INTRODUCTION

to

NERVOUS SYSTEM
ANATOMY

M1 - Gross and Developmental Anatomy
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Lecture/Syllabus Outline

I. Major Divisions of the Nervous System
II. Cranial Nerves (structure)
III. Spinal Nerves (structure)
IV. Autonomic Nervous System (functional)
V. Functional Components of Spinal Nerves
VI. Dermatomes
I. Major divisions of the nervous system include:

A. **Central nervous system (CNS)** - an anatomical (i.e. structural) classification
   1. Brain
   2. Spinal cord

B. **Peripheral nervous system (PNS)** - an anatomical (i.e. structural) classification
   1. Cranial nerves - arise from the brain
   2. Spinal nerves - arise from the spinal cord

C. **Somatic nervous system (SNS)** - a functional classification. Parts of this system begin in the CNS and enter the PNS to supply the body wall (“soma”).

D. **Autonomic nervous system (ANS)** - a functional classification. Parts of this system begin in the CNS and enter the PNS to supply the viscera.
   1. Parasympathetic division
   2. Sympathetic division

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II. Cranial nerves

(all twelve pairs shown)

A. **Twelve pairs of cranial nerves** arise from various parts of the brain and have both numbers designated by Roman numerals and names.

   1. Most of the cranial nerves will not be studied until you begin the Head and Neck portion of the course, when they will be studied in detail.

B. **Cranial nerve XI**, the **spinal accessory nerve**, has been introduced this week in regard to the trapezius muscle, which is a muscle that it innervates.

C. **Cranial nerve X**, the **vagus nerve**, will be taught during the study of the parasympathetic system, the Thorax, the Abdomen, and the Head and Neck.
III. Spinal Cord and Spinal Nerves

*Spinal nerves arise from the spinal cord.*

*There are 31 pairs of spinal nerves.*

*Each pair arises from and is named for a spinal cord segment.*

*There are:
  * 8 cervical pairs
  * 12 thoracic pairs
  * 5 lumbar pairs
  * 5 sacral pairs
  * 1 coccygeal pair

On this Netter drawing, only the ventral rami of the spinal nerves are shown.

Note that there are 8 cervical spinal nerves, but only 7 cervical vertebrae. Consider the location of each cervical spinal nerve in relation to the vertebrae.
From the T1 pair downward, each pair of nerves is named according to the vertebra that lies above it. For example, the L2 spinal nerves pass through the intervertebral foramina below the L2 vertebra.
Spinal Nerves
(two pairs shown)

1. The **DORSAL ROOT** (sensory root) of a spinal nerve arises from the posterolateral aspect of the spinal cord and swells as it forms the dorsal root ganglion.
2. The **VENTRAL ROOT** (motor root) of a spinal nerve arises from the anterolateral aspect of the spinal cord.
3. The **SPINAL NERVE** itself occupies the space within an intervertebral foramen and is only about one centimeter long before dividing into dorsal and ventral rami.
4. The **DORSAL RAMUS** (ramus=branch) is the smaller branch of the spinal nerve and passes posteriorly.
5. The **VENTRAL RAMUS** is the larger branch of the spinal nerve and passes anteriorly.
"Typical" Spinal Nerve (T2 - T11) and its branches in relation to body surfaces

1. Dorsal root
2. Ventral root
3. Spinal nerve
4. Dorsal ramus
   4a. Medial branch
   4b. Lateral branch
5. Ventral ramus
   5a. Anterior branch
   5b. Latera branch

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Ventral rami other than T2-T11 interconnect to form Somatic Nerve Plexuses

Cervical plexus
(for neck)

Brachial plexus
(for upper limb)

Lumbar plexus
(for lower limb)

Sacral plexus
(for lower limb and perineum)

Sciatic nerve
I. **Major divisions** of the nervous system include:

A. **Central nervous system** (CNS)-an anatomical (i.e. structural) classification

   1. Brain
   2. Spinal cord

B. **Peripheral nervous system** (PNS)-an anatomical (i.e. structural) classification

   1. Cranial nerves-arise from the brain
   2. Spinal nerves-arise from the spinal cord

C. **Somatic nervous system** (SNS)-a functional classification. Parts of this system begin in the CNS and enter the PNS to supply the body wall.

D. **Autonomic nervous system** (ANS)-a functional classification. Parts of this system begin in the CNS and enter the PNS to supply the viscera.

   1. Parasympathetic division
   2. Sympathetic division

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IV. **Autonomic Nervous System**

The ANS is a functional rather than a distinctly structural classification.

A consistent feature of the ANS is the two-neuron connection, which transmits an impulse from the CNS to an end organ and has an autonomic ganglion interposed between the two neurons.

In terms of motor function, the SNS is called “voluntary”, whereas the ANS is called “involuntary”.
Rami Communicantes
Connect
the Ventral Rami to the Sympathetic Chains

White rami-
(myelinated)
Carry preganglionic sympathetic
and visceral afferent fibers

Gray rami-
(unmyelinated)
Carry postganglionic sympathetic
fibers
V. Functional Components of Spinal Nerves

A. General somatic afferent (GSA)
   SNS
   Sensory nerve fibers from body surface and muscles

B. General visceral afferent (GVA)
   ANS
   Sensory nerve fibers from internal organs, blood vessels, and glands

C. General somatic efferent (GSE)
   SNS
   Motor nerve fibers to skeletal muscle

D. General visceral efferent (GVE)
   ANS
   Motor nerve fibers to smooth muscle and glands

Somatic Motor Neuron

- If the motor neuron is part of a spinal nerve:
  - Cell body is located in the ventral gray horn.
  - Axon travels through the ventral root.
  - Axon enters the dorsal or the ventral ramus.
  - Axon innervates skeletal muscle.
  - Axon may be several feet long.

Single neurons connect the CNS via the PNS to the end organs.
**Sensory Neuron**

- The cell body is located in a sensory ganglion.
- If the sensory neuron is part of a spinal nerve:
  - Axon’s central process:
    - synapses in the dorsal gray horn.
    - travels through the dorsal root.
  - Axon’s peripheral process:
    - enters the dorsal or the ventral ramus.
    - connects with sensory receptors.
    - may be several feet long.
Summary: General Somatic Afferent (sensory) and Somatic Efferent (motor) – Fig. 4.49 Grant’s 12th.

Summary: General Visceral Efferent and Visceral Afferent – Fig. 4.51 Grant’s 12th.
**C. Anterolateral View**

* Spinal branches arise from the vertebral, intercostal, lumbar, or sacral artery, depending on level of spinal cord.
**Dermatome**

- A skin area supplied with sensation by a spinal nerve

Dermatomes are circumferential on trunk.

Dorsal rami

Ventral rami

Dermatomes are strips & patches on limbs.

(Limbs are supplied by ventral rami only).

### Clinical Correlation:

**Herpes Zoster Virus** – “Shingles”

May lie dormant in dorsal root ganglion – may be activated by stress.
Segmental Innervation of Muscles

Each skeletal muscle is innervated by somatic motor fibers from specific spinal nerves.

1. Because of the formation of somatic nerve plexuses, the segmental innervation of muscles cannot be recognized by dissection.

2. The segmental innervation of muscles has been discerned by clinical studies and this information is important to the anatomist, neurologist, and neurosurgeon.

3. The named peripheral nerve innervation of muscles can be recognized by dissection.

Laminectomy: