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Integrating the Neuro Exam Into Daily Practice

Rosanne Thomas PT MS PhD

Why bother?
The Nervous System Guides Movement

Integrates:

Need/Desire \rightarrow \text{Outcome}

Why Bother

• Pieces of the puzzle
• How and why your patient moves the way he does/ or doesn’t
• Time constraints prevent testing everything for every patient
• Need to understand all testing options to be able to effectively choose and prioritize
• Facilitates correlation between pathology, impairments, functional limitations and goals
Objectives 1 - 5

1. Identify the scientific basis for the efficacy of neurological examination procedures.
2. Identify selection of sensory and motor neurological screening based on patient need and complexity.
3. Accurately perform an appropriate and prioritized sensory examination for a given patient diagnosis.
4. Describe the relationship between sensory input and motor output.
5. Assess reflex integrity and dysfunctional implications.

Objectives 6 - 10

6. Appropriately evaluate tone and articulate one of its possible contributions to movement dysfunction.
7. Differentiate superficial vs. deep and simple vs. complex sensory requirements during the examination process.
8. Distinguish movement dysfunction secondary to CNS, PNS, and peripheral dysfunction.
9. Identify the neuroscience correlation to examination findings and articulate the anatomical and/or physiological significance of deficits identified during the neurological examination.
10. Describe findings of sensory and motor testing to maximize efficient and accurate identification of impaired sensory and motor function and correlate to functional deficits.
Parts of a Neuro Exam

1- Sensory
2- Motor
3- Tone
4- Motor Control
5- Balance
6- Coordination

This webinar focuses on:
1- Sensory
2- Motor
3- Tone
4- Motor Control
5- Balance
6- Coordination
Webinar Parts

- Nervous System Review of relevant body structure and function
- Sensory Exam
  - Detailed explanation
  - Video
  - Documentation
- Motor Exam
  - Detailed explanation
  - Video
  - Documentation

Nervous System Review

Central Nervous System has 3 parts:

- Brain
- Brain Stem
- Spinal Cord 🔄 Anterior Horn Cell (motor)
Peripheral Nervous System

- Cranial nerves (12)
- Spinal nerves (31)
- Ganglions, peripheral nerves
- Receptors

Note: AHC = AMN (Alpha Motor Neuron) = LMN (Lower Motor Neuron)

Nervous System Function-

CNS – process info, make adjustments

PNS – bring info to/from CNS

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CNS/PNS Division at Spinal Cord Level

Spinal nerve & nerve root – most proximal parts of the PNS

Nerve root = that portion of the nerve that connects it to the spinal cord. Made up of Anterior (ventral) root
Posterior (dorsal) root

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**Dermatome**

Definition:

*The area of skin supplied by a single nerve root*

- Varies greatly person to person
- Often a great deal of overlap

Dermatomes are supplied by **RECEPTORS**

- Afferents to a particular spinal cord segment
Classification of Sensory System

• Location of receptor
• Type of receptor

Sensory Receptor Location

- Superficial
- Deep
- Combined or Cortical

1-Superficial (exteroceptors)
• Responsible for superficial sensation
• Receive stimulus from external environment via skin and subcutaneous tissue
• Responsible for perception of pain, temperature, light touch/pressure
2 – Deep sensations (proprioceptors)
  • Receive stimulus from mm, tendons, ligaments, joints, fascia
  • Responsible for position sense, kinesthesia (mov’t) sense, vibratory sense

3 - Combined or Cortical Sensations
  • Require info from both exteroceptors & proprioceptors
  • Require intact function of cortical sensory association areas
  • Responsible for stereognosis, 2 point discrimination, graphesthesia, tactile localization, texture recognition

Classification of Sensory System

Location of receptor

Type of receptor
  • Mechanoreceptors
  • Thermo-
  • Nocioceptors (pain)
  • Chemo-
  • Photic (electromagnetic)
Types of mechanoreceptors/proprioceptors:

1- Ruffini Endings
2- Pacinian Corpuscles
3- Golgi-Mazzoni Corpuscles
4- GTO
5- Muscle Spindle
Ruffini Endings

Expanded free nerve ending in fibrous layer of the joint capsule

- Greatest distribution in PROXIMAL joints
- Monitors direction & speed of capsular stretch & joint position changes
- Low-threshold, slowly adapting
- Strong postural receptors

