

Medical Neuroscience | Tutorial Notes

Lower Motor Neuronal Control—Lower Motor Neuron Syndrome

MAP TO NEUROSCIENCE CORE CONCEPTS¹

NCC1. The brain is the body's most complex organ.

NCC3. Genetically determined circuits are the foundation of the nervous system.

LEARNING OBJECTIVES

After study of the assigned learning materials, the student will:

1. Characterize the signs associated with damage to lower motor neurons.

TUTORIAL OUTLINE

- I. Introduction
 - A. Overall organization of the neural centers that control movement (see [Figure 16.1](#)²)
 1. spinal cord circuits: “final common pathway” or “basic motor system”
 - a. **segmental reflexes** involving alpha (and gamma) motor neurons (i.e., “**lower motor neurons**”), local circuit interneurons, and afferent somatic sensory input (e.g., myotatic or “knee-jerk” reflex)
 - b. **intersegmental reflexes** mediated by interneurons that coordinate the activities of segmental circuits at multiple levels of the spinal cord (and brainstem) (e.g., central pattern generators for locomotion)
 2. descending control systems
 - a. volitional somatic movement: pyramidal motor system
 - (i) **motor cortex** (primary motor cortex and premotor cortex) plans and directs the execution of volition movements (“pyramidal” -- outflow from the motor cortex is directed down the pyramidal tract; i.e., via the medullary pyramids)
 - b. involuntary somatic movement (“extrapyramidal” -- outflow does not involve the pyramidal tract)
 - (i) brainstem centers (**reticular formation, vestibular nuclei, superior colliculus**) coordinate somatic motor activities that are largely involuntary (e.g., postural adjustments and orienting reflexes toward sensory stimuli)

¹ Visit [BrainFacts.org](https://www.brainfacts.org) for Neuroscience Core Concepts (©2012 Society for Neuroscience) that offer fundamental principles about the brain and nervous system, the most complex living structure known in the universe.

² Figure references to Purves et al., *Neuroscience*, 5th Ed., Sinauer Assoc., Inc., 2012. [[click here](#)]

- (ii) limbic centers in the forebrain (**amygdala, orbital-medial prefrontal cortex, hypothalamus**) also motivate movement (important in emotional or appetitive behavior, as well as addictive behavior)

II. Lower motor neuron syndrome

- B. presentation of clinical signs and symptoms is distinct for damage to lower and upper motor neurons (to be discussed in a later tutorial)
- C. damage to lower motor neurons interrupts the ability of the CNS to control the contractions of skeletal muscle
- D. the clinical picture usually entails:
 - 1. neural consequences
 - a. muscle paralysis (loss of volitional control) or paresis (partial paralysis or profound weakness)
 - b. areflexia (loss of reflexes)
 - c. loss of muscle tone
 - 2. muscle consequences
 - a. muscle atrophy
 - b. fibrillations (spontaneous twitches of denervated muscle fibers) and fasciculations (abnormal excitability and activity of motor units)

STUDY QUESTION

Which of the following neurological signs and symptoms would make you think that a patient you are examining probably DID NOT suffer a lower motor neuron injury?

- A. weakness when asked to contract against resistance
- B. anesthesia when affected skin was light brushed
- C. analgesia when affected skin was firmly pricked with a pin
- D. increased myotatic reflexes in the affected limb
- E. noticeable atrophy of muscles in the affected limb