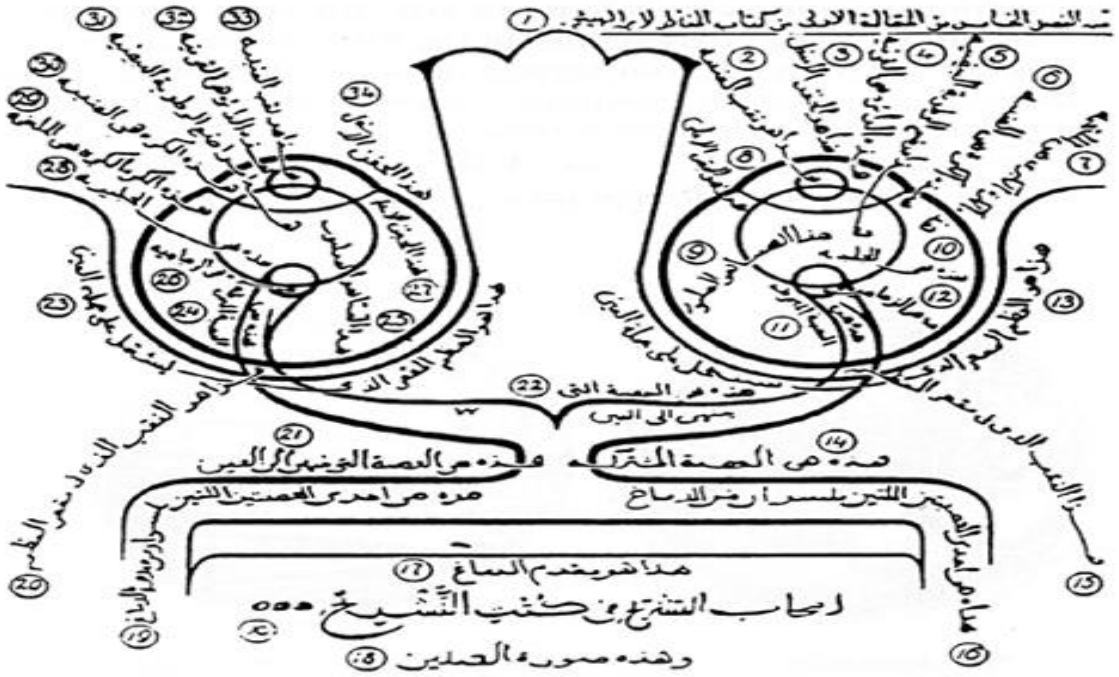
DIPLOPIA DEMISTIFIED: A GLOBAL DIAGNOSTIC APPROACH FROM BRAIN TO MUSCLE



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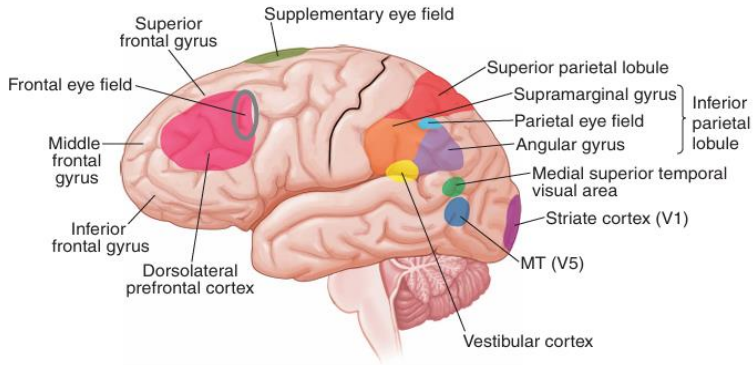
Disclosure

- None

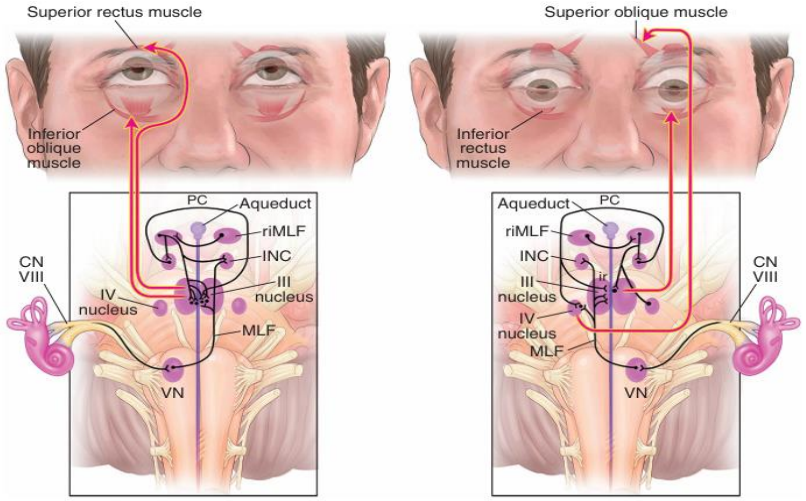
By the end of this session, participants will be able to:

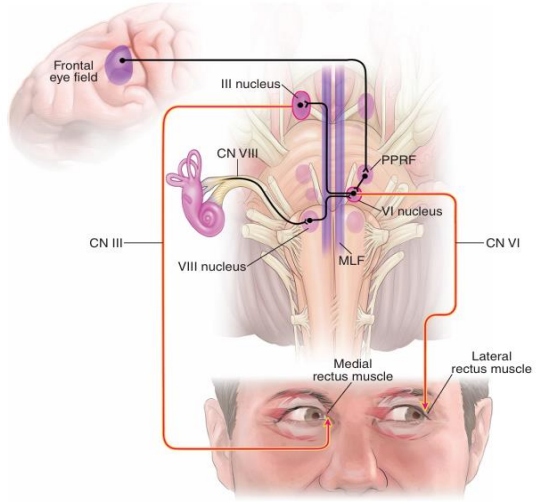
- Define diplopia, differentiate between monocular and binocular causes and Differentiating Paretic From Restrictive causes of Diplopia
- Trace the neural pathways governing eye movements, from supranuclear inputs to cranial nerves (III, IV, VI).
- Localize lesions systematically (brainstem, neuromuscular junction, extraocular muscles) and recognize etiologies by leve
- Apply a stepwise diagnostic approach (history, exam, ancillary tests like Hess screen, neuroimaging).

ANATOMICAL REVIEW – THE EYE MOVEMENT PATHWAY (FROM CORTEX TO ORBIT)

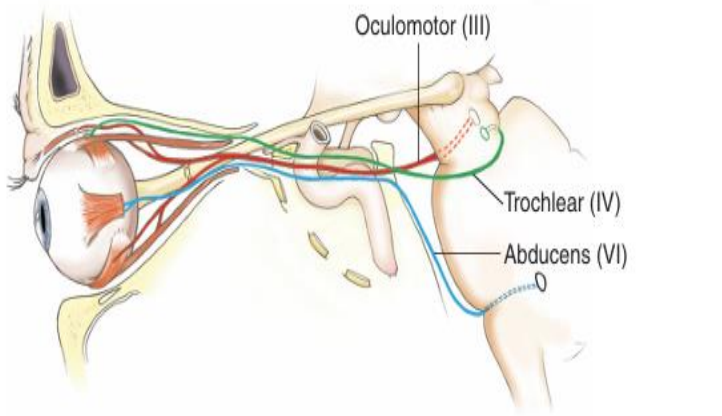


Overview of the cortical centers that control human eye movements. MT = midc temporal visual area. *(Redrawn by Rob Flewell, CMI.)*





Anatomical scheme for the synthesis of horizontal eye movements.



Lateral view of the course of CNs III, IV, and VI. *(Illustration by Dave Peace.)*

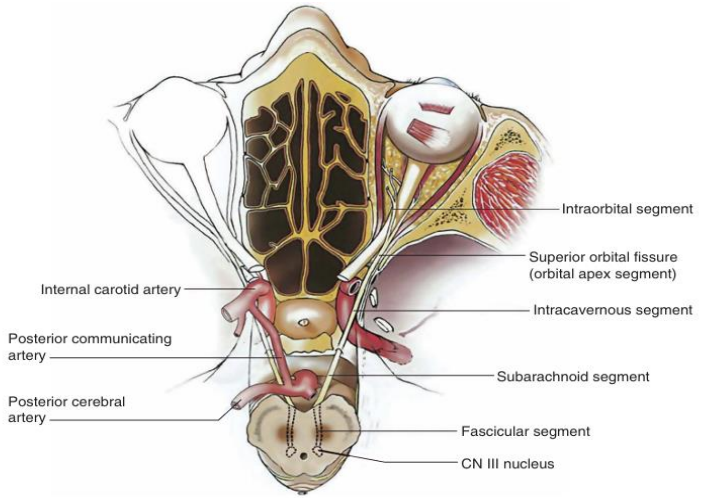
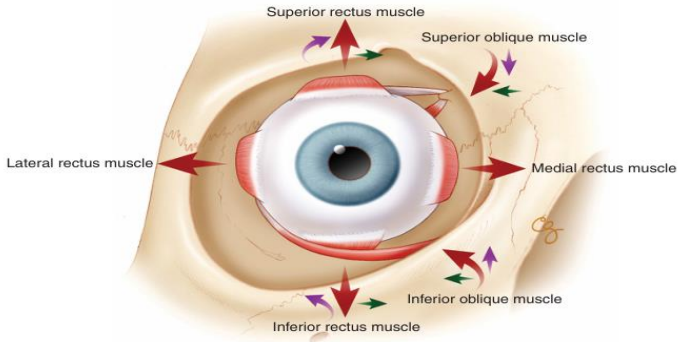


Illustration of the axial course of CN III from its origin in the midbrain. *(Reprinted from Foroozan R, Bhatti MT, Rhoton AL. Transsphenoidal diplopia. Surv Ophthalmol. 2004;49(3):352;*



Muscle	Primary	Secondary	Tertiary
Medial rectus	Adduction		
Lateral rectus	Abduction		
Inferior rectus	Depression	Extorsion	Adduction
Superior rectus	Elevation	Intorsion	Adduction
Inferior oblique	Extorsion	Elevation	Abduction
Superior oblique	Intorsion	Depression	Abduction

Primary, secondary, and tertiary functions of the extraocular muscles, right eye. *(Illustration by Christine Gralapp.)*

Localization of Potential Lesions

1.Supranuclear Causes of Abnormal Ocular Motility:

- Most supranuclear disorders affect both eyes equally and therefore do not cause diplopia except certain lesions:

Convergence insufficiency or spasm

Divergence insufficiency

Ocular tilt reaction

Skew/alternating skew deviation

Thalamic esodeviation

Localization of Potential Lesions

2. Nuclear Causes of Diplopia

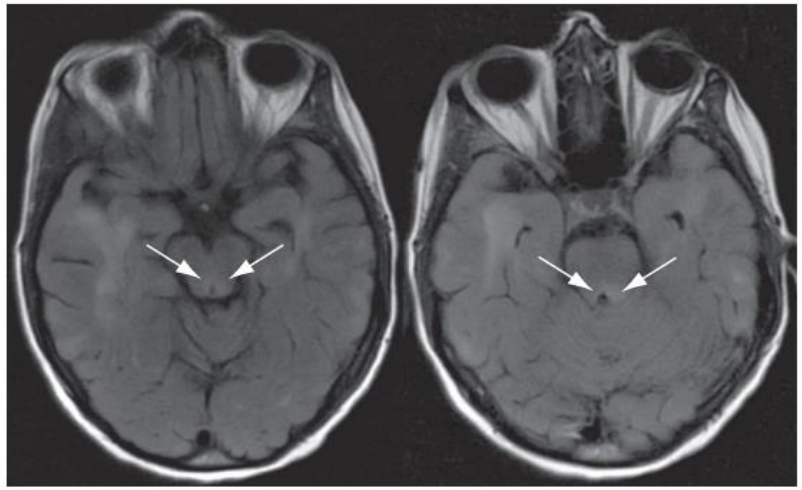
- The CN III nucleus lesions
- The CN IV nucleus lesions
- The CN VI nucleus lesions

3.Internuclear Causes of Diplopia

- Internuclear Ophthalmoplegia
- One- and- a- Half Syndrome

4.Ocular Motor Cranial Nerve Palsies

- The CN III Palsy : Pupil- involving nerve palsy, Pupil-sparing nerve palsy, Divisional third cranial nerve palsy and Aberrant regeneration of the third cranial nerve
- The CN IV Palsy
- The CN VI palsy
- Recurrent Painful Ophthalmoplegic Neuropathy



Bilateral internuclear ophthalmoplegia in a 53-year-old man with diplopia on lateral gazes.

One-and-a-half syndrome. This 15-year-old patient had a brainstem glioma that caused a gaze palsy to the left *(right photograph)* and a left internuclear ophthalmoplegia (evident here as incomplete adduction of the left eye on gaze to the right; *left photograph*). The only intact horizontal eye movement was abduction of the right eye. *(Courtesy of Steven A. Newman, MD.)*

Espinosa PS. Teaching NeuroImage: one-and-a-half syndrome. *Neurology.* 2008;70(5):e20.
Johkura K, Kudo Y, Amano Y, et al. Gaze palsy and exotropia in internuclear ophthalmoplegia. *J Neurol Sci.* 2015;353(1–2):158–160.

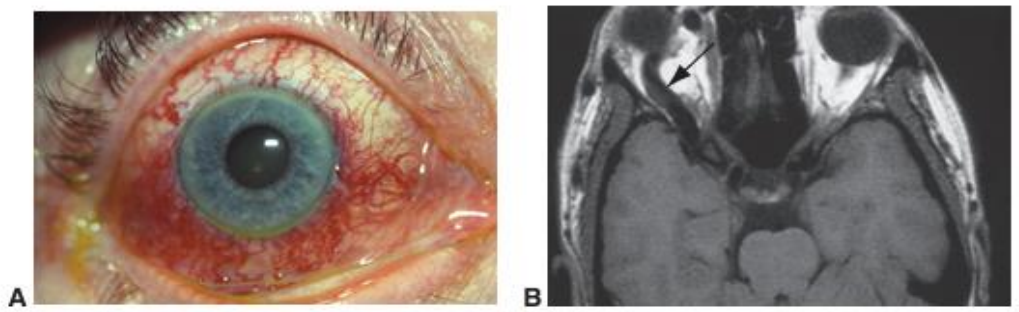
Localization of Potential Lesions

5.Paresis of More Than One Cranial Nerve

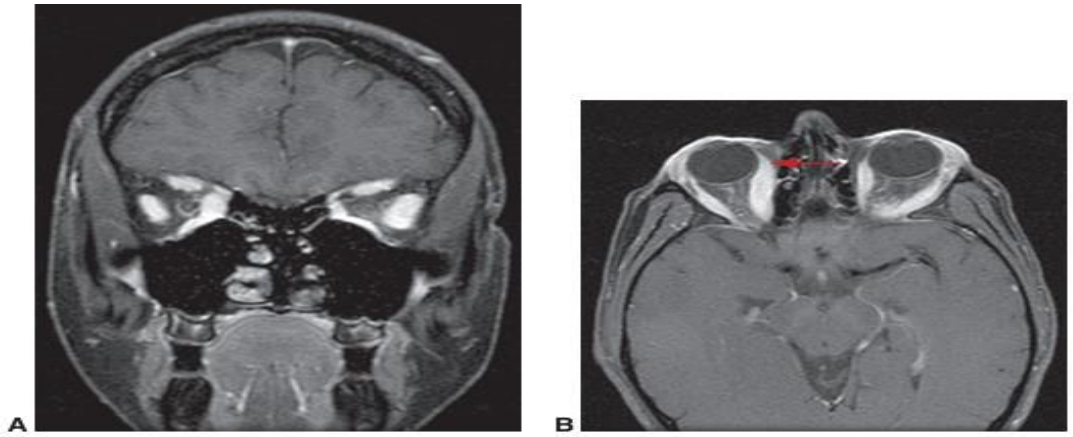
- Cavernous Sinus and Orbital Apex Involvement
- Tolosa-Hunt syndrome
- Carotid- cavernous sinus fistula

6.Myopathic, Restrictive, Orbital, Neuromuscular, and Other Causes of Diplopia

- Thyroid Eye Disease
- Orbital Myositis
- Posttraumatic Restriction
- Postsurgical Restriction
- Chronic Progressive External Ophthalmoplegia
- Neoplastic Involvement
- Heavy Eye Syndrome
- Sagging Eye Syndrome
- Ocular Neuromyotonia
- Neuromuscular Junction Causes of Diplopia
- Foveal Displacement Syndrome



Right carotid-cavernous sinus fistula. **A,** The elevated orbital venous pressure produces enlarged, corkscrew, arterialized episcleral and conjunctival blood vessels that extend to the limbus. **B,** Axial T1-weighted magnetic resonance imaging reveals an enlarged, dilated superior ophthalmic vein *(arrow)*. *(Courtesy of Karl C. Golnik, MD.)*



Orbital myositis. **A,** Coronal, T1-weighted, fat-suppressed magnetic resonance image with contrast shows enlargement and enhancement of the lateral, medial, and superior recti muscles of both eyes. **B,** Axial view shows involvement of the tendons *(arrow)*. *(Courtesy of James A. Garrity, MD.)*

Conclusion:

- Diplopia is typically caused by disruption of the infranuclear or internuclear pathways of the efferent visual system.
- Cranial nerve (CN) III, IV, and VI palsies cause diplopia with distinct strabismus patterns that can be differentiated on the basis of a detailed ocular motility examination.
- CN III palsy with or without pupillary involvement is due to an intracranial aneurysm until proven other wise.
- When diplopia does not follow a specific CN pattern, other causes, such as myasthenia gravis, thyroid eye disease, and carotid- cavernous fistula, should be considered