Pacinian Corpuscles

Greatest distribution in DISTAL joints
Responds to high velocity changes in joint position
Low-threshold, rapidly adapting
Active for brief period – onset of joint movement, sudden changes
Greater conduction velocity than Ruffini
Golgi-Mazzoni Corpuscles (Krause)

Present along inner surface of joint capsule
Responds to perpendicular compression of capsule – not stretching

Golgi Tendon Organ (GTO)

Located near musculotendon junction
Responds to contraction of mm
Stimulus $\left( - \right)$ agonist, $\left( + \right)$ antagonist
GTO info travels to 3 places via SC:

Agonist mm contracts:
• → + GTO in agonist mm
• GTO sends sens info via Ib → synapse in DH with interneurons
• Interneuron has 3 outputs

Muscle Spindle
• Located within mm fibers
• Slowly adapting
• Monitors amount of change in length of mm
• Motor as well as sensory components
• Sensory (1A, II afferent) info on rate & amount of change in mm length
• Motor – intrafusal fibers via gamma motoneurons
• Add to production of smooth, controlled, coordinated mov/t
Muscle Spindle Actions:

Extrafusal fiber stretches:
• → intrafusal fiber stretch
• → 1a fibers fire → respond to rate of str & Δin mm length
• → II fibers fire → respond to length only

Muscle Spindle Actions:

Info goes to 4 places via SC:
• AMN of agonist mm → +
• AMN of antagonist mm → --
• Interneurons → recurrent inhib via synergist mm
• Cerebellum → further reg & monitoring of mm position & length
Tracts

All sensory info enters (afferent) the spinal cord through the dorsal roots

From there – fiber differences:

1- large sensory fibers (Beta type A fibers) immediately enter dorsal column of spinal cord and ascend the cord

2- smaller fibers (type C and delta type A) as well as lateral collaterals from large fibers travel up and down before synapsing in dorsal horn cell that gives rise to ventral & lateral spinal thalamic tracts

Pathway transmission to Cortex

1. Receptor activation
2. Afferent fibers travel to the Spinal Cord (SC)
3. Fibers enter SC through the dorsal root
4. Travel in SC – either ipsilateral or contralateral
5. Synapse and cross
6. Travel to the Thalamus
7. Travel to the Sensory Cortex
Two Basic Pathways of transmission to Cortical Centers

1- Dorsal column/ medial lemniscal – discriminative touch
2- Anterolateral (spinal thalamic) – pain, temperature, crude touch

Dorsal Column

Primary fibers = receptors to spinal cord dorsal horn. Travel ipsilaterally to

Secondary fibers = DCN of medulla, CROSS travel in medial lemniscus to VPN of thalamus

Tertiary fibers = thalamus to primary sensory cortex
**Dorsal Column**

- Large, heavily myelinated fibers
- Fast
- High degree of spatial orientation of fibers with respect to their origin on body surface

**Anterolateral/ Spinal thalamic tract**

Mainly small, some not myelinated
Lower velocities
Poorly spatially oriented
Primary fibers = receptors to spinal cord dorsal horn. Travel up/down before synapsing on dorsal horn cells. CROSS in the SC, travel (lateral to DC)
Secondary fibers to thalamus
Tertiary = from thalamus to primary sensory cortex

http://www.iupucanatomy.com/images/Picture%201176.jpg
Anterolateral/ Spinal thalamic tract

- Mainly small, some not myelinated
- Lower velocities
- Poorly spatially oriented
Therefore:

- Sensory info that must be transmitted rapidly with high degree of specificity (location, pressure, etc)
- Fine gradations of intensity
- Discreetly localized
- Mechanoreceptive sensation alone

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- Sensory info slow, not localized
- Special capability to transmit broad spectrum of sensory modalities
- Pain, warmth, cold, crude touch sensations
Parts of a Neuro Exam

1- Sensory
2- Motor
3- Tone
4- Motor Control
5- Balance
6- Coordination
**Sensory Testing**

**Purpose:**

Aid localization of the lesion
- One side of body?
- Within a dermatome?
- Within a peripheral nerve distribution?
- Disruption along a spinal pathway?

