



**Neurological Society of Thailand**

**21/08/2019**

**Surat Thani Hospital**

# **Approach to Weakness**

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# **Neurologic Evaluation**

## **Weakness**



### **➤ Clinical data gathering**

**History**

**Physical examination:**

**motor system: tone/power; reflex**

**cranial nerves**

**sensory system**

### **➤ Interpretation, localization**

**Upper versus lower motor neuron**

**Motor pathway: cortex to muscle**



# Neurologic Evaluation

## General Concepts



### ➤ Clinical data gathering

#### History

- ✓ Chief complaint: clearly defined
- Present illness: as much as possible
- ✓ - Quality of symptoms
- Location: distinctive features e.g. character, severity, etc.
- ✓ - Time course

**onset:** abrupt or insidious  
**subsequent course:** improving,  
worsening, exacerbation-remission



# Neurologic Evaluation

## General Concepts



### Progressive:

- tumor
- degenerative

### Sudden:

- stroke
- trauma

### Paroxysmal:

- epilepsy
- syncope
- periodic paralysis
- transient ischemic attack

### Relapsing-remitting:

- multiple sclerosis
- neuromyelitis optica



# Neurologic Evaluation

## General Concepts



### ➤ Clinical data gathering

#### History

e.g.: exertion (fatigue)

#### Present illness:

✓ Factors precipitating/aggravating/  
alleviating symptoms

✓ Associated symptoms

systemic  
neurologic



# Neurologic Evaluation

## General Concepts



### ➤ Clinical data gathering

#### History

#### Past medical history:

- illnesses
- medication
- operations
- ✓ - immunization

Diet, tobacco, alcohol, substance abuse



# Neurologic Evaluation

## General Concepts



- **Ch** **Vaccine:** protective against organisms causing neurologic disorders (e.g. poliovirus, tetanus, rabies virus, Japanese encephalitis virus, meningococcal, pneumococcal, *Hemophilus influenzae*)
- His**
- Pas**
- i
  - r
- Die**
- Post vaccination:** immunological reactions i.e. ADEM (**A**cute **D**isseminated **E**ncephalo**M**yelitis)



# Neurologic Evaluation

## General Concepts



### ➤ Clinical data gathering

#### Family history:

*First degree relatives:* parents, siblings, children

*Second degree relatives:* grandparents, grandchildren

**Social history:** education, occupation





# **Neurologic Evaluation**

## **General Concepts**



### **➤ Physical examination**

**Mental status**

✓ **Cranial nerves**

✓ **Motor function**

✓ **Reflexes**

**Sensory function**

**Coordination**

**Gait and stance**



# Neurologic Evaluation

## Weakness



- **Inspection**
- **Muscle tone: tension of a muscle at rest**
  - ◆ **examination**
  - ◆ **interpretation**
- **Muscle power**
  - ◆ **examination**
  - ◆ **grading system**
  - ◆ **interpretation**



# Neurologic Evaluation

## Weakness



- **Inspection**
  - **Compare both sides**
  - **Look for muscle atrophy, asymmetry**
- Muscle tone
  - ◆ examination
  - ◆ interpretation
- Muscle power
  - ◆ examination
  - ◆ grading system
  - ◆ interpretation



# Neurologic Evaluation

## Weakness



- Inspection
  - **Muscle tone: tension of a muscle at rest**
    - ◆ examination
    - ◆ interpretation
- Muscle power
  - ◆ examination
  - ◆ grading system
  - ◆ interpretation



## Neurologic Evaluation

- Compare both sides
- Always check for tone i.e. resistance to *passive movement* (muscles relaxed)

**Tone: *upper limbs***

- hold one hand in the "shake hands" position

- support at the elbow  
elbow *flex/extend*  
forearm *supinate/pronate*

- hold forearm above the wrist  
wrist *flex/extend*

➤ Inspect

➤ Muscle

✓♦ exami

♦ interpre

➤ Muscle power

♦ examin

♦ grading

♦ interpre



## Neurologic Evaluation

- Compare both sides
- Always check for tone, i.e. resistance to *passive movement* (muscles relaxed)

**Tone: *lower limbs***

hand on knee, “roll” each knee from side to side

hands under knee, “snap” lifting, observe the heel

➤ Inspect

➤ Muscle

✓♦ exami

♦ interpre

➤ Muscle p

♦ examin

♦ grading system

♦ interpretation



# Neurologic Evaluation

## Weakness



- Inspection
- **Muscle tone: tension of a muscle at rest**
  - ♦ **examining Tone:**
  - ✓♦ **interpretation**
    - Hypotonia >> flaccid**
    - Normotonia**
    - Hypertonia: spasticity, rigidity**
- Muscle power
  - ♦ examining
  - ♦ grading system
  - ♦ interpretation



# Neurologic Evaluation

## Weakness



- Inspection
- Muscle tone: tension of a muscle at rest
  - ◆ examination
  - ◆ interpretation
- **Muscle power**
  - ✓◆ examination
  - ◆ grading system
  - ◆ interpretation



# Upper limb

***Shoulder*** Deltoid (abduction)

***Elbow*** Biceps (flexion)

Brachioradialis (flexion)

Triceps (extension)

***Radio-*** Pronator

Supinator

***Wrist*** Flexor

Extensor

***Finger*** Handgrip (flexion)

Extensor

Dorsal interossei (adduction)

Palmar interossei (abduction)

# Upper limb

- **Deltoid:** Exert pressure close to elbow
- **Biceps:** Place one hand at patient's shoulder to stabilize
- **Triceps:** Test with arm extended is less painful than with arm flexed

