If you are viewing this course as a recorded course after the live webinar, you can use the scroll bar at the bottom of the player window to pause and navigate the course.

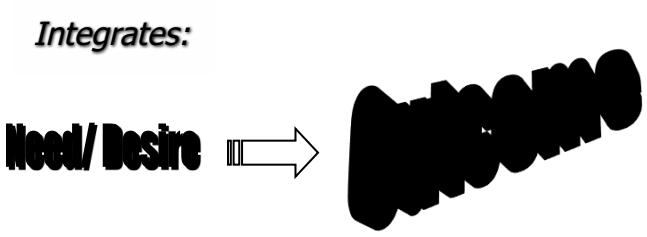
This handout is for reference only. It may not include content identical to the powerpoint. Any links included in the handout are current at the time of the live webinar, but are subject to change and may not be current at a later date.

Integrating the Neuro Exam Into Daily Practice

Rosanne Thomas PT MS PhD

Why bother?

The Nervous System Guides Movement



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

Parts of a Neuro Exam

This webinar focuses on:

1- Sensory

2- Motor

3- Tone

4- Motor Control

5- Balance

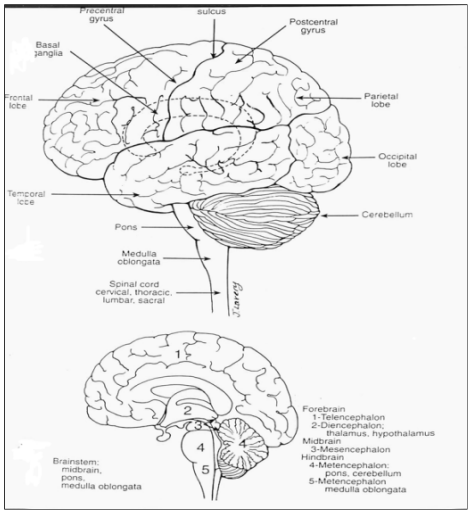
6- Coordination

Webinar Parts

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

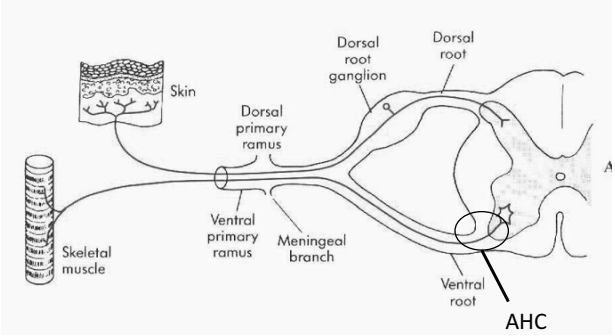
Nervous System Review

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-

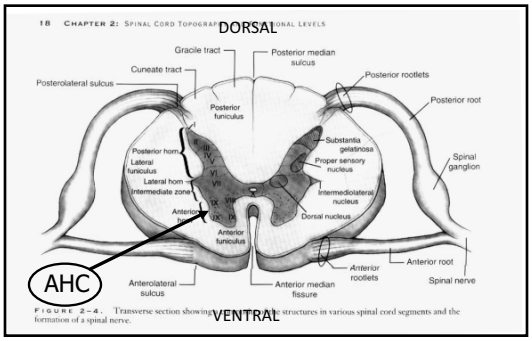
Efferent *Away from the CNS*

CNS – process info, make adjustments

PNS – bring info to/from CNS

Afferent *Toward the CNS*

CNS/PNS Division at Spinal Cord Level

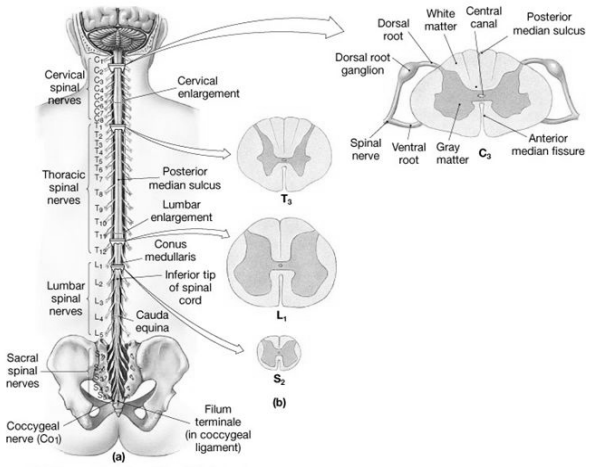


Spinal nerve & nerve root – **most proximal parts of the PNS**

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

Posterior (dorsal) root

CNS/PNS Division at Spinal Cord Level



2

Dermatome

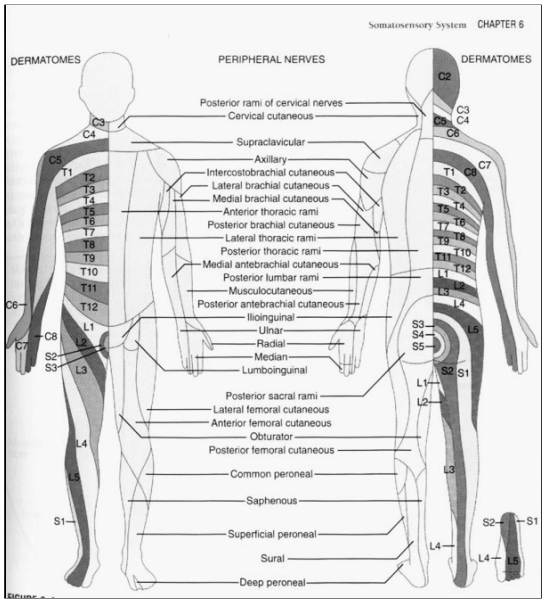
Definition:

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

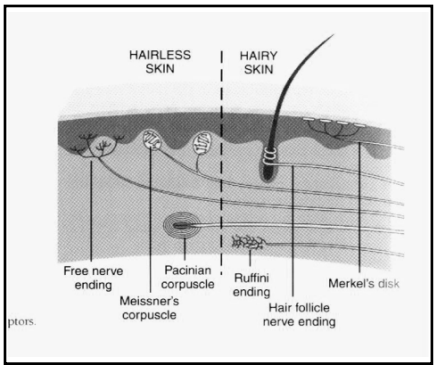
Location of receptor

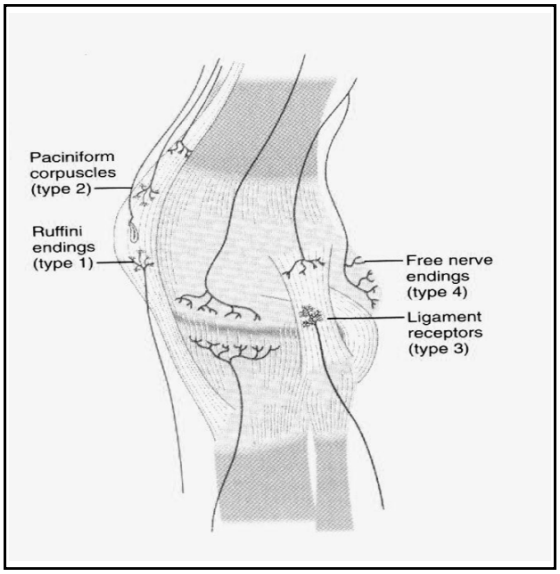
Type of receptor

- 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

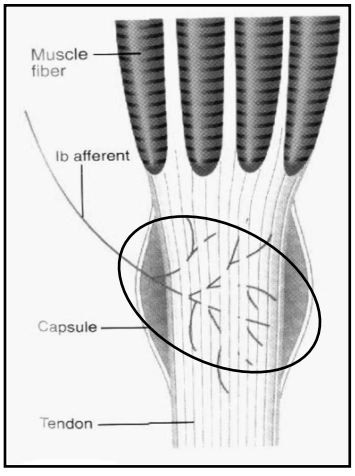
Golgi Tendon Organ (GTO)

Located near musculotendon junction

Responds to contraction of mm

Stimulus (-) agonist,

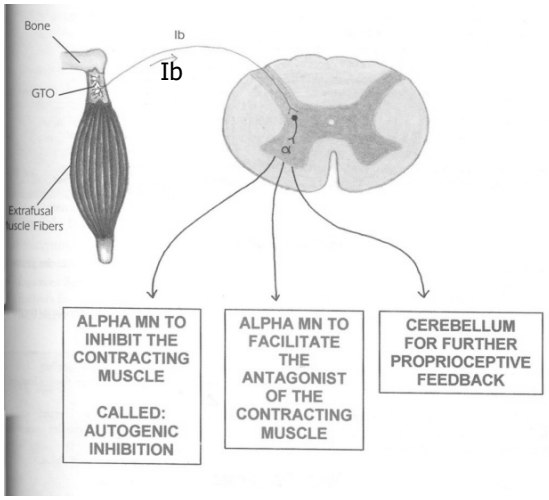
(+) antagonist



GTO info travels to 3 places via SC:

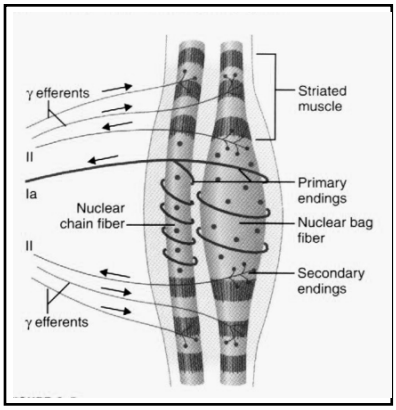
Agonist mm contracts:

- → + GTO in agonist mm
- GTO sends sens info via Ib→ synapse in DH with interneurons
- Interneuron has 3 outputs



Muscle Spindle

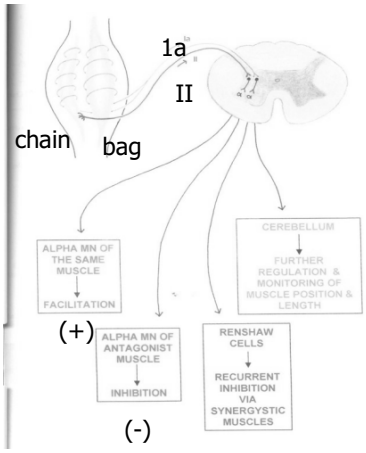
- Located within mm fibers
- Slowly adapting
- Monitors amount of change in length of mm
- Motor as well as sensory components
- Sensory (1A, II afferent) info on rate & amount of change in mm length
- Motor – intrafusal fibers via gamma motoneurons
- Add to production of smooth, controlled, coordinated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



Muscle Spindle Actions:

Extrafusal fiber stretches:

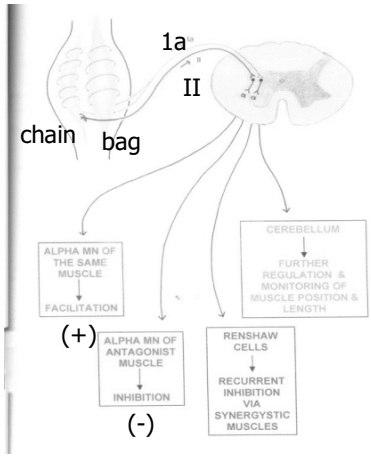
- → intrafusal fiber stretch
- → 1a fibers fire→respond to rate of str & Δin mm length
- → II fibers fire→ respond to length only



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

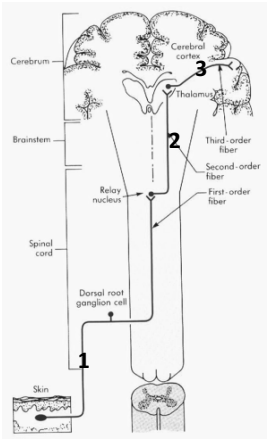
From there – fiber differences:

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

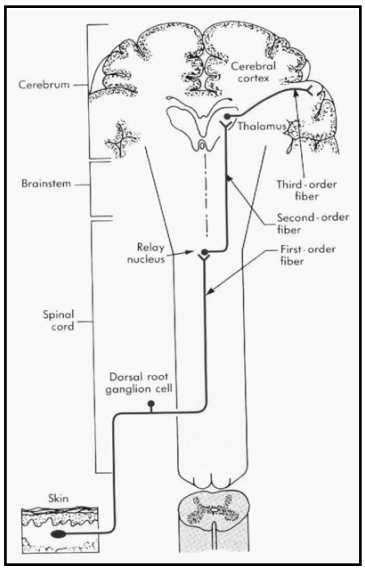
Primary	1. Receptor activation 2. Afferent fibers travel to the Spinal Cord (SC) 3. Fibers enter SC through the dorsal root 4. Travel in SC – either ipsilateral or contralateral
Secondary	5. Synapse and cross 6. Travel to the Thalamus
Tertiary	7. Travel to the Sensory Cortex

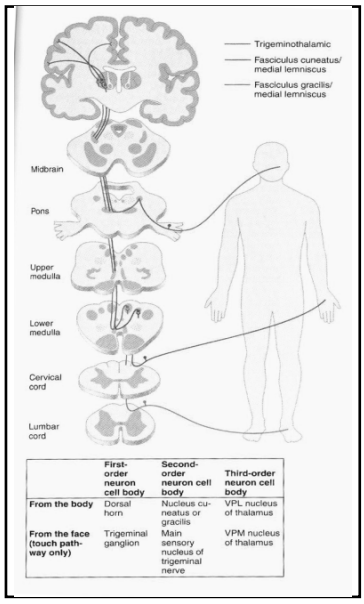


Two Basic Pathways of transmission to Cortical Centers

1- Dorsal column/ medial lemniscal – discriminative touch

2- Anterolateral (spinal thalamic) – pain, temperature, crude touch





	First-order neuron cell body	Second-order neuron cell body	Third-order neuron cell body
From the body	Dorsal horn	Nucleus cuneatus or gracilis	VPL nucleus of thalamus
From the face (touch pathway only)	Trigeminal ganglion	Main sensory nucleus of trigeminal nerve	VPM nucleus of thalamus

Dorsal Column

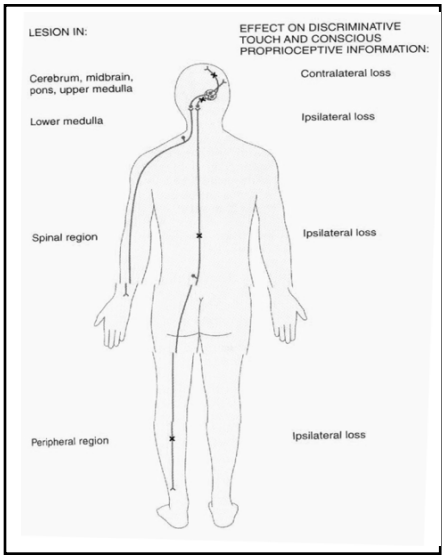
Primary fibers = receptors to spinal cord dorsal horn. Travel ipsilaterally to

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

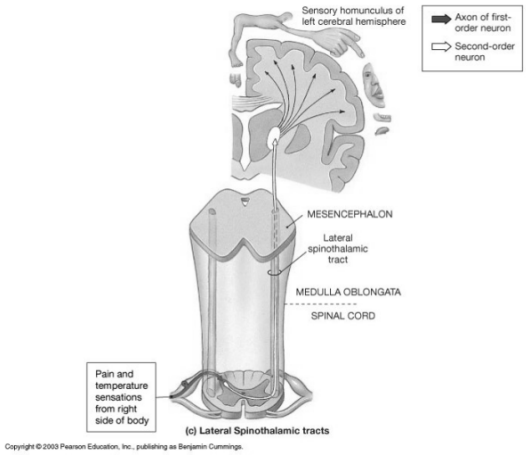
Lower velocities

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)

