Pupillary Light Reflex
relative afferent pupillary defect (RAPD)
relative afferent pupillary defect (RAPD)

swinging-flashlight test
relative afferent pupillary defect (RAPD)
relative afferent pupillary defect (RAPD)

- Usually before the chiasm problem
  - Retinal detachment
  - Ischemic retina
  - Optic nerve: ischemia, compression neuritis, recovered neuritis, etc.
  - Diabetic retinopathy
  - Demyelination (MS)
- Unilateral Optic track lesion
- Unilateral mid brain lesion
Accommodation and parasympathetic

The pupil near reflex
Pupillary Adjustment
extrastriatal
light-near dissociation
light-near dissociation

- Adie’s tonic pupil
- Damage to the dorsal mid-brain (tectal area) around the cerebral aqueduct “but not the E W nucleus”
  - Stroke
  - Meningitis
  - Tumor
  - Neurosyphilis
  - Diabetic neuropathy
  - Demyelination (MS)
- Dorsal midbrain syndrome
  (Parinaud's Syndrome)
Anisocoria
Anisocoria

- Efferent pathway or the eye itself
- Adie’s tonic pupil
- One side Dorsal midbrain syndrome
- Horner syndrome
Corticospinal and Corticonuclear Projections
Corticospinal pathway

- Primary motor area (precentral gyrus)
- Premotor area
- Primary gustatory area
- Frontal eye field area
- Frontal lobe
- Broca's speech area
- Prefrontal cortex
- Lateral cerebral sulcus
- Primary auditory area
- Anterior

- Right side of body
  - Internal capsule
  - Cerebral peduncle
- Upper motor neuron
- Pons
- Midbrain
- Medulla
- Pyramid
- Decussation (crossing) in medulla
- Spinal cord
- Spinal nerve
  - Lower motor neuron
  - To skeletal muscles in the distal parts of the limbs
The Motor Cortex
Corticospinal Fibers:
- Somatotopy,
- Laterality,
- Trajectory

Text Fig. 25-6, see also Atlas Figs. 8-13, 8-14A and 8-14B
Internal Capsule in MRI

Atlas Fig. 5-12
Corticospinal Fibers In MRI:

Atlas Fig. 8-14A
Corticospinal Fibers In MRI:

Atlas Fig. 8-14A
Expanding Extramedullary Lesion
<table>
<thead>
<tr>
<th><strong>Upper Motor Neuron Syndrome</strong></th>
<th><strong>Lower Motor Neuron Syndrome</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Weakness</td>
<td>Weakness or paralysis</td>
</tr>
<tr>
<td>Spasticity</td>
<td>Decreased superficial reflexes</td>
</tr>
<tr>
<td>Increased tone</td>
<td>Hypoactive deep reflexes</td>
</tr>
<tr>
<td>Hyperactive deep reflexes</td>
<td>Decreased tone</td>
</tr>
<tr>
<td>Clonus</td>
<td>Fasciculations and fibrillations</td>
</tr>
<tr>
<td>Babinski’s sign</td>
<td>Severe muscle atrophy</td>
</tr>
<tr>
<td>Loss of fine voluntary movements</td>
<td></td>
</tr>
</tbody>
</table>
Pyramidotomy
5 months after pyramidal tract lesion:
Corticonuclear Projections
Corticonuclear Fibers

- Direct to motor neurons of nucleus
- Indirect to motor neurons via adjacent reticular formation
- Bilateral projection
- Primarily crossed projections

Motor cortex, precentral gyrus

Frontal eye field

Bilateral for upper face

Genu of IC

rtMLF
OcNu
TroNu
TrlMoNu
PPRF
AbdNu
FacNu
Crossed for lower face
NuAm
Crossed for uvula (soft palate)
Crossed for genioglossus muscle
HyNu
AccNu
Internal Capsule in MRI
Accessory Nerve CN XI

- Direct to motor neurons of nucleus
- Indirect to motor neurons via adjacent reticular formation
- Bilateral projection
- Primarily crossed projections

Key:
- Genu of IC
- Motor cortex, precentral gyrus
- Frontal eye field
- rMLF
- OcNu
- TroNu
- TriMoNu
- PPRF
- AbdNu
- FacNu
- Crossed for lower face
- NuAm
- Crossed for uvula (soft palate)
- Crossed for genioglossus muscle
- HyNu
- AccNu

* Indicates important points or regions related to the accessory nerve.
Accessory Nerve CN XI

Motor neurons in the cervical spinal cord → Trapezius & sternocleidomastoid muscles
The sternocleidomastoid will tilt the head towards the shoulder on the same side, thereby, rotating the head to turn the face to the opposite direction.
Trigeminal Nerve: CN V

- Direct to motor neurons of nucleus
- Indirect to motor neurons via adjacent reticular formation
- Bilateral projections
- Primarily crossed projections
Facial Nerve: CN VII
Facial Nerve: CN VII

- Direct to motor neurons of nucleus
- Indirect to motor neurons via adjacent reticular formation
- Bilateral projection
- Primarily crossed projections

Motor cortex, precentral gyrus
Genu of IC
Bilateral for upper face

TriMoNu
PPRF
AbdNu
FacNu
NuAm
HyNu
AccNu

Frontal eye field

Crossed for lower face
Crossed for uvula (soft palate)
Crossed for genioglossus muscle
The Facial Nerve

Central Seven

Bell Palsy
Corticonuclear Fibers

Text Fig. 25-15

Nucleus ambiguus

Hypoglossal nucleus
Lesion of the Hypoglossal Nerve

Text Fig. 25-16
Control of eye movement
Lateral rectus

1° - Abduction
To test - look lateral

Superior rectus

1° - Elevation
2° - Intorsion & adduction
To test - look out then up

Superior oblique

1° - Intorsion
2° - Depresion & abduction
To test - look in then down

Optic nerve

Medial rectus

1° - Adduction
To test - look medial

Nose

Eye

Annulus

Nose

Inferior rectus

1° - Depression
2° - Extorsion & adduction
To test - look out then down

Inferior oblique

1° - Extorsion
2° - Elevation & abduction
To test - look in then up
Third Nerve Palsy

Eye “down and out”
Trochlear Nerve Palsy

Note: Right eye

- Instead of intorsion and depression action of superior oblique
- See extorsion and elevation

Observe how the axes over the right eye shift when patient generates a compensatory head movement

Attempted Correction:
- Patient tilts head to her left
- Tucks chin to foveate on object
- Left eye will align accordingly
Abducent nerve injury
Conjugate Movements:

1. Saccadic
2. Tracking (pursuit)
3. Vestibulo-Ocular Reflex
4. Optokinetic Reflex
Disconjugate Movements:

5. Vergence
Basic pathway for controlling saccadic eye movements
Basic pathway for controlling saccadic eye movements
Basic pathway for controlling visual pursuit eye movements
Conjugate eye movements

Disconjugate eye movements
Conjugate eye movements

Disconjugate eye movements

Internuclear Ophthalmoplegia
ONE-AND-A-HALF SYNDROME
<table>
<thead>
<tr>
<th>Ocular reflexes in conscious patients</th>
<th>Ocular reflexes in unconscious patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Normal</td>
<td>(3) MLF lesion (bilateral)</td>
</tr>
<tr>
<td>(2) Brainstem intact</td>
<td>(4) Low brainstem lesion</td>
</tr>
</tbody>
</table>

- **Cold H₂O**
- **Warm H₂O**
The Uncus and Uncal Herniation
Uncus
The Uncus and Uncal Herniation
The Kernohan Syndrome

Text Fig. 25-18

Atlas Fig. 5-23
<table>
<thead>
<tr>
<th>SYNDROME</th>
<th>STRUCTURES INVOLVED</th>
<th>CORRESPONDING DEFICIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benedikt syndrome (Weber and Claude)</td>
<td>Corticospinal fibers in crus, Oculomotor nerve fibers, Red nucleus, Cerebellothalamic fibers (Medial lemniscus)</td>
<td>Contralateral hemiplegia, Ipsilateral oculomotor palsy, dilated pupil, diplopia, Contralateral tremor, hyperkinesias, Contralateral ataxia (Contralateral loss of vibratory sense, position sense, discriminative touch)</td>
</tr>
<tr>
<td>Claude syndrome†</td>
<td>Oculomotor nerve fibers, Red nucleus, Cerebellothalamic fibers (Trochlear nucleus)</td>
<td>Ipsilateral oculomotor palsy, dilated pupil, diplopia, Contralateral tremor, hyperkinesias, Contralateral ataxia (Weakness of contralateral superior oblique muscle)</td>
</tr>
<tr>
<td>Dejerine syndrome (medial medullary)</td>
<td>Corticospinal fibers in pyramid, Hypoglossal nerve fibers or nucleus, Medial lemniscus</td>
<td>Contralateral hemiplegia, Ipsilateral deviation of tongue on protrusion, Contralateral loss of vibratory sense, position sense, discriminative touch</td>
</tr>
<tr>
<td>Foville syndrome‡</td>
<td>Corticospinal fibers in basilar pons, Abducens nerve fibers, Middle cerebellar peduncle</td>
<td>Contralateral hemiplegia, Ipsilateral abducens (lateral rectus) palsy, diplopia, Ataxia</td>
</tr>
<tr>
<td>Gubler or Millard-Gubler syndrome§</td>
<td>Corticospinal fibers in basilar pons, Facial nerve fibers or nucleus (Anterolateral system), (Trigeminal nerve fibers)</td>
<td>Contralateral hemiplegia, Ipsilateral weakness of facial muscles (Impaired pain and thermal sense on contralateral side of body), (Impaired pain and thermal sense on ipsilateral side of face)</td>
</tr>
<tr>
<td>Midpontine base syndrome</td>
<td>Corticospinal fibers in basilar pons, Trigeminal nerve fibers, Middle cerebellar peduncle</td>
<td>Contralateral hemiplegia, Ipsilateral paralysis of masticatory muscles; ipsilateral loss of pain and thermal sensations on face, Ataxia</td>
</tr>
<tr>
<td>Raymond syndrome</td>
<td>Corticospinal fibers in basilar pons, Abducens fibers in basilar pons</td>
<td>Contralateral hemiplegia, Ipsilateral abducens (lateral rectus) palsy, diplopia</td>
</tr>
<tr>
<td>Wallenberg syndrome (lateral medullary, posterior inferior cerebellar artery)</td>
<td>Spinal trigeminal tract, Anterolateral system, Vestibular nuclei, Nucleus ambiguus, Restiform body</td>
<td>Ipsilateral loss of pain and thermal sense on face, Contralateral loss of pain and thermal sense on the body, Vertigo, nystagmus, nausea, vomiting, Hoarseness, dysphagia, deviation of the uvula to opposite side on phonation, Ataxia</td>
</tr>
<tr>
<td>Weber syndrome</td>
<td>Corticospinal fibers in crus, Oculomotor nerve fibers, Corticonuclear fibers in crus, Substantia nigra</td>
<td>Contralateral hemiplegia, Ipsilateral oculomotor palsy, dilated pupil, diplopia, Contralateral weakness of facial muscles on lower half of face; deviation of the tongue to contralateral side on protrusion, ipsilateral weakness of trapezius and sternocleidomastoid muscles, Contralateral Parkinson-like tremor, akinesia</td>
</tr>
</tbody>
</table>

Table 25-1