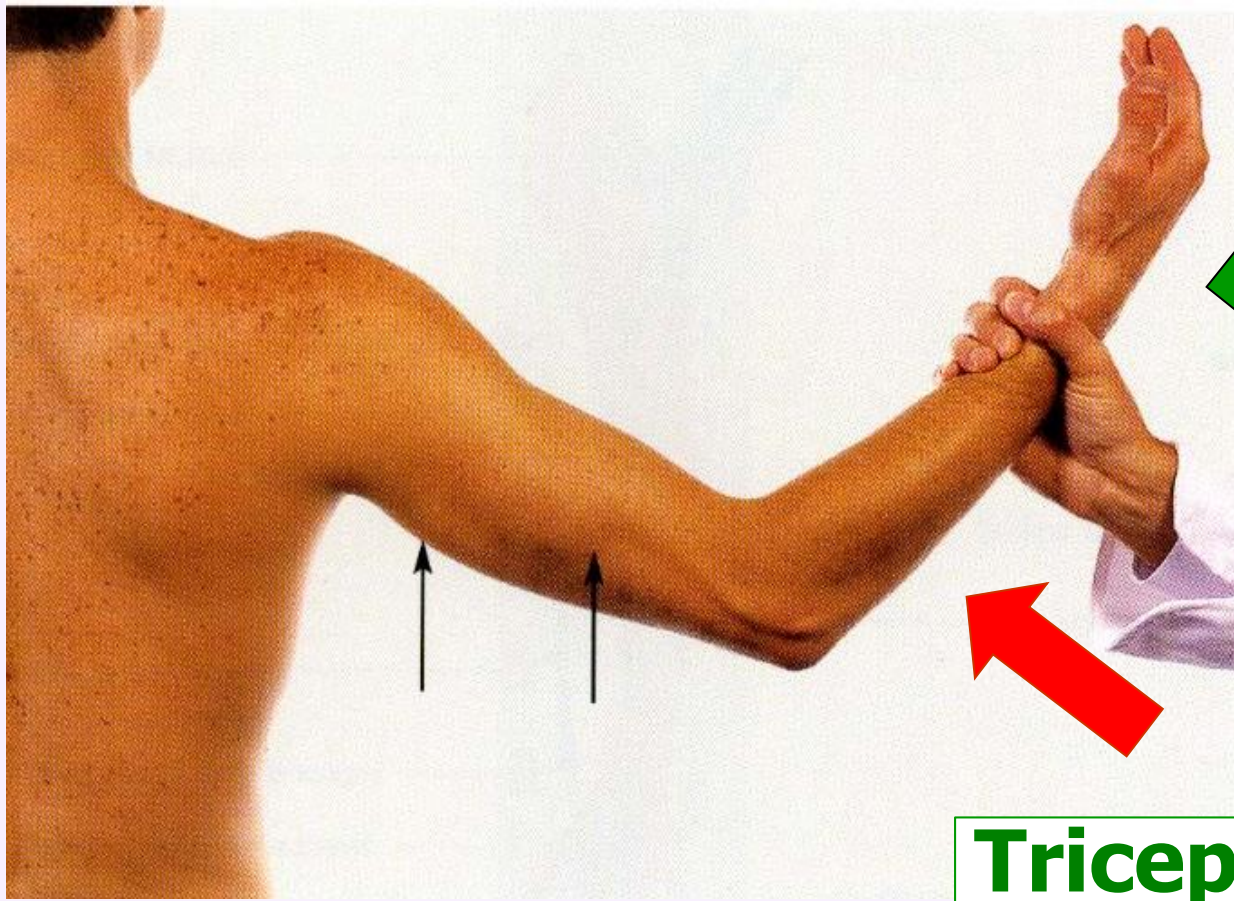


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# Neurologic Evaluation

## Weakness

MRC



**Triceps**

**Elbow extension**

**Extend elbow  
against resistance**

# Upper limb

- **Deltoid:** Exert pressure close to elbow
- **Biceps:** Place one hand at patient's shoulder to stabilize
- **Triceps:** Test with arm extended is less painful than with arm flexed
- **Pronator sign** to detect *mild weakness*

# Upper limb

## Pronator sign

### Position:

- raise both arms forward
- fully extend and supinate both arms
- fully extend and abduct fingers
- close the eyes

### Interpretation: test positive if

- arm drift down
- elbow flex
- forearm pronate
- wrist and fingers flex

**Minimal arm  
weakness**

# Lower limb

## *Hip*

**Gluteus maximus (extension)**

**Iliopsoas (flexion)**

**Adductor**

**Abductor**

## *Knee*

**Quadriceps (extension)**

**Hamstring (flexion)**

## *Ankle*

**Gastrosolieus (extension)**

**Tibialis anterior (flexion)**

**Tibialis posterior (inversion)**

**Peroneii (eversion)**

## *Toe*

**Flexor**

**Extensor**



# Lower limb

**Hip**

**Gluteus maximus (extension)**

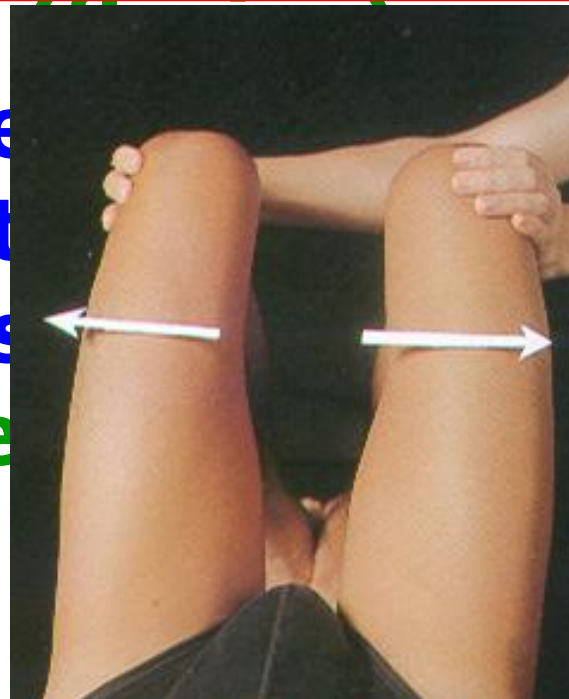
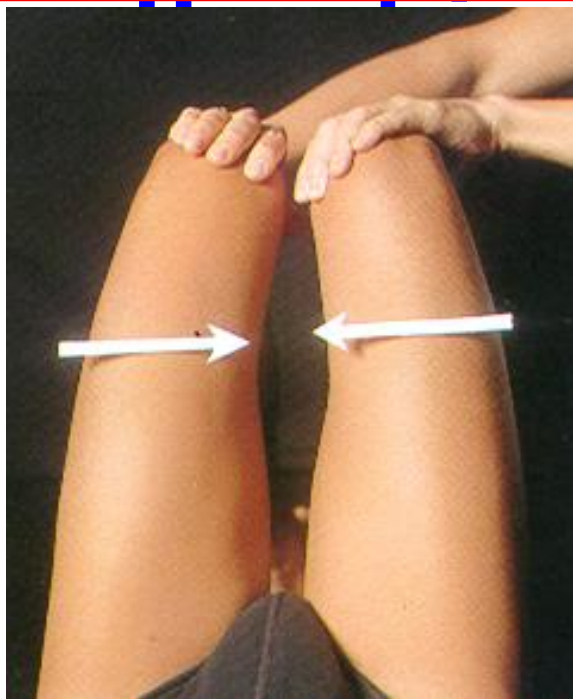
**Iliopsoas (flexion)**

## Hints:

- Avoid pressing on the thigh
- Use the knee as pressure point

**Ankle**

**Toe**



(flexion)  
(extension)



# Neurologic Evaluation

## Weakness



Grade	Character
0	No movement
1	Minimal movement
2	Horizontal movement
3	Against gravity, unsustain
4	Against resistance, partial
5	Against resistance, strong (normal)

