, while a stroke in the MCA will give motor and sensory dysfunctions and probably visual if the stroke affects the deep white matter.



#### Important terms:- MCQ

- Hemianopia :Blindness in half of the visual field.
- Congruous Hemianopia :-Identical defect in the 2 visual fields, common with lesions in the posterior optic radiation.
- Incongruous Hemianopia: Defect in the two visual fields that differ in one or more ways, common with lesions of the optic tract.
- Homonymous :Affecting the same part of the visual field of each eye either LT or RT.

-The picture above is very important and here are some steps that you should remember when describing the visual defects above:-

- 1-You should mention the side (is it left or right?)
- 2-Is it hemianopia or quadrantanopia?
- 3-Is it congruous or incongruous?
- 4-Is it superior or inferior?
- 5-Is there any macular sparing?

#### The visual field defect and lesion sites "Important":- MCQ

1-Complete blindness in the LT eye (anopsia) > due to damage to retina, orbit or optic nerve.

3-Bilateral temporal Hemianopia > in pituitary adenoma and acromegaly.

4- RT homonymous congruous hemianopia > lesion is in LT optic tract.

5- RT homonymous congruous superior quadrantanopia >pie in the sky > lesion is in the left temporal lobe.

6- RT homonymous congruous inferior quadrantanopia >pie in the floor > lesion is in the left parietal lobe.

7-RT homonymous hemianopia with macular sparing > the lesion is in the occipital cortex > why there's sparing ? because the macular fibers receive dual blood supply from MCA and PCA.

## Examination:-

### • Visual acuity

- Distance ( ex. Snellen Chart )

- Near

### • Visual field

- **Confrontation test** (check central scotoma by telling the patient to look toward your eye and then asking him do you see it ? sometimes he'll say I can't see it there's something blocking which will indicate central scotoma)

- Goldman

- Humphrey

### • Fundoscopy

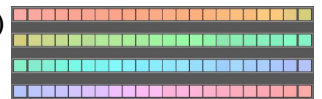
- Light

- Dark

### • Color vision

- Ishihara ( do it monocular "test each eye separately" to check for color blindness but we cannot determine which color is deficient")

- AOC " 100 hu test " ( patients are asked to arrange colored blocks in the right order )



### • Pupil examination

- Direct ophthalmoscopy (higher magnification about 15 times but it's not good for examining the peripheral part of the retina)

- Slit lamp and lens

- Indirect ophthalmoscopy (higher field  $>60^\circ$  (total refractive power of eye)  $\div 20 = 3$  which means that the image is 3 times bigger than the normal)

- Check pupils size and shape (if pupils are unequal this indicates efferent abnormality) .

- Swinging flashlight test and observing the amount of constriction between two eyes to test for RAPD " relative afferent pupillary defect MCQ"

Total right optic nerve damage will not affect the pupillary size in both eyes, in the absence of Horner's syndrome or 3<sup>rd</sup> nerve palsy. Shining the light at the right pupil will not cause any reaction while shining it at the left pupil will constrict both pupils.

### -The doctor gave another example:-

If the nerve in the RT eye was not damaged completely let's say it is damaged by 50%. When you shine the light on the LT eye both LT and RT pupils will constrict by 100%. If you shift the light to the RT pupil that was already constricted by 100% stimulus it can only take 50% because the other 50% is already damaged (constrict less therefore appearing to dilate).

- If the efferent is not functioning you'll see the pupils dilated from the beginning.

- Optic neuropathy affects the color vision early unlike cataract and diabetic retinopathy which affect the visual acuity before the color vision.

