Spinal Cord and Reflexes

An Introduction
**Vertebra**

- C1-7
- Cervical enlargement
- T1-12
- L1-5
- Conus medullaris
- S1-4 or S5
- Co1-3 or 4

**Nerve S**

- C1-8
- Lumbar enlargement
- L1-5
- Conus equina
- S1-5
- Zilum termination
- Co1
- Co1

*Paired*
Spinal Cord – Cross Section

1. Sensory nerve
2. Motor nerve
3. Posterior root ganglion
4. Posterior root
5. Anterior root
6. Spinal nerve
7. Posterior white column
8. Anterior white column
9. Anterior grey horn
10. Posterior grey horn
11. Grey commissure
12. Central canal
13. Anterior median fissure
14. Posterior median fissure
15. Lateral white column
Spinal Cord Levels -- Anatomy

- Hi cervical
  - Greatest white matter
- Cervical enlargement
  - Grey matter large; innervates extremities
- Thoracic
- Lumbar/enlargement
  - Grey matter large; innervates extremities
- High sacral
  - Grey matter large; innervates extremities; least white matter

- Grey matter
- Spinal root of XI
Spinal Cord Levels -- Physiology

- Cervical enlargement (C3-T1)
  - Hand
  - Forearm
  - Arm

- T2-L1
  - Ribs
  - Back
  - Abdomen

- L2-S5
  - Foot
  - Leg
  - Thigh
  - Hip
  - Extensor
  - Flexor
  - Abductor
  - Adductor
Spinal Cord Levels – Clinical Applications
Dermatomes

1. Considerable overlap between neighboring dermatomes – as much as up to 8 dermatomes away
2. Borders are not exactly the same for touch as for pain and temperature
3. Dermatomes for pain and temp somewhat less extensive
4. Touch fibers belonging to a dorsal root overlap with those from neighboring roots moreso than do fibers for pain and temp.
Applications of Dermatomes

• Intact Dermatomes
  1. C3-5 = diaphragm = ok
  2. C4 = shoulder shrugs = ok
  3. C5 = deltoid and elbow flexes = ok
  4. C7 = wrist flexes = ok
  5. C5-6 = biceps reflex = ok
  6. C7 = triceps reflex = ok
  7. L2 = hip flexes = ok
  8. L3-4 = knee extends = ok
  9. L5-S1 = dorsiflexion = ok
  10. S1-S2 = plantarflexion = ok

• Lesions and Functional Goals
  1. C5 → run electric wheelchair with mouth
  2. C6 → feed self with clip-ons
  3. C7 → drive car with hand controls
  4. C8 → transfer by self to/from bed, auto, toilet
  5. T1-8 → transfers self to/from tub
  6. T9-12 → ambulate with braces and crutches
  7. S1-2 → ambulate with cane
Cord Overview
1. Gracile fasciculi – to medulla; body position, recognize touch, shape, texture, size
2. Cuneate fasciculi – Ibid.
4. Posterior spinocerebellar tract – to cerebellum; movement and posture
6. Anterior spinocerebellar tract – Ibid.
9. Vestibulospinal tract – from vestibular nuclei; equilibrium and balance

Ipsilateral activity
Spinal Cord Tracts – Physiology, too --

3. Lateral corticospinal tract – aka pyramidal tract; voluntary movements

5. Rubrospinal stract – from red nucleus; movement and posture

7. Lateral spinothalamic tract – to thalamus; pain and temperature

8. Reticulospinal tract – from reticular activating system; increases motor activity

10. Anterior spinothalamic tract – to thalamus; pressure, crude touch, posture and muscle action

11. Anterior corticospinal tract – part of pyramidal tract; from motor cortical area; voluntary movements

Contralateral activity
Cord Overview -- Again
Cord by Region

Cervical Cord
C = shortest, thinnest axons
S = longest, thickest axons

Thoracic Cord
Cord by Region -- 2
Cord by Region -- 3

- Note “lamination” of regions
- Note “loss” of regions as the cord goes farther down
- Note orientation of laminates between AP and PA views
Sensory Abnormality Problems and Patterns

An Elementary Overview
Thalamic Lesion

- Complete hemianalgesia (The inability to feel pain on one side of the body.)
Cauda equina Lesion

- Loss of sensation over sacral segments
- May be unilateral – usually bilateral
- Referred to as “saddle sensory disturbances” in a generic sense
Central cord Lesion