✓♦ grading system

Grading system: Medical Research Council (**MRC**); UK





# Neurologic Evaluation

## Weakness



- Inspection
- Muscle tone: tension of a muscle at rest
  - ◆ examination
  - ◆ interpretation
- **Muscle power**
  - ◆ examination
  - ◆ grading system
  - ✓◆ interpretation



# Neurologic Evaluation

## Weakness



### Patterns of weakness

#### - pyramidal weakness

#### Pyramidal weakness:

***upper limb:*** flexor group stronger

“decorticate posture”

***lower limb:*** extensor group stronger

: upper motor neuron (UMN)

: corticospinal tract lesion



# Neurologic Evaluation

## Weakness



### Patterns of weakness

- pyramidal weakness
- proximal weakness

### Proximal weakness:

more weakness of proximal group

(arms and legs)

: muscle disease e.g.

metabolic myopathy

myositis

: neuromuscular junction



# Neurologic Evaluation

## Weakness



### Patterns of weakness

- pyramidal weakness
- proximal weakness
- distal weakness

### Distal weakness:

➤ more weakness of **distal** group,  
muscle wasting may be present

: peripheral nerve e.g.

✓ distal symmetrical polyneuropathy



# Neurologic Evaluation

## Weakness



### Patterns of weakness

- pyramidal weakness
- proximal weakness
- distal weakness

### Specific pattern:

- weakness/wasting according to
  - : peripheral nerve distribution
  - : brachial, lumbosacral plexus
  - ✓ : spinal nerve roots
  - : cauda equina
  - : muscular dystrophy

# Neurologic Evaluation

## General Concepts

### ➤ Physical examination

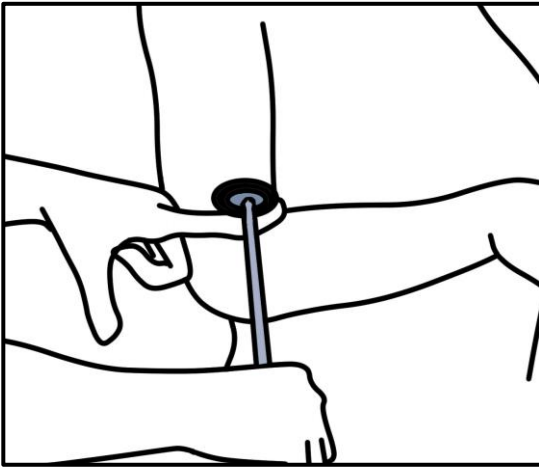
#### Procedure

- optimum posture
- symmetry for comparison
- ✓ - relaxed posture
- brisk and strong percussion
- observe the responses

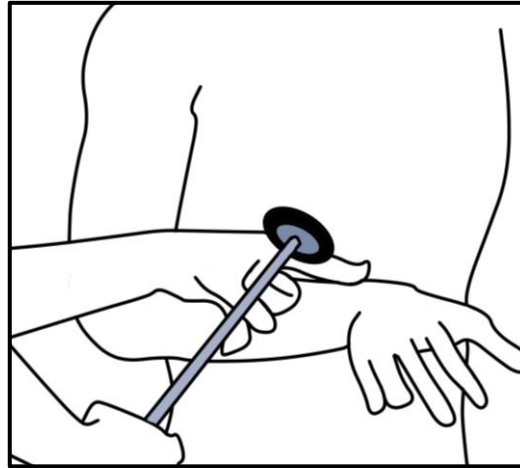


# Neurological Examination

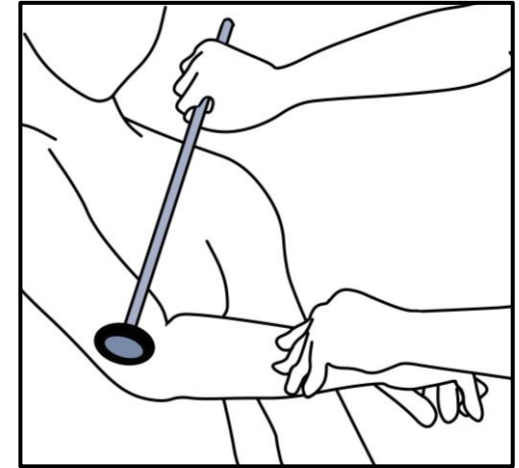
## Muscle Stretch Reflex



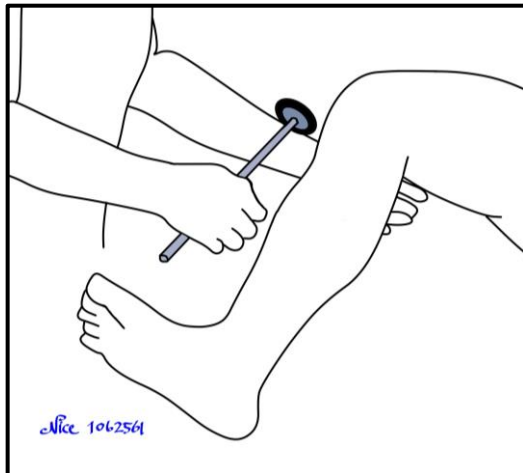
**Biceps reflex (C5-6)**  
**Musculocutaneous**



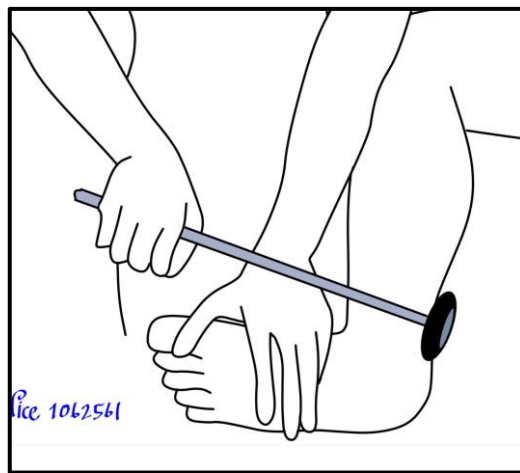
**Brachioradialis (C5-6)**  
**Radial nerve**



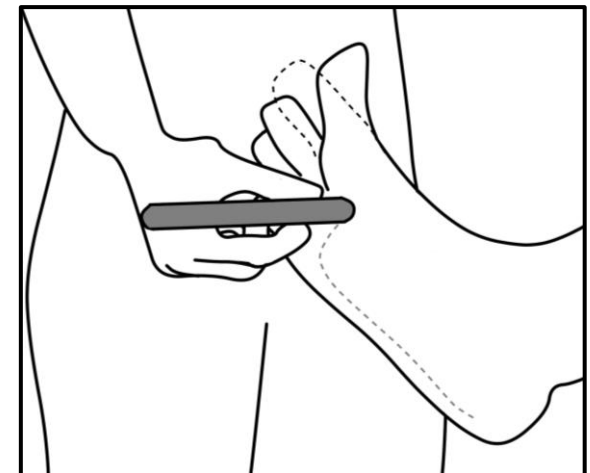
**Triceps reflex (C7-8)**  
**Radial nerve**



**Quadriceps reflex (L2-3)**  
**Femoral nerve**



**Ankle reflex (S1-2)**  
**Tibial nerve**



**Plantar reflex**  
**Tibial nerve**



# Neurological Examination



## Muscle Stretch Reflex

**Reflex spreading:**

**UMN lesion** above level  
of the muscle to which  
reflex spreads, e.g. hip  
*adduction* with knee  
jerk

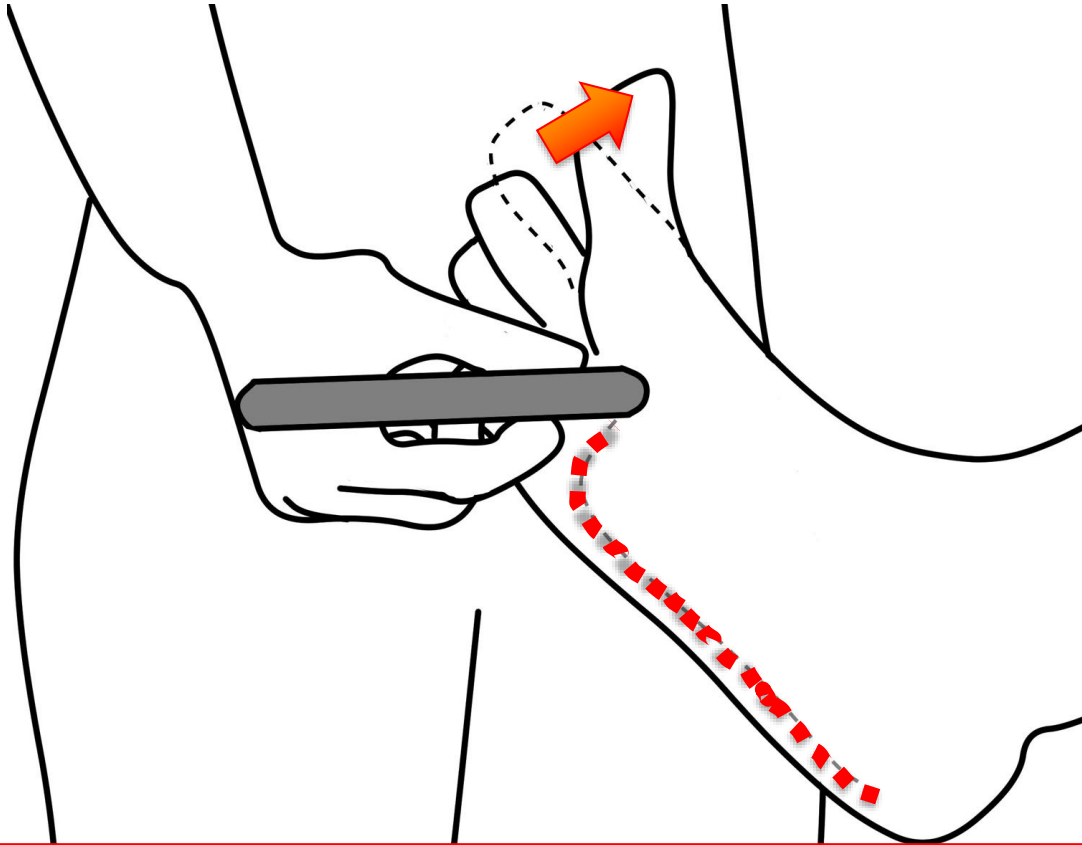
**Quadriceps reflex (L2-3)**

**Femoral nerve**



# Neurological Examination

## Superficial Reflex



**Normal:** Plantar flexion of big toe

**Abnormal:** Dorsiflexion of big toe

**Tibial nerve**



# Neurological Evaluation

## Muscle Stretch Reflex



### Interpretation (grading)

Grading	Interpretation
<b>0</b>	<b>absent</b>
<b>1+ or +</b>	<b>diminished</b>
<b>2+ or ++</b>	<b>normal</b>
<b>3+ or +++</b>	<b>brisk</b>
<b>4+ or ++++</b>	<b>brisk with clonus</b>



# Neurological Examination

## Muscle Stretch Reflex



### ➤ Signs associated with corticospinal tract lesion

- Clonus
- Grasp reflex
- Tromner sign
- Babinski sign

**Tromner sign** Flick the hyperextended middle finger results in flexion of other fingers



# Neurologic Evaluation

## Weakness



- **Muscle power**
  - ◆ **examination**
  - ◆ **grading system**
  - ◆ **interpretation: localize the lesion**

**UMN *versus* LMN *versus* non neurogenic**

**UMN:** upper motor neuron from motor cortex > corona radiata (corticobulbar/corticospinal tracts) > posterior limb of internal capsule > brainstem > spinal cord (corticospinal tract)

**LMN:** lower motor neuron from anterior horn cell > ventral rami of spinal nerve > brachial/lumbosacral plexus > peripheral nerve

**NMJ:** neuromuscular junction



# Neurological Evaluation

## Motor System

Cortical

Sub  
cortical

Brain  
stem

Spinal  
cord

UMN

LMN

Anterior horn cell

Spinal nerve

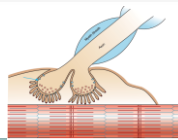
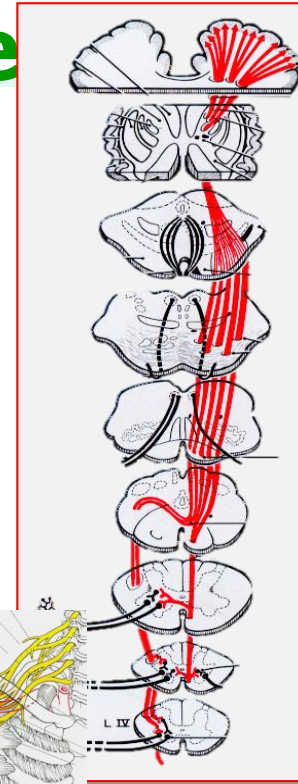
Nerve plexus

Peripheral nerve

Neuromuscular junction

Muscle

Non neurogenic





# Neurologic Evaluation

## Weakness



- **Muscle power**
  - ♦ examination
  - ♦ grading system
  - ♦ **interpretation: localize the lesion**

**UMN *versus* LMN *versus* non neurogenic**

**UMN:** upper motor neuron from motor cortex > corona radiata (corticobulbar/corticospinal tracts) > posterior limb of internal capsule > brainstem > spinal cord (corticospinal tract)