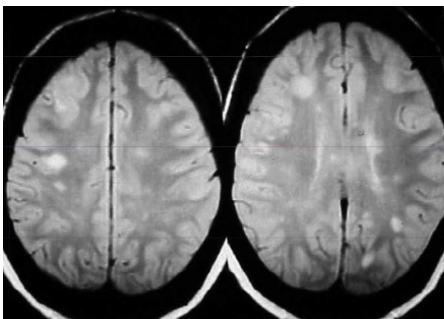
**Diagnosis:**

Ischemic	Congenital and genetic problems	Compression	Trauma	Inflammation
<ul style="list-style-type: none"> <li>- Non-arteritic ischemic</li> <li>- optic neuropathy</li> <li>- Central retinal artery occlusion</li> <li>- Other retinal emboli</li> <li>- Giant cell arteritis with ION ( ischemic optic neuritis )</li> </ul>	<ul style="list-style-type: none"> <li>- Congenital retinal dystrophies</li> <li>- Optic nerve hypoplasia</li> <li>- Leber hereditary optic neuropathy</li> <li>- Dominant and recessive optic atrophy</li> <li>- Glaucoma</li> </ul>	<ul style="list-style-type: none"> <li>- Intraorbital Optic Nerve</li> <li>- Intracranial Optic Nerve</li> <li>- Optic chiasm</li> <li>- Optic tract</li> <li>- Posterior afferent system</li> </ul>	<ul style="list-style-type: none"> <li>- Globe</li> <li>- Intraorbital Optic Nerve</li> <li>- Optic canal</li> <li>- Optic chiasm</li> <li>- Occipital lobe</li> </ul>	<ul style="list-style-type: none"> <li>- Optic neuritis</li> <li>- Orbital pseudotumor</li> <li>- Other</li> </ul>

**Case 1**

25 year old man who was exposed to a firecracker that exploded near his left eye  
 NLP OS ( no light perception in the left eye )

Diagnosis:- optic nerve avulsion

**Case 2**

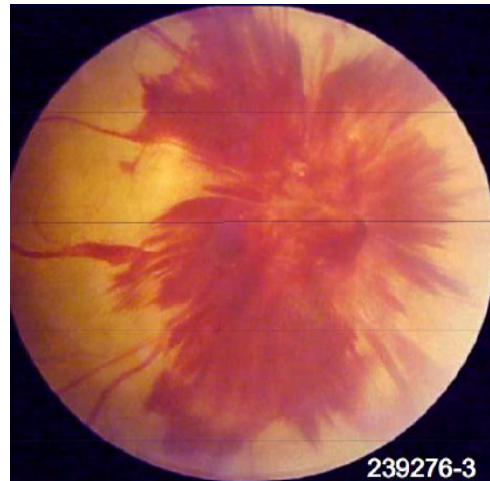
27 y/o woman developed blurred vision OD and mild right periorbital pain  
 VA 20/50, MRI abnormal

Diagnosis: multiple Sclerosis(optic neuritis)

### Case 3 (doctor didn't mention it)

28 y/o woman developed modest left periorbital pain 3 weeks ago  
she has some blurring of vision OS

- B-scan showed posterior scleritis



### Case 4

Bilateral optic nerve swelling

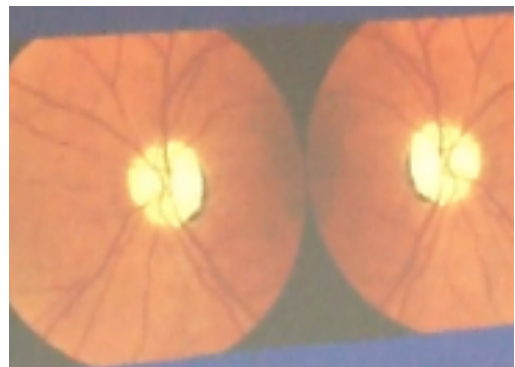


### Case 5:-

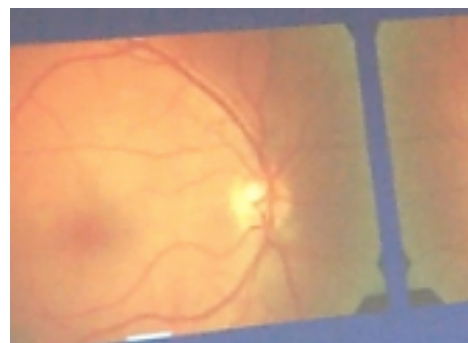
Pale nerve "optic atrophy" due to infection, inflammation or tumor.

-What's the difference between papilledema and bilateral optic disc swelling?

Bilateral optic disc swelling is a general term but papilledema is specific to bilateral optic disc swelling secondary to increase ICP due to tumor, mass, hemorrhage, or pseudotumor cerebri (common in young women from 20-40s).



Normal pic!