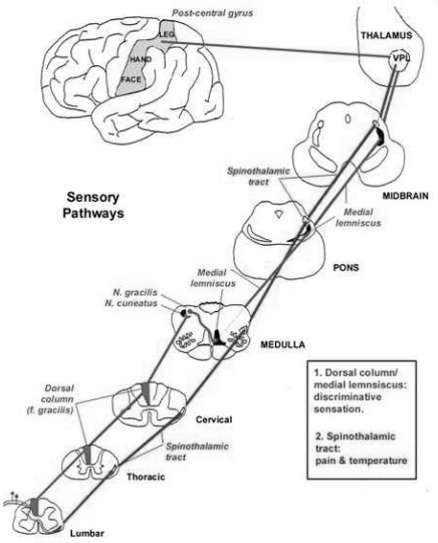
Secondary fibers to thalamus

Tertiary = from thalamus to primary sensory cortex



http://www.iupucanatomy.com/images/Picture%201176.jpg

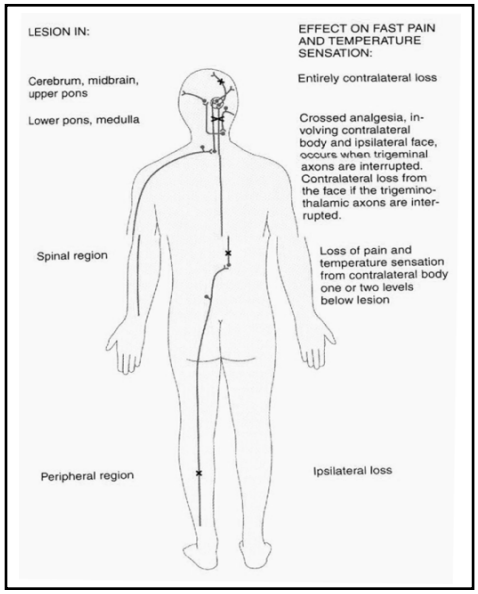
D O R S A L C O L U M N



S P I N A L T H A L A M I C

http://medinfo.ufl.edu/year2/neuro/review/images/fig05.jpg

Anterolateral/ Spinal thalamic tract



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

Therefore:

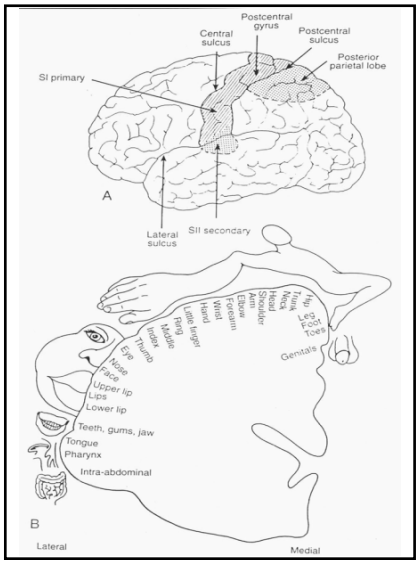
- Sensory info that must be transmitted rapidly with high degree of specificity (location, pressure,etc)
- Fine gradations of intensity
- Discretely localized
- *Mechanoreceptive* sensation alone

Dorsal Column

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

Anterolateral/ Spinal thalamic

Sensory Cortex



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

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

Looking for response – level of consciousness

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

Diagnostic, prognostic and functional information

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

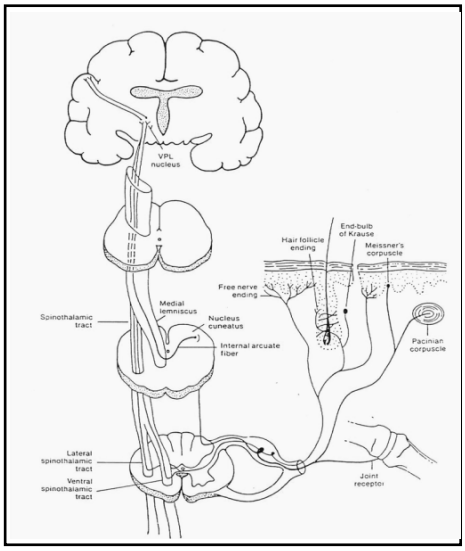
Patient tells when vibration stops

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

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

SENSORY EXAM	TEST	Normal? (L vs. R)	Neuroanatomical localization
LIGHT TOUCH	Test at key dermatomal points		
Upper extremity	C4 acromioclavicular joint		**Superficial cutaneous mechanoreceptors;**
	C5 lateral antecubital fossa proximal to elbow crease		
	C6 thumb		**Large, myelinated peripheral nerve fibers;**
	C7 middle finger		
	C8 little finger		
	T1 medial antecubital fossa proximal to medial epicondyle		**dorsal column/medial lemniscus**
	T2 apex of axilla		
Lower extremity	L2mid-anterior thigh		
	L3 medial femoral condyle of knee		
	L4 medial malleolus		
	L5 dorsum of foot, third toe		
	S1 lateral heel		
	S2 popliteal fossa of knee		
	S3 Ischial tuberosity		
	S4-5 perianal area		

PAIN/SHARP	Test at key dermatomal points			
Upper extremity	C4 acromioclavicular joint		**Superficial cutaneous free nerve endings and nociceptors;**	**Diffuse peripheral neuropathy: decreased perception to pain affecting distal extremities more than proximal (stocking/glove hypoaesthesia). Focal mononeuropathies (single nerve disease) shows more localized deficits.**
	C5 lateral antecubital fossa proximal to elbow crease			
	C6 thumb		**Small, lightly myelinated peripheral nerves ;**	
	C7 middle finger			
	C8 little finger			
	T1 medial antecubital fossa proximal to medial epicondyle			
	T2 apex of axilla		**Contralateral spinothalamic tract**	
Lower extremity	L2mid-anterior thigh			
	L3 medial femoral condyle of knee			
	L4 medial malleolus			
	L5 dorsum of foot, third toe			
	S1 lateral heel			

69

Sensory Exam Overview continued

SENSORY EXAM	TEST	Normal? (L vs. R)	Neuroanatomical localization	Clinical comments
Lower extremity	S2 popliteal fossa of knee			
	S3 Ischial tuberosity			
	S4-5 perianal area			
PROPRIOCEPTION	Digit up & down, right/left			
Upper extremity	Index finger		**Deep mechanoreceptors**	**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.**
Lower extremity	Ankle		**Large, myelinated peripheral nerve fibers;**	
	Big Toe			
VIBRATION			**dorsal column/medial lemniscus**	
Upper extremity	Styloid process of wrist			
	Epicondyle of elbow			
Lower extremity	Big Toe			
	Malleolus			

Rosanne Thomas Neuro Exam webinar

70

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

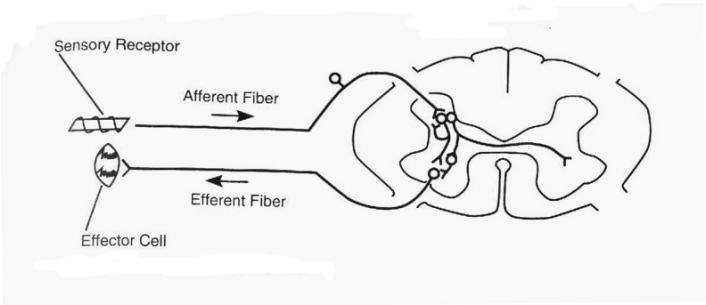
Testing divided into 2 parts:

1- Deep tendon reflexes

2- Superficial

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

DTR



Mechanism of action:

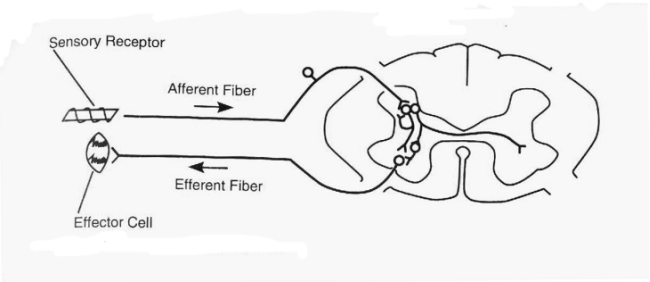
•brief, small stretch to the muscle produces a brief muscle contraction

Sensory receptor responsible:

•Muscle Spindle

UMN vs LMN

What makes a hyperreflexive response?