**LMN:** lower motor neuron from anterior horn cell > ventral rami of spinal nerve > brachial/lumbosacral plexus > peripheral nerve

**NMJ:** neuromuscular junction



# Neurologic Evaluation

## Weakness



### ➤ Muscle power

Type/Parameters	Upper motor neuron	Lower motor neuron
<b>Tone</b>	<b>Increase*</b>	<b>Decrease</b>
<b>Atrophy</b>	<b>Uncommon</b>	<b>Prominent</b>
<b>Fasciculation</b>	<b>Absent</b>	<b>Present</b>
<b>Deep tendon reflex</b>	<b>Hyperreflexia*</b>	<b>Hyporeflexia/ Areflexia</b>
<b>Plantar reflex</b>	<b>Extensor</b>	<b>Flexor</b>

**\*Acute phase: hypotonia; hyporeflexia/areflexia**



# Neurologic Evaluation

## Weakness



Localization Parameter	Cerebral hemisphere	Brainstem	Spinal cord
<b>Distribution of muscles involved</b>	<b><i>Contralateral</i></b> leg and arm, cranial muscles	<b><i>Contralateral</i></b> leg and arm, cranial nerve involvement	<b><i>Ipsilateral</i></b> leg and arm, specific group (segmental)
<b>Type</b>	UMN	UMN	LMN and UMN*
<b>Atrophy</b>	Absent or mild	Absent or mild	When involve anterior horn cell
<b>Tendon reflex</b>	↑	↑	↑
<b>Plantar reflex</b>	Extensor	Extensor	Extensor
<b>Sensory symptoms</b>	When involve sensory cortex	When involve sensory tract	When involve STT, posterior column
<b>Example</b>	Tumor, motor neuron disease, stroke	Stroke	Myelitis, Syringomyelia

**UMN:** upper motor neuron; **LMN:** lower motor neuron  
**STT:** spinothalamic tract; **MND:** motor neuron disease





## Cortical lobe signs

Language (dominant hemisphere)

Gaze deviation (frontal eye field)

Cortical sensation

Apraxia

# Evaluation

al hemisphere

**Distribution of muscles** *Contralateral* cranial muscles, arm and leg; cortical lobe signs

**Type**

**UMN**

**Atrophy**

**Absent or mild**

**Tendon reflex**

**Increased**

**Plantar reflex**

**Extensor**

**Sensory symptoms**

**Present if involve sensory cortex**

**Additional deficits**

**Gaze deviation, motor aphasia  
(in dominant hemisphere)**

**Example**

**Tumor, hemispheric infarction,  
motor neuron disease**



# Neurologic Evaluation

## Weakness



Localization	Cerebral		
Parameter	Subcortical		
Distribution of muscles	<b><i>Contralateral</i></b> cranial muscles, arm and leg (severity leg = arm)		
Type	UMN		
Atrophy	Absent or mild		
Tendon reflex	Increased		
Plantar reflex	Extensor		
Sensory symptoms	Present if involve thalamus		
Additional deficits			
Example	Lacunar infarction		

**UMN:** upper motor neuron; **LMN:** lower motor neuron  
**STT:** spinothalamic tract; **MND:** motor neuron disease



## Cranial nerve

Mid brain: CN III, IV

Pons: CN V, VI, VII, VIII

Medulla: CN IX, X, XI, XII

## Evaluation

Weakness

### Brain stem

Parameter	Brain stem
Distribution of muscles	<b>Contralateral</b> leg and arm, <b>cranial nerve involvement</b>
Type	UMN
Atrophy	Absent or mild
Tendon reflex	Increased
Plantar reflex	Extensor
Sensory symptoms	Present if involve sensory tract
Additional deficits	CN involvement
Example	Brainstem infarction

UMN: upper motor neuron; LMN: lower motor neuron  
STT: spinothalamic tract; MND: motor neuron disease



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## Sensory

- vibratory, joint position **ipsilateral**
- pinprick, touch **contralateral**

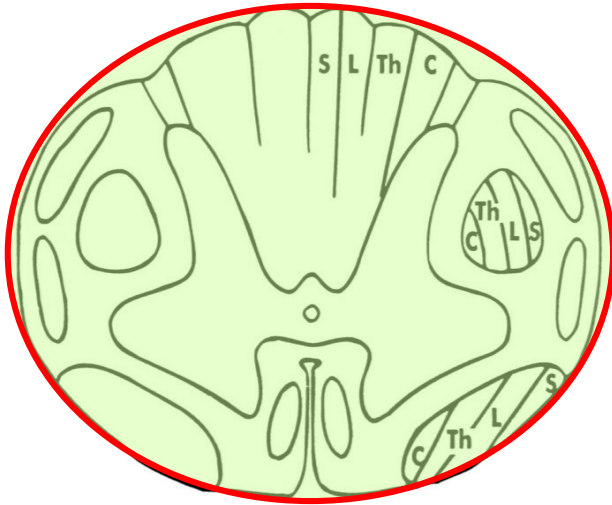
**ANS:** bowel, bladder, sweating

cord

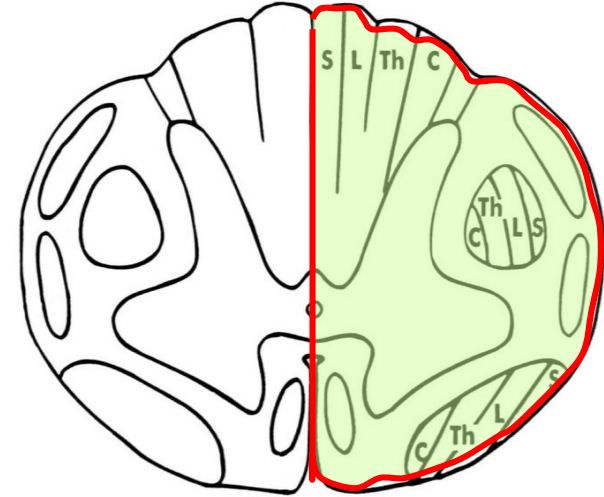
Distribution of muscles	<b><i>ipsilateral</i></b> leg and arm, specific muscle group (segmental)
Type	LMN (at the level)+ UMN (below)*
Muscle pain/tenderness	absent
Atrophy	present if involve anterior horn cell
Tendon reflex	increased (below)
Plantar reflex	extensor
Sensory symptoms	present if involve spinothalamic tract, posterior column
Example	myelitis, syringomyelia