Case 4 (not mentioned by the doctor)

14 y/o girl, vision OS began to decline gradually without pain

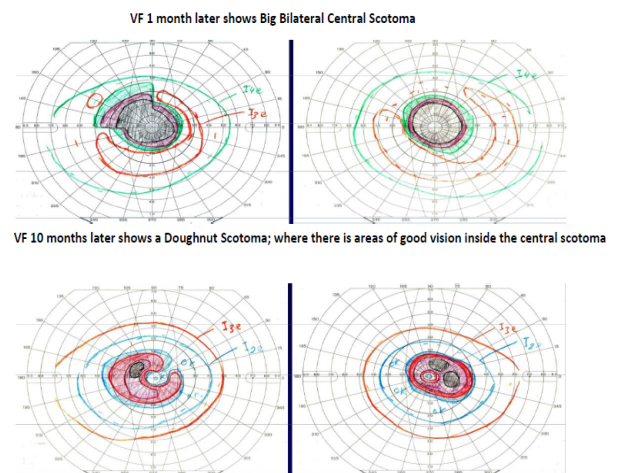
• First visit with VA OD 20/40 and OS CF at 3'

• Pale, flat optic disks OU

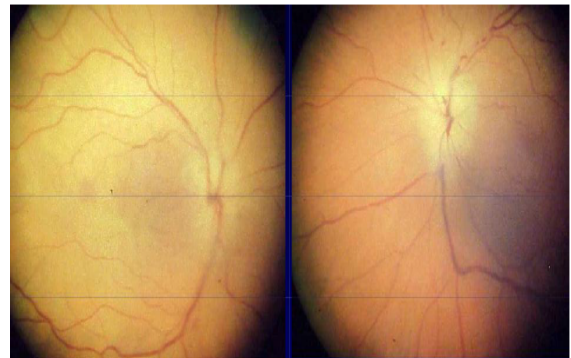
• VA 1 month later CF at 3' OU

• VA 10 months later 20/20 OU

• **Diagnosis** LHON-like optic neuropathy



Day 2



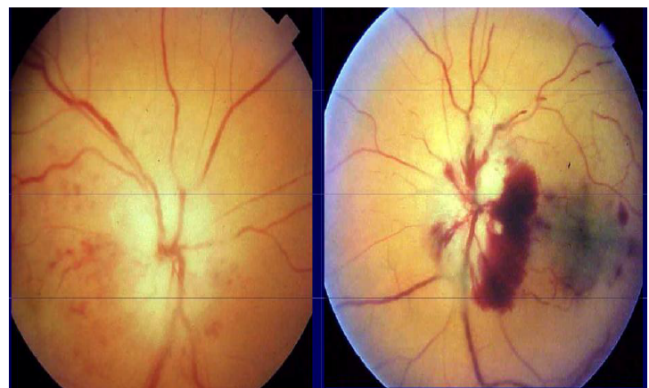
Case 5

Dx :- **Giant cell arteritis**

Can cause blindness in two days.

-SLE and sarcoidosis causes bilateral optic neuropathy

Day 4

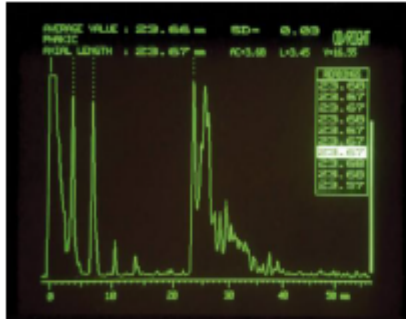


Total blindness in both eyes

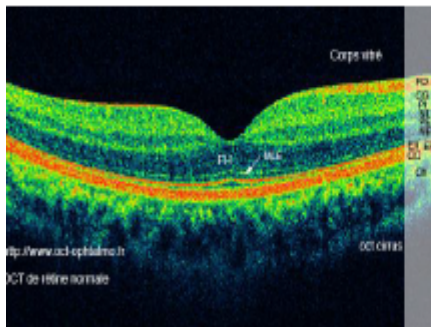
## Tests:-

### • During exam

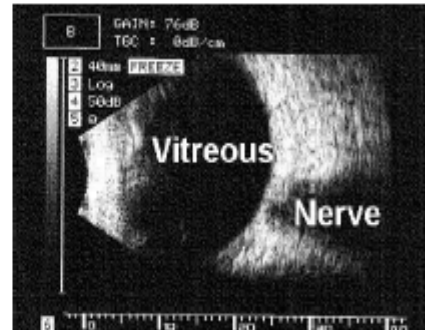
- Visual fields
- A scan



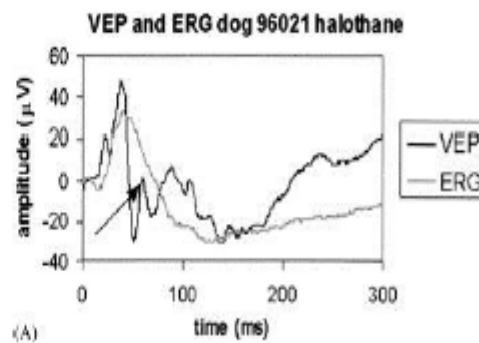
- OCT



- B scan



- ERG/VEP

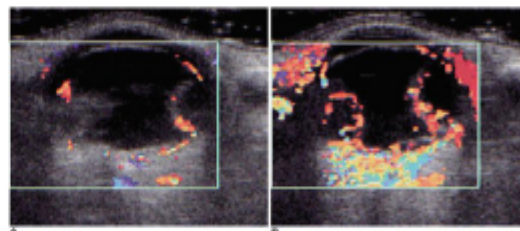


### • Neuro-imaging

- CT scan ( better for bone )
- MRI ( superior to CT )

### • Ultrasound

- Orbital color Doppler
- Carotid Doppler



### • Blood tests

- Vasculitis (ESR, CBC, ANA, VDRL)
- Uremia (BUN, Creatinine, U/A )
- Liver function tests SGOT, SGPT, alkaline phosphatase)
- Electrolytes
- Genetic evaluation

All blood test must be done.  
Although Syphilis is rare but  
the VDRL test should be done  
because it is easily treatable

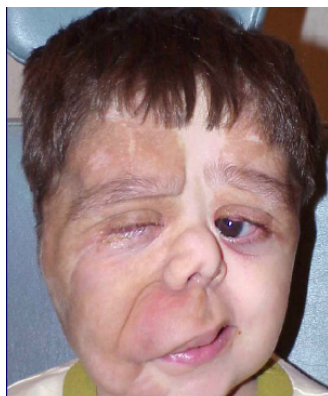
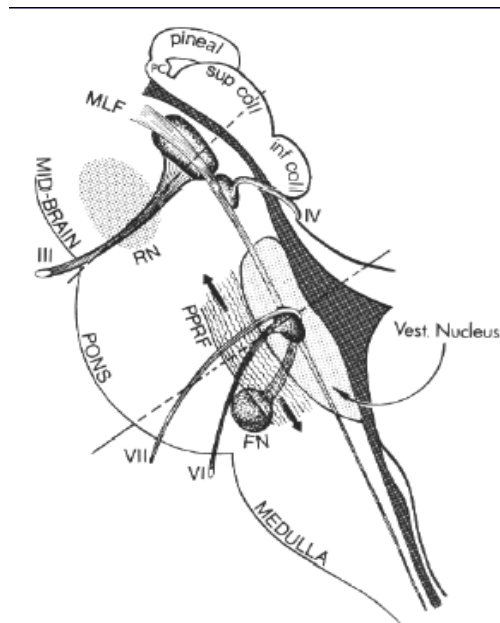


## Efferent System

- Anatomy
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### Anatomy:

- The facial nerve (7th) loops around the nucleus of the 6th cranial nerve. A single brain mass affecting both of them together is not uncommon.
- The 3rd nerve runs across the top of the cavernous sinus in about half its length and this has an important clinical implication. PCA is located above the cavernous sinus so commonly the 3rd nerve would be affected if a PCA aneurysm ruptures
- 4th cranial nerve is the only nerve located posteriorly and immediately decussating and runs in a horizontal course.
- 6th cranial nerve has the longest intracranial course of cranial nerves and can be damaged in the brain stem or more often in its intracranial course.
- Cavernous sinus wall is formed of the tough dura matter. If the internal carotid artery ruptures here, the high blood pressure of the artery will be contained within the sinus, given rise to a C-C fistula (carotid-cavernous). Patients usually present with sudden or insidious onset of redness in one eye associated with progressive proptosis or bulging.



Neurofibromatosis type 1 affecting the development of the skull and the globe.  
The picture show a big orbit and the superior orbital fissure is 5 times bigger

Not mentioned by the doctor!

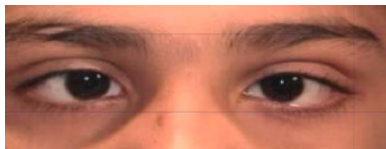
- **Examinations** :- Just look at patient



- Are eyes straight? No! there's esotropia.



Are the eyes proptotic? Yes! Also, there's lid retraction and injection of sclera.



Are there any spontaneous eye movements?  
Yes there's nystagmus



What is the lid position?  
Ptosis + dilated pupil in the Rt eye.