**Assumptions with sensory testing:**

1. Patient can understand instructions
2. Patient can communicate responses
3. Patient can cooperate by keeping eyes closed
Parts of Sensory Testing

1- Ability to **PERCEIVE** sensory modalities
   - determines if a pathway for a particular sense is functioning
2- Ability to **INTEGRATE** or interpret a sensory stimulus
   - determine if the patient can use info from a sensory stimulus in a meaningful way
   - **NOT done if perception testing reveals deficits**

Grading of Sensory Responses:

- Absent
- Diminished intact/slowed
- Normal
- Hypersensitive
**Sensory Testing Technique:**

1. Demo with patient’s eyes open
2. Actual test with patient’s eyes closed
3. Compare
   - Right/Left
   - Proximal/Distal
   - Same/Different

**Sensation Types**

- **Superficial**
  - Light touch, superficial pain, thermal
- **Deep**
  - Deep pressure, deep pain, position sense, passive motion sense
Superficial Sensation

1- Light touch
2- Superficial pain
3- Thermal

Light touch – Discriminative touch
- Transmitted via Dorsal Column
- Usually done within dermatomes
- Patient indicates if does or does not perceive stimulus
- Note if diminished, normal, hypersensitive
Video – Light Touch

- UE Light touch
- LE Light touch

Superficial Sensation

1- Light touch
2- Superficial pain - Pin prick
3- Thermal
   Hot/cold
   - Transmitted via Anterolateral/ Spinal Thalamic
   - Usually done within dermatomes
   - Patient indicates if does or does not perceive stimulus
   - Note if diminished, normal, hypersensitive
Video – Pain/ Sharp

- UE Pain/Sharp
- LE Pain/Sharp

Documentation for Superficial Sensory Testing

- Sensory Modality – Light touch? Pain? Temperature?
- Area tested – UE, LE, trunk? R or L?
- List the dermatomes tested UE – C5 – T2, LE – L3 – S1
- Examples:
  - Light touch intact BUE C5 – T2 dermatomes
  - Pain intact BLE L3 – S1 except hyper LLE L4 dermatome
  - Light touch & pain diminished RUE C6,7 dermatome
**Deep Sensation**

1- Deep pressure
2- Deep pain
3- Position sense/ Akinesthesia
4- Passive motion sense
5- Vibration

*Deep Sensation*

1- Deep pressure – *firmer than light touch*
2- Deep pain – *squeeze muscle belly or tendon*
3- Position sense/ Akinesthesia
4- Passive motion sense
5- Vibration
**Deep Sensation**

- Deep pressure – *firmer than light touch*
- Deep pain – *squeeze muscle belly or tendon*
- Position sense/ Akinesthesia
- Passive motion sense
- Vibration

Looking for response – level of consciousness

Diagnostic, prognostic and functional information

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**Deep Sensation**

1. Deep pressure
2. Deep pain
3. Position sense/ Akinesthesia
4. Passive motion sense
5. Vibration

Position sense/Kinesthesia - ability to perceive motion, position of joint
- large vs small movement
- Stop & wait for patient to imitate
Deep Sensation

1- Deep pressure
2- Deep pain
3- Position sense/ Akinesthesia
4- Passive motion sense
5- Vibration

Passive MOTION sense
PT moves involved extremity while patient mirrors mov’t with eyes closed
Simultaneous with test mov’t

Video – Deep Sensation

• UE Position Sense
• UE Passive Motion Sense
• LE Position Sense and Passive Motion Sense
Deep Sensation

1- Deep pressure
2- Deep pain
3- Position sense/ Akinesthesia
4- Passive motion sense
5- Vibration

Vibrate tuning fork against a bony prominence
styloid process, wrist, epicondyle, malleolus
Allow patient time to perceive stimulus
Patient tells when vibration stops

Video – Deep Sensation

• UE Position Sense
• UE Passive Motion Sense
• LE Position Sense and Passive Motion Sense
• Vibration
Documentation for Deep Sensory Testing

• Position sense – record number of trials correct
  • Position sense R index finger correct 4/4 trials
  • Position sense L ankle correct ¾ trials with delayed responses

• Passive motion sense – specify joints involved
  • Passive motion sense B wrists intact but slow

• Vibration – specify bony landmark used & both measures
  • Vibration intact L malleolus for both fast and slow responses

Overview

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Integration of Sensory Stimulation

Requires functioning of Cerebral Cortex

- Done ONLY once the ability to perceive sensation has been determined
- Not done if the patient can’t perceive sensation accurately

Integration of Sensory Stimulation

Types:

1- 2 point discrimination
   - compare right vs left
   - varies by location – thigh, hand, finger
   - start apart & decrease space

2- Localization of touch
   - ask patient to point to an area
3- Extinction phenomenon-
   - 2 stimuli simultaneously applied
     - opposite sides body
     - proximal/distal on same extremity
     - proximal/distal on same side of the body

4- Stereognosis

5- Graphesthesia

Video – Sensory Integration

- Two point Discrimination
- Alternate Two point Discrimination
- Point localization
- Extinction Phenomenon
**Sensory Exam Overview**

<table>
<thead>
<tr>
<th>SENSORY EXAM</th>
<th>TEST</th>
<th>Normal? (L vs. R)</th>
<th>Neuroanatomical localization</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RIGHT TOUCH</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper extremity</td>
<td>C4 axillary/brachial point</td>
<td>Superficial cutaneous mechanoreceptors; Large, myelinated peripheral nerve fibers; dorsal column/medial lemniscus</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C5 lateral cutaneous tissue proximal to elbow crease</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C6 thumb</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C7 middle finger</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C8 little finger</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lower extremity</td>
<td>L2 open of ankle</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>L3 medial femoral condyle of knee</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>L4 medial malleolus</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>L5 dorsum of foot, third toe</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>S1 lateral heel</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>S2 popliteal fossa of knee</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>S3 ischial tuberosity</td>
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<td></td>
<td>S4-5 perineal area</td>
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</tbody>
</table>

| **PAIN/SHARP** | Test at key dermatomal points | | |
| Upper extremity | C4 axillary/brachial point | Superficial cutaneous free nerve endings and nociceptors; Small, lightly myelinated peripheral nerves; Contralateral spinothalamic tract |
| | C5 lateral cutaneous tissue proximal to elbow crease | |
| | C6 thumb | |
| | C7 middle finger | |
| | C8 little finger | |
| Lower extremity | L2 open of ankle | |
| | L3 medial femoral condyle of knee | |
| | L4 medial malleolus | |
| | L5 dorsum of foot, third toe | |
| | S1 lateral heel | |

**Sensory Exam Overview continued**

<table>
<thead>
<tr>
<th>SENSORY EXAM</th>
<th>TEST</th>
<th>Normal? (L vs. R)</th>
<th>Neuroanatomical localization</th>
<th>Clinical comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LOWER EXTREMITIES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper extremity</td>
<td>Index finger</td>
<td>Deep mechanoreceptors</td>
<td>Large, myelinated peripheral nerve fibers; dorsal column/medial lemniscus</td>
<td>Proprioceptive and/or vibration deficits usually associated with failed Romberg, imbalance, ataxic/steppage gait, B12 disease and syphilis affect only these modalities. Loss of vibration poor prognostic indicator of stroke recovery.</td>
</tr>
<tr>
<td>Lower extremity</td>
<td>Ankle</td>
<td></td>
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<tr>
<td></td>
<td>Big Toe</td>
<td></td>
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<tr>
<td><strong>VIBRATION</strong></td>
<td></td>
<td></td>
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<tr>
<td>Upper extremity</td>
<td>Styloid process of wrist</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Epicondyle of elbow</td>
<td></td>
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</tr>
<tr>
<td>Lower extremity</td>
<td>Big Toe</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Malleolus</td>
<td></td>
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</tr>
</tbody>
</table>

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Parts of a Neuro Exam

1- Sensory
2- Motor
3- Tone
4- Motor Control
5- Balance
6- Coordination

Motor Testing

Reflexes
  Superficial
  Deep Tendon
Myotomes
  GMT
Reflexes

Testing divided into 2 parts:
1- Deep tendon reflexes
2- Superficial

Indicates that the reflex arc is intact & capable of functioning at specific levels

Mechanism of action:
• brief, small stretch to the muscle produces a brief muscle contraction

Sensory receptor responsible:
• Muscle Spindle
**UMN vs LMN**

*What makes a hyperreflexive response?*

- **UMN lesion – above AHC**
  - hyper due to inhibition from higher brain centers

- **LMN lesion – below AHC**
  - hyporeflexive
  - something interrupting the reflex arc

---

**UMN vs LMN lesion symptoms**

- **UMN lesion:**
  - Hyperreflexia
  - Hypertonicity

- **Examples:**
  - CVA, Parkinson’s disease, Brain Injury

- **LMN lesion:**
  - Hyporeflexia
  - Hypotonicity

- **Examples:**
  - Carpal tunnel syndrome, Peripheral neuropathy, PN injury
Spinal Cord Injury

- At injury level – HYPO (LMN lesion)
- Above injury level – NORMAL
- Below injury level – HYPER (UMN lesion)

Deep Tendon Reflex Testing

Grading:
0 = no response
+ = hypoactive response
++ = normal
+++ = hyperactive
++++ = very hyperactive
DTR Method of Documentation

Reflex testing for various spinal levels

C5 - Biceps
C6 - Brachioradialis
C7 - Triceps
L4 - Quads (patellar)
L5 - Hams
S1 - Achilles

Video – DTR testing

• UE reflexes
• LE reflexes
• LE reflexes cont.
Superficial Reflex Testing

- Elicited by stroking skin with handle of reflex hammer or finger
- Done bilaterally
  - Upper abdomen – stroke laterally across upper abdomen → mov’t of umbilicus up & toward side stroked
  - Lower abdomen → mov’t down and toward side stroked

Babinski (Plantar)

- Stroke lateral aspect of heel toward sole of foot

Normal – Toe flexion
Abnormal – extension of big toe, fanning of others

Documentation – Present or Absent
Primary Motor Pathway – Corticospinal Tract

- Efferent pathway
- crosses lower medulla
- synapses at AHC

Myotome

Definition: Groups of muscles supplied by a single nerve root

Lesion at nerve root → paresis (incomplete paralysis i.e. weakness)

Lesion at peripheral nerve → complete paralysis of mm supplies by that nerve
Video – Myotome testing

- UE Myotome
- LE Myotome

Tone Testing

Definition – *Muscle resistance to passive stretch*

Resistance may be due to:
- physical inertia
- intrinsic mechanical elastic stiffness of muscle & connective tissue
- reflex muscle contraction

Postural tone – used to describe a pattern of muscle tension that exists throughout the body
**Categories of Tone**

Hypertonia - ↑ above normal resting levels

Hypotonia - ↓ below normal resting levels

Dystonia – impaired or disordered tonicity
- sustained involuntary mov’t

---

**Tone Examination**

1- Initial observation
   - abnormal posturing
      - amount of spontaneous movement
2- Passive motion testing - Move the limb randomly & at a continuous rate

- Normal = limb moves easily & PT able to alter direction & speed without excess resistance
- Hyper = limb feels stiff & resists mov’t
- Hypo = limb feels heavy & unresponsive
3- Pendulum test – let leg drop & swing

4- Drop arm test –
- Normal = limb falls momentarily then catches & maintains position as intact, automatic proprioception reacts to prevent it from falling
- Hypo = limb falls abruptly
- Hyper – a delay & then resistance to falling

5- Ashworth Scale –
- 5 point ordinal scale with established reliability and validity

Hypertonicity Scale – Modified Ashworth

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No increase in muscle tone</td>
</tr>
<tr>
<td>1</td>
<td>Slight increase in muscle tone, manifested by a catch and release or by minimal resistance at the end range of motion when the affected parties moved in flexion or extension</td>
</tr>
<tr>
<td>1+</td>
<td>Slight increase in muscle tone, manifested by a catch, followed by minimal resistance throughout the remainder (less than half) of the range of motion</td>
</tr>
<tr>
<td>2</td>
<td>More marked increase in muscle tone through most of the range of motion, but the affected part is easily moved</td>
</tr>
<tr>
<td>3</td>
<td>Considerable increase in muscle tone, passive movement is difficult</td>
</tr>
<tr>
<td>4</td>
<td>Affected part is rigid in flexion or extension</td>
</tr>
</tbody>
</table>

https://www.youtube.com/watch?v=5vzUHyH4Fk
### Motor Exam Overview

<table>
<thead>
<tr>
<th>MOTOR</th>
<th>Test</th>
<th>Grade</th>
<th>Neuroanatomical localization</th>
</tr>
</thead>
<tbody>
<tr>
<td>TONE:</td>
<td>Tonic passive movement:</td>
<td>Hypo, hyper, or normal tone?</td>
<td></td>
</tr>
<tr>
<td>Upper Extremity</td>
<td>Elbow</td>
<td>Motor unit</td>
<td>Cortex spinal tract → Basal ganglia &amp;/or its connections</td>
</tr>
<tr>
<td></td>
<td>Wrist</td>
<td>Motor unit</td>
<td>Cortex spinal tract → Basal ganglia &amp;/or its connections</td>
</tr>
<tr>
<td>Lower Extremity</td>
<td>Knees</td>
<td>Motor unit</td>
<td>Cortex spinal tract → Basal ganglia &amp;/or its connections</td>
</tr>
<tr>
<td></td>
<td>Ankles</td>
<td>Motor unit</td>
<td>Cortex spinal tract → Basal ganglia &amp;/or its connections</td>
</tr>
<tr>
<td>BULK &amp; INVOLUNTARY MOVEMENT</td>
<td>Head</td>
<td>Bulb: normal, hypertrophy or atrophy?</td>
<td>Motor unit Cortex spinal tract → Basal ganglia &amp;/or its connections</td>
</tr>
<tr>
<td></td>
<td>Extremities</td>
<td>Motor unit</td>
<td>Cortex spinal tract → Basal ganglia &amp;/or its connections</td>
</tr>
</tbody>
</table>