# Neurologic Evaluation

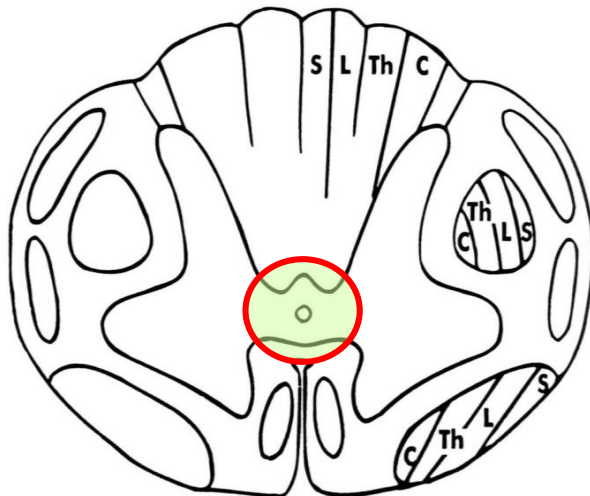
## Spinal Cord Syndromes



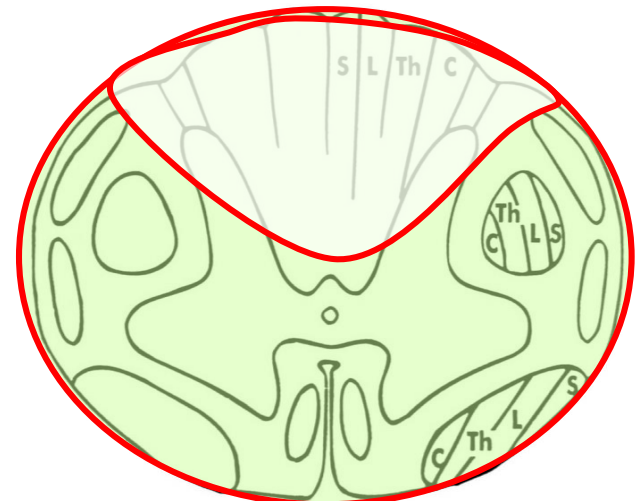
**Complete transection**



**Brown Sequard (hemicord)**



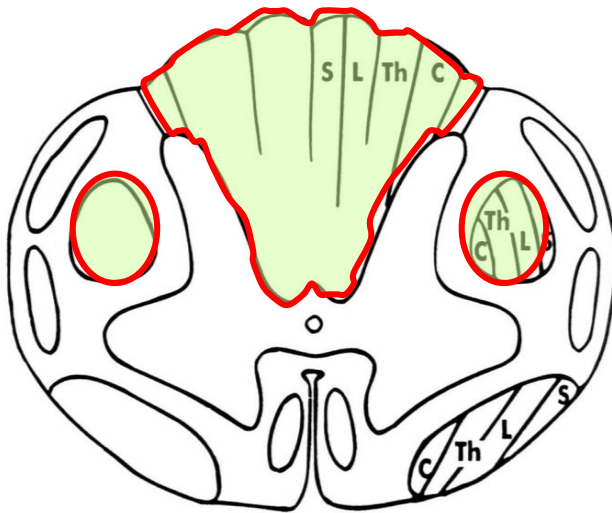
**Central cord**



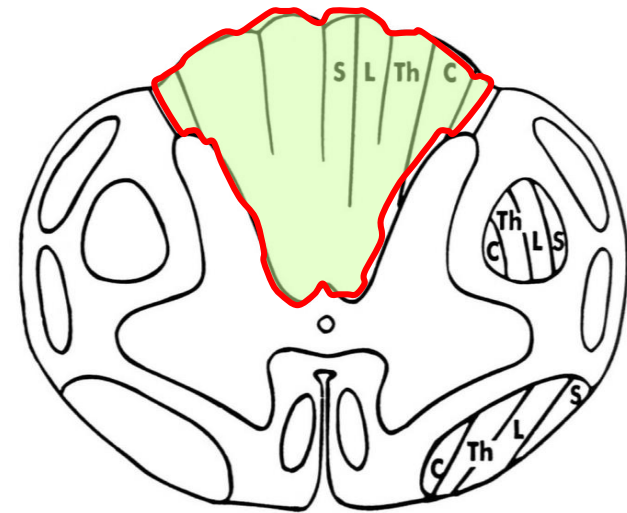
**Anterior spinal artery**

# Neurologic Evaluation

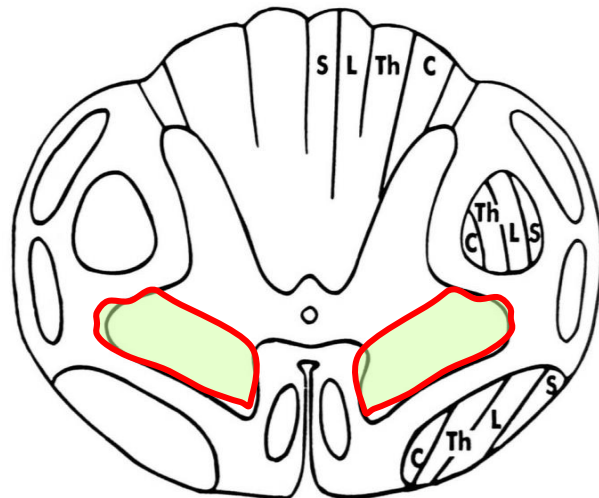
## Spinal Cord Syndromes



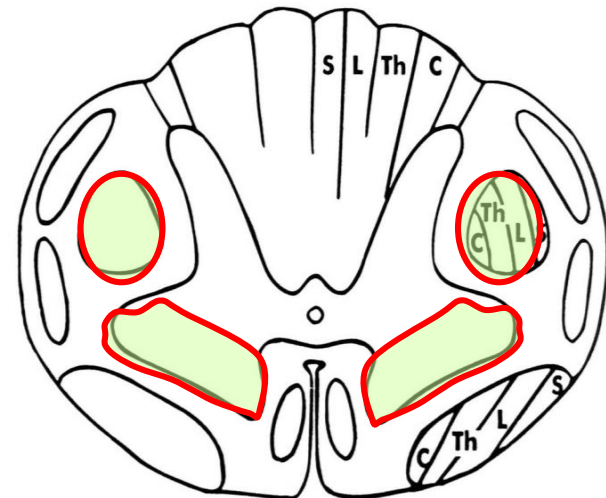
**Postero-lateral column**



**Posterior column**



**Anterior horn**

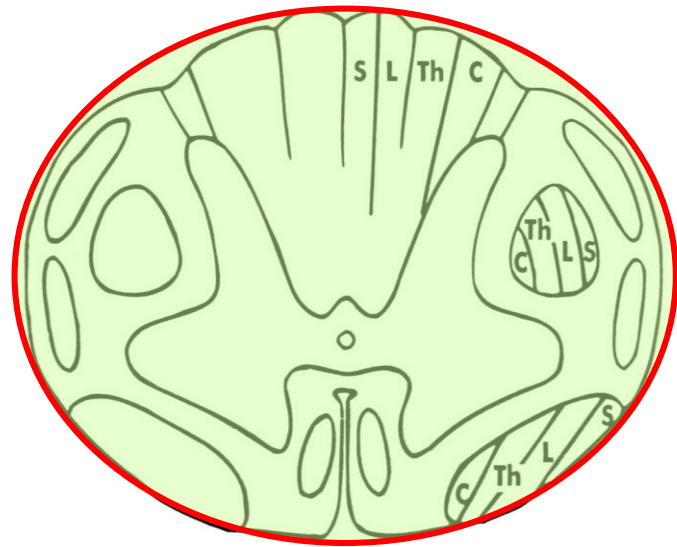


**Anterior horn-pyramidal tract**



# Neurologic Evaluation

## Spinal Cord Syndromes

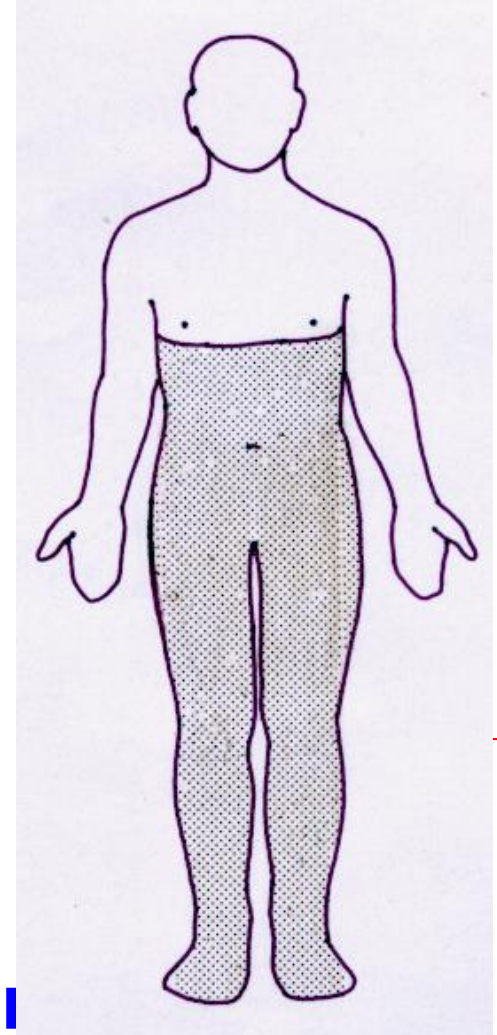


### Complete transection

**Motor:** para-, tetraplegia (\*spinal shock); LMN at the level

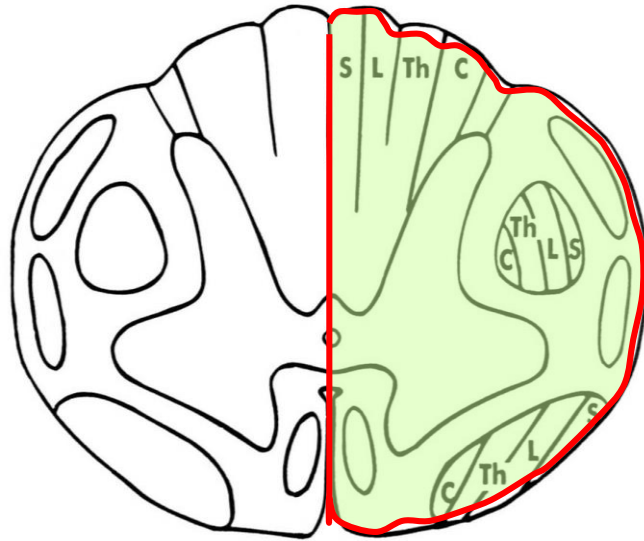
**Sensory:** all modalities below the level

**ANS:** urgency, retention, incontinence



# Neurologic Evaluation

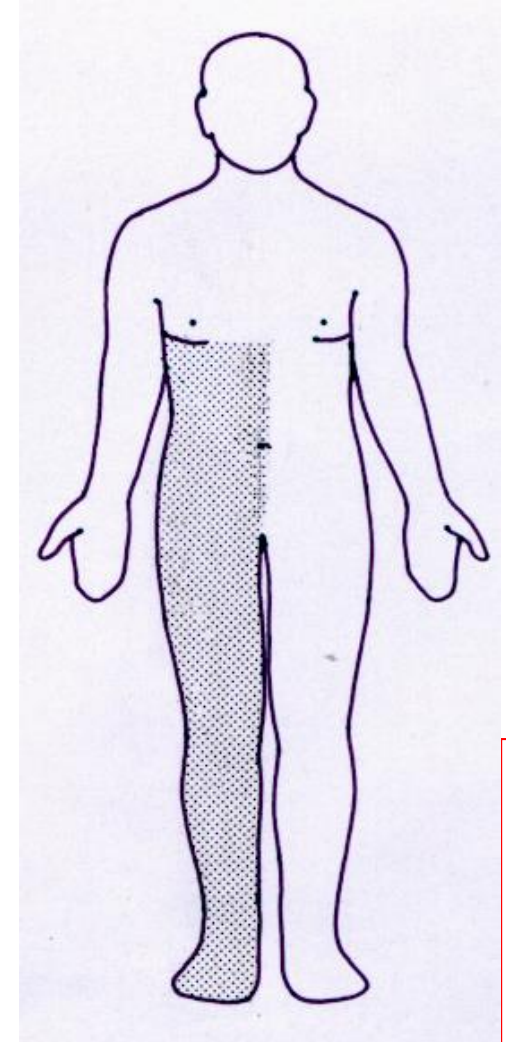
## Spinal Cord Syndromes



### Brown Sequard (hemicord)

**Motor:** *ipsilateral* hemiplegia

**Sensory:** *contralateral* pain,  
temperature; *ipsilateral* jps,  
vibratory (2 segments below)







# Neurologic Evaluation

## Weakness



Localization Parameter	Spinal nerve	Nerve plexus	Peripheral nerve
Distribution of muscles involved	Segmental muscle group	Arms or legs (brachial or lumbo sacral plexus)	Specific groups
Type	LMN	LMN	LMN
Atrophy	Prominent	Prominent	Prominent
Tendon reflex	↓	↓	↓
Plantar reflex	Flexor	Flexor	Flexor
Sensory symptoms	Present	Present	Absent in pure motor nerve
Example	Cervical spondylosis	Brachial plexus injury	Carpal tunnel syndrome