- Temperature and pain sensation loss
- Normal touch
Half-cord Lesion

1. Pain/Temp sensation loss
2. Positional/vibrational loss
Whole-cord Lesion

- Complete loss of sensation at a specific level
- May not make 100% sense given overlap of dermatome and myotome activities
Pyramidal Tracts – aka Corticospinal Tracts
Motor Neurons

**Upper Motor Neurons**
- Found in corticospinal (or pyramidal tract) in brain/spinal cord

**Clinical Signs:**
1. Loss of voluntary movement
2. Spasticity
3. Sensory loss
4. Pathological reflexes (2+ is “normal”; >2+)

**Injury:**
1. Hemiplegia (paralysis of half of the body)
2. Paraplegia (paralysis of lower portion of body and both legs)
3. Quadriplegia (paralysis of all 4 limbs – aka tetraplegia)

**Lower Motor Neurons**
- Include anterior horn cells, nerve roots, peripheral nervous system cells

**Injury:**
1. Diminished reflexes (< 2+)
2. Flaccid paralysis
3. Muscular atrophy
Stretch Reflex – Mono-Synaptic
Deep Tendon Reflexes – DTR’s – Polysynaptic – Reverses Stretch Reflex
Crossed Extensor/Flexor Mixed Reflex

- The “Defend-Yourself” Reflex
- The “Step On-A-Tack” Reflex
Reflexes

An Introduction
Achilles’ Tendon Reflex

• Percuss the Achilles’ tendon
• Foot plantar flexes
• The flexion is exaggerated with upper motor neuron damage
• Flexion is decreased or absent with lower motor neuron damage
• aka ankle jerk reflex

• May percuss as above
• May percuss as shown in lab
Babinski – A Busy Feller

**Babinski’s Reflex**
- Dorsiflexion of Toe #1 following lateral to medial stroking of the sole (normal)
- If toe extends and outer toes flare = + for pyramidal tract lesions
- Abnormal response is present in infants until right at 6 months’ of age

**Babinski’s Sign**
- Decreased or absent achilles’ tendon reflex in sciatica
Biceps Reflex

- Percuss the biceps brachii insertion tendon
- Forearm flexes (may need to feel tendon jerk under thumb)
- May percuss as shown to the right
- May percuss as shown in lab
## “C” Reflexes

<table>
<thead>
<tr>
<th>Ciliospinal</th>
<th>Corneal</th>
<th>Cremasteric</th>
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</thead>
<tbody>
<tr>
<td>Stroke/pinch/scratch skin of back of neck</td>
<td>Eyelids close due to corneal irritation</td>
<td>Stroke front of inner thigh</td>
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<tr>
<td>Observe pupillary dilation</td>
<td></td>
<td>Causes testicular retraction</td>
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</tbody>
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Light Reflex

- Pupil constricts with light shone into it
Moro Startle Reflex

- Blow in face
- Blow on top of abdomen
- Infant responds with rapid abduction/extension of arms with adduction of arms (embracing/hugging)

- Disappears after 1-2 months’ of age
- If absent or unilateral, the presence of this reflex may suggest brain damage or a birth-originated injury
Patellar Reflex

• aka knee jerk
• Percuss patellar ligament
• Lower leg extends
• In lower motor neuron damage: diminished/abolished reflex
• In upper motor neuron damage: muscle tone/response is greatly increased (pathological reflex)

• May percuss as above.
  • May percuss as demonstrated in lab.
## “P” Reflexes

<table>
<thead>
<tr>
<th>Pilomotor</th>
<th>Plantar/palmar grasp</th>
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<tbody>
<tr>
<td>Goose flesh due to skin cooling rapidly or after emotional reaction</td>
<td>Lightly stroke the palm</td>
</tr>
<tr>
<td></td>
<td>Grasps at stimulus; Present at birth; Gone by about 6 months’ of age</td>
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</tbody>
</table>
Perez Reflex

1. Clean penis or pudendum
2. Hold face down
3. Suprapubic pressure
4. Stroke para spinous muscles firmly
5. Collect urine

6. Baby cries
7. Back extends
8. Leg/arm reflexion
9. Baby urinates
“R” Reflexes

Red Light Reflex

- Reflected red light on ophthalmological exam (photos, too).
- Generally indicates a lack of cataracts.

Rooting Reflex

- Stroke cheek.
- Mouth moves to stimulus.
- Present at birth.
- Gone by 4 months’ of age if awake when tested.
- Gone by 7 months’ of age if asleep when tested.
Triceps Reflex

• Percuss triceps insertion tendon.
• Causes forearm extension (sort of) while arm is held loosely in bent position.
• May percuss as shown, right.
• May percuss as shown in lab.