-Movements of both eyes in all directions(its binocular) .

- Have the patient move eyes in all directions, not just the direction where you think there is a problem.

- Hold lids if necessary (only after looking first without holding lids).

- Examine each eye separately if necessary  
(if the patient has one eye, in children with esotropia +crossed fixation)



**Hold lids** if the patient looks down to compare the upper border of limbus to detect mild inferior movement abnormality. In the pic (complete ptosis + dilated pupil in the LT eye).

## • Smooth pursuit

Allow the eyes to closely follow a relatively slowly moving object while your head is stable(slow eye movement). Normally, both eyes move together in a smooth way.

## • Saccades (fast eye movement):-

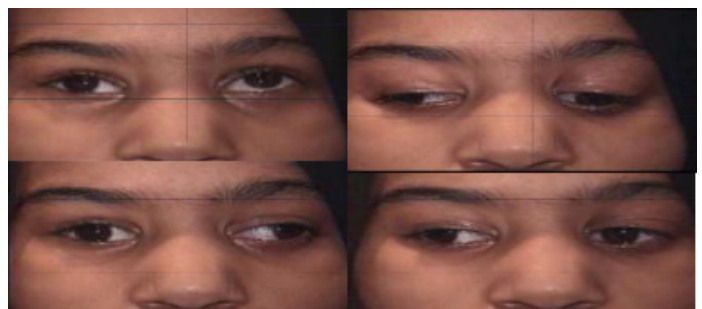
- The reflex that permits a rapid refixation from one point in the visual field to another.

- They are quick simultaneous movement of both eyes in the same direction.

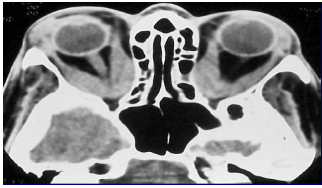
- **Saccadic dysmetria** in cerebellar disease ( patients eyes go beyond and come back)

**Case** (not mentioned by the doctor)  
10 y/o girl born with weakness of the face. The parents noticed unusual eye movements at early age

**Diagnosis** bilateral Mobius Syndrome,  
Rt >Lt or possible congenital injury to the 3rd cranial nerve OD.



## Diagnosis:



**Extraocular muscles** (inflamed or enlarged muscles may damage the optic nerve at the narrow apex).



**Mass:-**Left optic nerve sheath meningioma resected. Developed progressive ptosis with pain, treated as sinusitis and resolved.



Neuromuscular junction :-

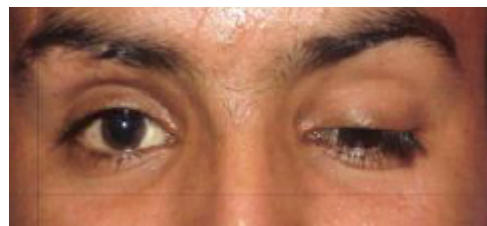
**Dx: Myasthenia gravis** (bilateral ptosis, patient try to overcome the ptosis by elevating the eyebrows, absent wrinkles cause muscle tone is weak).



**Trauma :-**  
Ocular dystopia (due to blowout fracture to floor of orbit)



**Single cranial nerves:-** Congenital 4th nerve palsy, note that the right eye is slightly higher. The pt may complain of vertical diplopia which gets worse when the affected eye looks toward the nose.



**Single cranial nerves:-** Oculomotor nerve (3)

A complete oculomotor nerve palsy will result in a characteristic down and out position in the affected eye. The eye will be displaced downward, because the superior oblique (innervated by the 4th nerve) is unantagonized by the paralyzed superior rectus and inferior oblique. It will be displaced outward because the lateral rectus (innervated by the 6th nerve) is unantagonized by the paralyzed medial rectus. The affected individual will also have a ptosis or dropping of the eyelid and pupil dilatation.



**- Single cranial nerves:-** Abducent nerve (6)  
>Right eye does not abduct



### -Others:-



Neurofibromatosis

- Dysmorphism



Unusual teeth



This Patient has tuberous sclerosis(usually comes with astrocytoma"brain tumor"). In the pic you can see adenoma sebaceum which is rash of reddish spots or bumps, which appear on the nose and cheeks in a butterfly distribution. ( The doctor said that you don't need to remember it)!



**Unusual posture :-**

Dx : Congenital fibrosis of the ocular muscles type 1, the hallmark is that the patient tilt his head back because the eyes can't be elevated to primary gaze.

- Can develop spinal deformity if left untreated.