**UMN:** upper motor neuron; **LMN:** lower motor neuron  
**STT:** spinothalamic tract; **MND:** motor neuron disease

<b>Cervical</b>	<b>C1-8</b>
<b>Thoracic</b>	<b>T1-12</b>
<b>Lumbar</b>	<b>L1-5</b>
<b>Sacral</b>	<b>S1-5</b>

# Neurologic Evaluation

## Weakness



	<b>Spinal nerve</b>	

<b>Distribution of muscles</b>	<b>Segmental muscle group</b>
<b>Type</b>	<b>LMN</b>
<b>Atrophy</b>	<b>Prominent</b>
<b>Tendon reflex</b>	<b>Decreased</b>
<b>Plantar reflex</b>	<b>Flexor</b>
<b>Sensory symptoms</b>	<b>Present (segmental)</b>
<b>Additional deficits</b>	
<b>Example</b>	<b>Cervical spondylosis</b>

**UMN:** upper motor neuron; **LMN:** lower motor neuron  
**STT:** spinothalamic tract; **MND:** motor neuron disease

**Brachial plexus C5-T1**

**Trunk: upper/middle/lower**

**Cord: lateral/medial/posterior**

**Lumbosacral plexus L1-S2**

**valuation**

**SS**

**erve plexus**

**Distribution of  
muscles**

**Arms or legs (brachial or lumbo-  
sacral plexus)**

**Type**

**LMN**

**Atrophy**

**Prominent**

**Tendon reflex**

**Decreased (involved level)**

**Plantar reflex**

**Flexor**

**Sensory symptoms**

**Present to nerve distribution**

**Additional deficits**

**Example**

**Brachial plexus injury**

**UMN:** upper motor neuron; **LMN:** lower motor neuron  
**STT:** spinothalamic tract; **MND:** motor neuron disease





# Neurologic Evaluation

## Weakness



Localization			
Parameter	Peripheral nerve		
Distribution of muscles	Specific group ( <b>mononeuropathy</b> )		
Type	LMN		
Atrophy	Prominent		
Tendon reflex	Decreased or normal		
Plantar reflex	Flexor		
Sensory symptoms	Specific to nerve distribution Absent in pure motor nerve		
Additional deficits			
Example	Carpal tunnel syndrome, diabetic mononeuropathy		



# Neurologic Evaluation

## Weakness



Localization			
Parameter	Peripheral nerve		
Distribution of muscles	Distal limb ( <b>polyneuropathy</b> )		
Type	LMN		
Atrophy	Prominent		
Tendon reflex	Decreased		
Plantar reflex	Flexor		
Sensory symptoms	Present (distal limb)		
Additional deficits			
Example	Guillain Barré syndrome, diabetic polyneuropathy		

**UMN:** upper motor neuron; **LMN:** lower motor neuron  
**STT:** spinothalamic tract; **MND:** motor neuron disease



# Neurologic Evaluation

## Weakness



Localization Parameter	Neuromuscular junction	Muscle
<b>Distribution of muscles involved</b>	<b>Symmetrical, proximal limb, ocular, bulbar muscle</b>	<b>Symmetrical, proximal limb</b>
<b>Type</b>	<b>Non neurogenic</b>	<b>Non neurogenic</b>
<b>Atrophy</b>	<b>Absent</b>	<b>In muscular dystrophies</b>
<b>Tendon reflex</b>	<b>Normal or ↓</b>	<b>Normal or ↓</b>
<b>Plantar reflex</b>	<b>Flexor</b>	<b>Flexor</b>
<b>Sensory symptoms</b>	<b>Absent</b>	<b>Absent</b>
<b>Example</b>	<b>Myasthenia gravis Lambert Eaton syndrome</b>	<b>Myositis, hypokalemia, thyrotoxic</b>

**UMN:** upper motor neuron; **LMN:** lower motor neuron  
**STT:** spinothalamic tract; **MND:** motor neuron disease



# Neurologic Evaluation

## Weakness



Localization		
Parameter	Neuromuscular junction	
Distribution of muscles	Symmetric, usually proximal limbs	
Type	Non neurogenic	
Atrophy	Absent	
Tendon reflex	Normal	
Plantar reflex	Flexor	
Sensory symptoms	Absent	
Additional deficits	Ocular, facial, bulbar muscles	
Example	Myasthenia gravis, Lambert Eaton syndrome	

**UMN:** upper motor neuron; **LMN:** lower motor neuron  
**STT:** spinothalamic tract; **MND:** motor neuron disease



# Neurologic Evaluation

## Weakness



Localization		
Parameter	Muscle	
Distribution of muscles	Symmetric, usually proximal limbs	
Type	Non neurogenic	
Atrophy	Present in muscular dystrophies	
Tendon reflex	Normal or decreased	
Plantar reflex	Flexor	
Sensory symptoms	Absent	
Additional deficits	Muscle pain/tenderness in inflammatory disease	
Example	Myositis, hypok <sup>+</sup> , thyrotoxic	

**UMN:** upper motor neuron; **LMN:** lower motor neuron  
**STT:** spinothalamic tract; **MND:** motor neuron disease





# Neurologic Evaluation

## Weakness



Pattern of Weakness	Localization
Upper limb: extensor muscles Lower limb: flexors muscles	Upper motor neuron (corticospinal tract: CS)
Hemiparesis	Upper motor neuron CS
Multifocal, asymmetric weakness <i>without</i> sensory involvement	Motor neuron disease Multifocal motor neuropathy Myasthenia gravis (uncommon)
Multifocal, asymmetric weakness <i>with</i> sensory involvement	Polyradiculopathy Multifocal neuropathy



# Neurologic Evaluation

## Weakness



Pattern of Weakness	Localization
<b>Symmetric weakness, proximal or generalized without sensory involvement</b>	<b>Myopathy Motor neuron disease NMJ disorder</b>
<b>Generalized motor &gt; sensory</b>	<b>Polyradiculoneuropathy</b>
<b>Asymmetric cranial muscles with or without limbs</b>	<b>Myasthenia gravis</b>
<b>Distal symmetric motor only</b>	<b>Distal myopathies Distal spinal muscular atrophy</b>
<b>Distal symmetric sensory &gt; motor</b>	<b>Length-dependent polyneuropathy</b>



# Neurologic Evaluation

## Weakness



Pattern of Weakness	Localization
Multiple nerves, asymmetric	Multifocal polyneuropathy
Multiple roots, asymmetric	Polyradiculopathy
Multiple nerves and roots single extremity	Plexopathy
Single root	Monoradiculopathy
Single nerve	Mononeuropathy



# **Neurologic Evaluation**

## **Weakness**



### **➤ Clinical data gathering**

**History**

**Physical examination:**

**motor system: tone/power; reflex**

**cranial nerves**

**sensory system**

### **➤ Interpretation, localization**

**UMN versus LMN versus non neurogenic**

**Motor pathway: cortex to muscle**