### MUSCLE STRENGTH:

<table>
<thead>
<tr>
<th>Test</th>
<th>Grade</th>
<th>Neuroanatomical localization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper Extremity</td>
<td>Shoulders C5</td>
<td>C5 myotome</td>
</tr>
<tr>
<td></td>
<td>Biceps C6</td>
<td>C6 myotome</td>
</tr>
<tr>
<td></td>
<td>Triceps C7</td>
<td>C7 myotome</td>
</tr>
<tr>
<td></td>
<td>Wrist Extensors C6</td>
<td>C6 myotome</td>
</tr>
<tr>
<td></td>
<td>Wrist Flexors C7</td>
<td>C7 myotome</td>
</tr>
<tr>
<td></td>
<td>Grip C7&amp;T1</td>
<td>C7&amp;T1 myotomes</td>
</tr>
<tr>
<td></td>
<td>Finger Flexors C8</td>
<td>C8 myotome</td>
</tr>
<tr>
<td></td>
<td>Finger extensors &amp; abductors C7, C8, T1</td>
<td>C7, C8, T1 myotomes</td>
</tr>
<tr>
<td>Lower Extremity</td>
<td>Hip Flexion L1&amp;2</td>
<td>L1&amp;2 myotome</td>
</tr>
<tr>
<td></td>
<td>Knee Extension L3&amp;4</td>
<td>L3&amp;4 myotome</td>
</tr>
<tr>
<td></td>
<td>Knee Flexion L3&amp;4</td>
<td>L3&amp;4 myotome</td>
</tr>
<tr>
<td></td>
<td>Ankle Dorsiflexion L4&amp;5</td>
<td>L4&amp;5 myotome</td>
</tr>
<tr>
<td></td>
<td>Ankle plantar Flexion S1</td>
<td>S1 myotome</td>
</tr>
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</table>

### Motor Exam Overview continued

<table>
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<tr>
<th>Test</th>
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<th>Neuroanatomical localization</th>
</tr>
</thead>
<tbody>
<tr>
<td>MOTOR EXAM, CONT’D</td>
<td>Compare L &amp; R (grade 0-4)</td>
<td>Musculocutaneous n.; C5-C7 spinal cord &amp; roots</td>
</tr>
<tr>
<td>REFLEXES</td>
<td>Biceps</td>
<td>C5</td>
</tr>
<tr>
<td>Upper Extrem. DTR</td>
<td>Triceps</td>
<td>C7</td>
</tr>
<tr>
<td></td>
<td>Brachioradialis</td>
<td>C6</td>
</tr>
<tr>
<td></td>
<td>Patellar</td>
<td>L4</td>
</tr>
<tr>
<td>Lower Extrem. DTR</td>
<td>Achilles</td>
<td>S1</td>
</tr>
<tr>
<td></td>
<td>Plantar (Babinski)</td>
<td>Tibial n.; S1 to S2 spinal cord &amp; roots</td>
</tr>
</tbody>
</table>
Summary

• The neuro exam
  • Aids in confirming a dx
  • Aids in determining impairments that may be contributing to functional limitations
  • Guides the clinician in determining a functional prognosis
  • Must be done systematically and correctly for maximum reliability and validity

Neuro Exam Sequencing

• Sensory Exam – *Done before motor exam*
  • Ability to perceive
    • Superficial sensation – light touch, pain/temp,
    • Deep sensation –
      • proprioception – position sense, passive motion sense
      • Vibration
  • Ability to integration or interpret sensation
    • Point localization, 2 point discrimination, extinction, graphesthesia
Neuro Exam Sequencing

• Motor Exam – *Done after Sensory testing*
  • Reflexes – DTRs, Babinski
  • Posturing
  • GMT within myotomes
  • Tone
    • Passive Motion
    • Ashworth
    • Drop arm
    • Pendulum

References

• Zasler ND. Validity assessment and the neurological physical examination. *NeuroRehabilitation*. 2015. 36: 401-413.