LMN lesion – below AHC	UMN lesion – above AHC
- hyporeflexive - something interrupting the reflex arc	- hyper due to ↓inhibition from higher brain centers

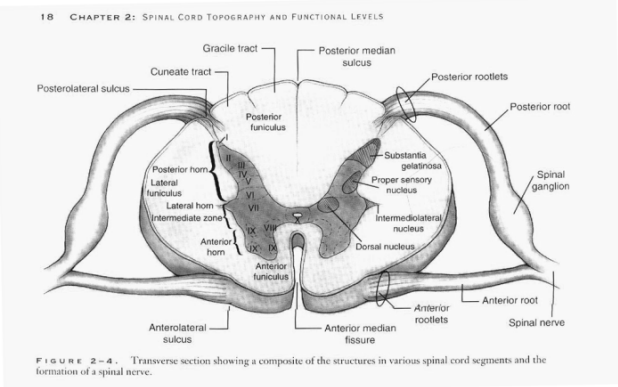
UMN vs LMN lesion symptoms

UMN lesion:	Examples:
•Hyperreflexia •Hypertonicity	CVA, Parkinson's disease, Brain Injury

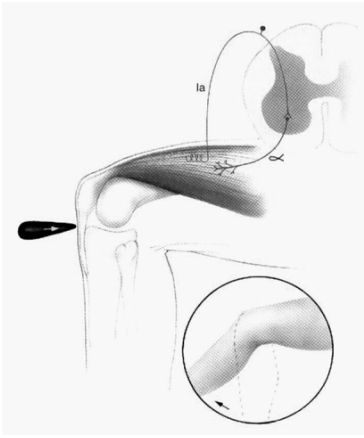
LMN lesion:	Examples:
•Hyporeflexia •Hypotonicity	Carpel tunnel syndrome, Peripheral neuropathy, PN injury

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

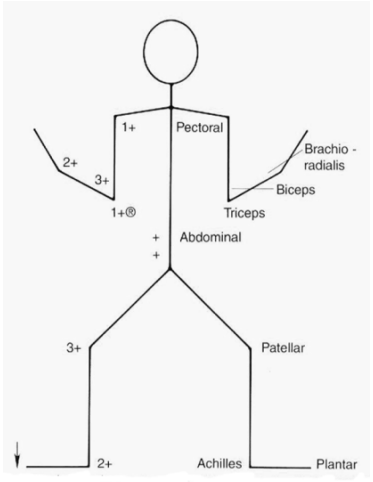
++++ = very hyperactive

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

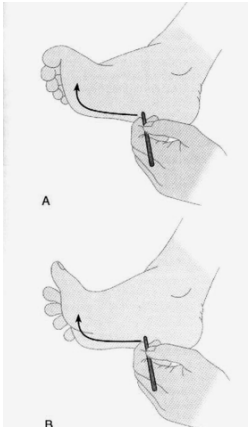
-Elicited by stroking skin with handle of reflex hammer or finger

-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

Superficial Reflex Testing



Babinski (Plantar)

- Stroke lateral aspect of heel toward sole of foot

Normal – Toe flexion

Abnormal – extension of big toe, fanning of others

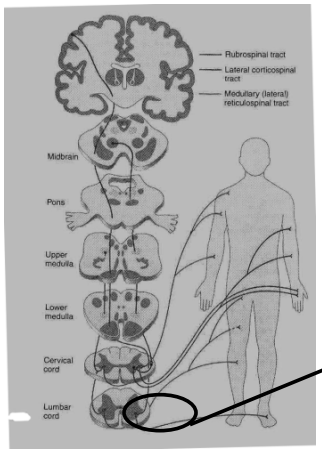
Documentation – Present or Absent

Primary Motor Pathway – Corticospinal Tract

-Efferent pathway

-crosses lower medulla

-synapses at AHC



Primary – Motor cortex to AHC

Secondary – AHC to NMJ

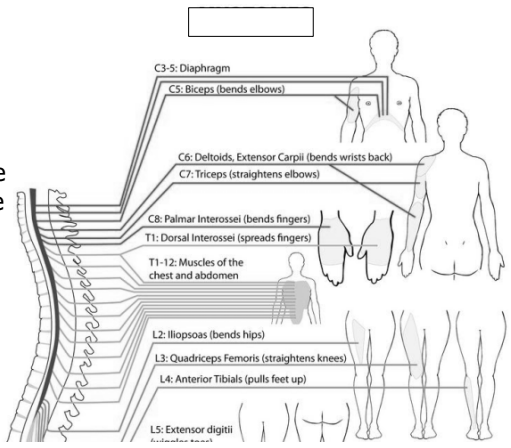
Myotome

Myotome

Definition: *Groups of muscles supplied by a single nerve root*

Lesion at nerve root paresis (incomplete paralysis ie 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

Grade	Description
0	No increase in muscle tone
1	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
1+	Slight increase in muscle tone, manifested by a catch, followed by minimal resistance throughout the remainder (less than half) of the range of motion
2	More marked increase in muscle tone through most of the range of motion, but the affected part is easily moved
3	Considerable increase in muscle tone, passive movement is difficult
4	Affected part is rigid in flexion or extension

https://www.youtube.com/watch?v=cGvxUyjH4Fk

Motor Exam Overview

MOTOR	Test	Normal? Grade L&R	Neuroanatomical localization
TONE:	Test passive movement:	Hypo, hyper, or normal tone?	
Upper extremity	Elbow		**Motor unit → Corticospinal tract → Basal ganglia &/or its connections →**
	Wrist		
Lower Extremity	Knees		
	Ankles		
BULK & INVOLUNTARY MOVEMENT	Head	Bulk: normal, hypertrophy or atrophy?	**Motor unit Basal ganglia &/or its connections**
	Neck		
	Extremities		
MUSCLE STRENGTH:	L&R against resistance	(Grade 0-5)	**Done in myotomes**
Upper Extremity	Deltoids C5		**C5 myotome**
	Biceps		**C6 myotome**
	Triceps		**C7 myotome**
	Wrist Extensors		**C6 myotome**
	Wrist Flexors		**C7 myotome**
	Grip		**C7&T1myotomes**
	Finger flexors		**C8 myotome**
	Finger extensors & abductors		**C7, C8, T1 myotomes**
Lower Extremity	Hip Flexion		**L1&2 myotome**
	Knee Extension		**L3&4 myotome**
	Knee Flexion		**L3&4 myotome**
	Ankle Dorsiflexion		**L4&5 myotome**
	Ankle plantar Flexion		**S1 myotome**
	Test	**Grade L&R**	**Neuroanatomical localization**

91

Motor Exam Overview continued

Test	Grade L&R	Neuroanatomical localization		
MOTOR EXAM, CONT'D	Compare L & R	(Grade 0-4)		**Clinical comments**
REFLEXES	Biceps	C5	Musculocutaneous n.; C5-C7 spinal cord & roots	
Upper Extrem. DTR	Triceps	C7	Radial n.; C6 to C8 cord & roots	**Hyporeflexia indicates peripheral nerve or LMN lesion; Hyperreflexia, spasticity, or clonus indicate corticospinal tract lesion.**
	Brachioradialis	C6	Radial n.;C5 & C6 spinal cord & roots	
	Patellar	L4	Femoral n.; L3 to L4 spinal cord & roots	
Lower Extrem. DTR	Achilles	S1	Tibial n.; S1 spinal cord & roots	
	Plantar (Babinski)		**Tibial n.; S1 to S2 spinal cord & roots**	

Rosanne Thomas Neuro Exam webinar

92

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

- Clark NC, Roijezon U, Treleaven J. Proprioception in musculoskeletal rehabilitation. Part 2: Clinical Assessment and Intervention. *Manual Therapy.* 2015. 20: 378-387.
- Connell LA, Tyson SF. Measures of sensation in neurological conditions: a systematic review. *Clinical Rehabilitation.* 2011. 26(1): 68-80.
- Han J, Waddington G, Adams R, et. al. Assessing proprioception: a critical review of methods. *J Sports & Health Science*. 2016. 5L 80-90.
- Maher AB. Neurological assessment. *International J Ortho & Trauma Nursing*. 2016. 22: 44-53.
- Roijezon U, Clark NC, Treleaven J. Proprioception in musculoskeletal rehabilitation. Part 1: Basic Science and principles of assessment and clinical interventions. *Manual Therapy.* 2015. 20:368-377.
- Thaller M, Hughes T. Inter-rater agreement of observable and elicitable neurological signs. *Clinical Medicine.* 2014. 14(3): 264-267.
- Zasler ND. Validity assessment and the neurological physical examination. *NeuroRehabilitation.* 2015. 36: 401-413.