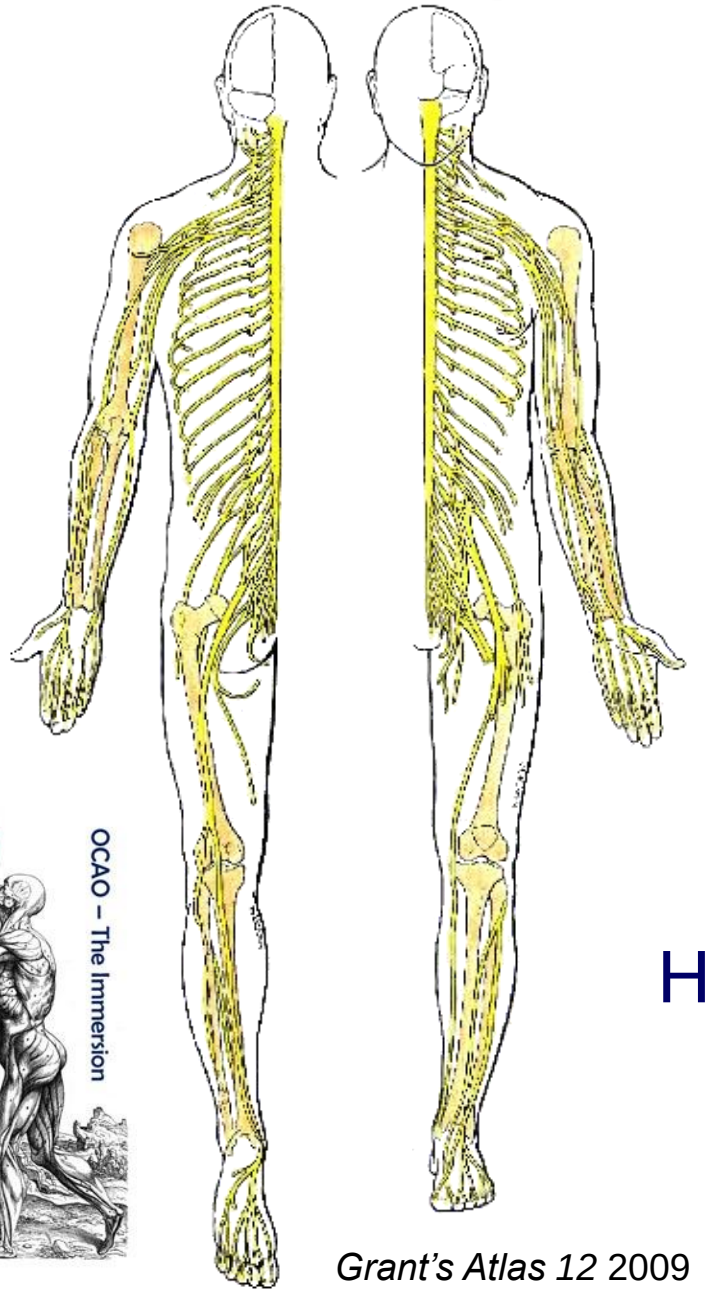
Peripheral Nervous System 1: The Somatic System



Grant's Atlas 12 2009

1 August 2011

Handout download: Blackboard or
http://www.oucom.ohiou.edu/dbms-witmer/anatomy_immersion.htm

Reading: Moore's COA6 46–57

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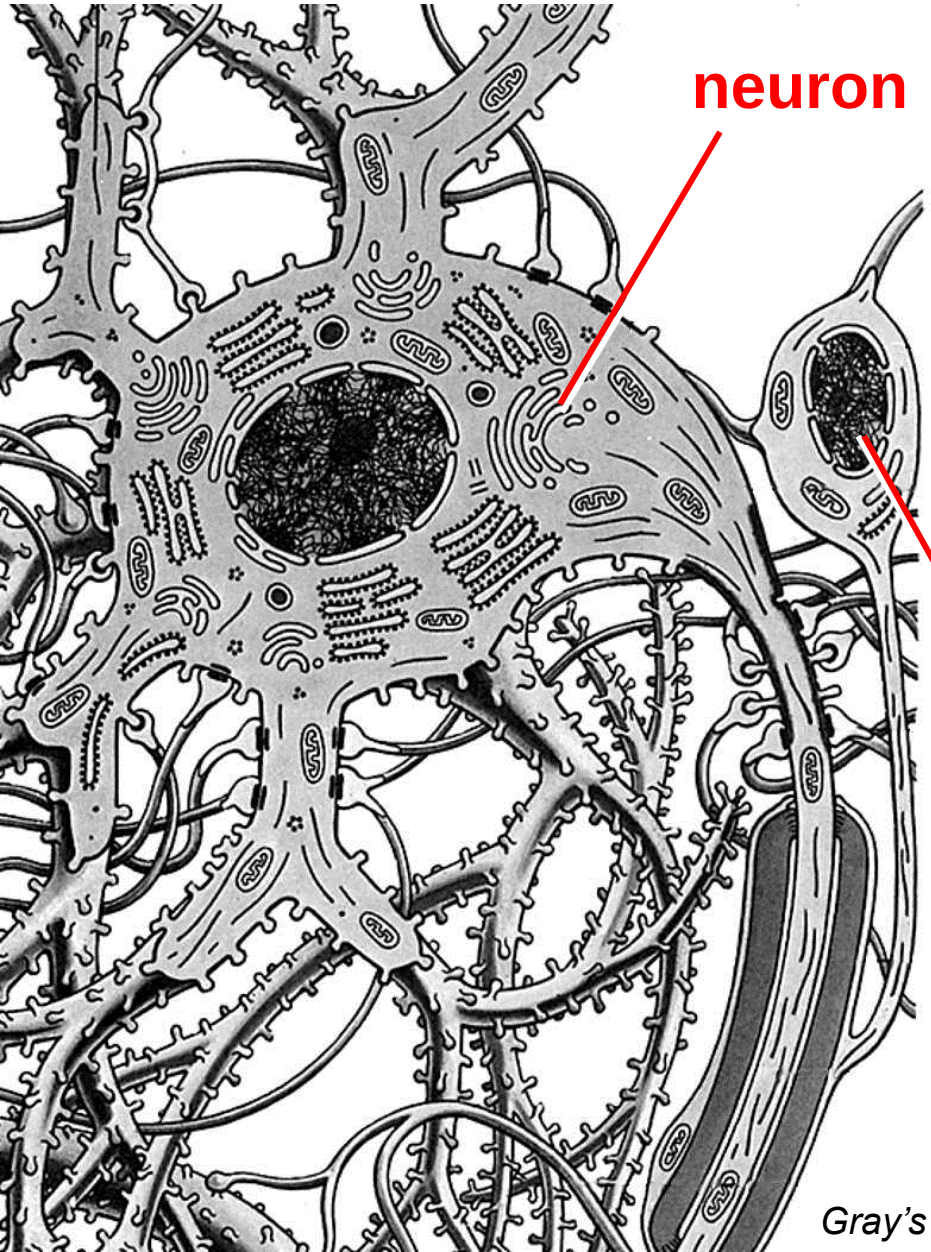
Dichotomies

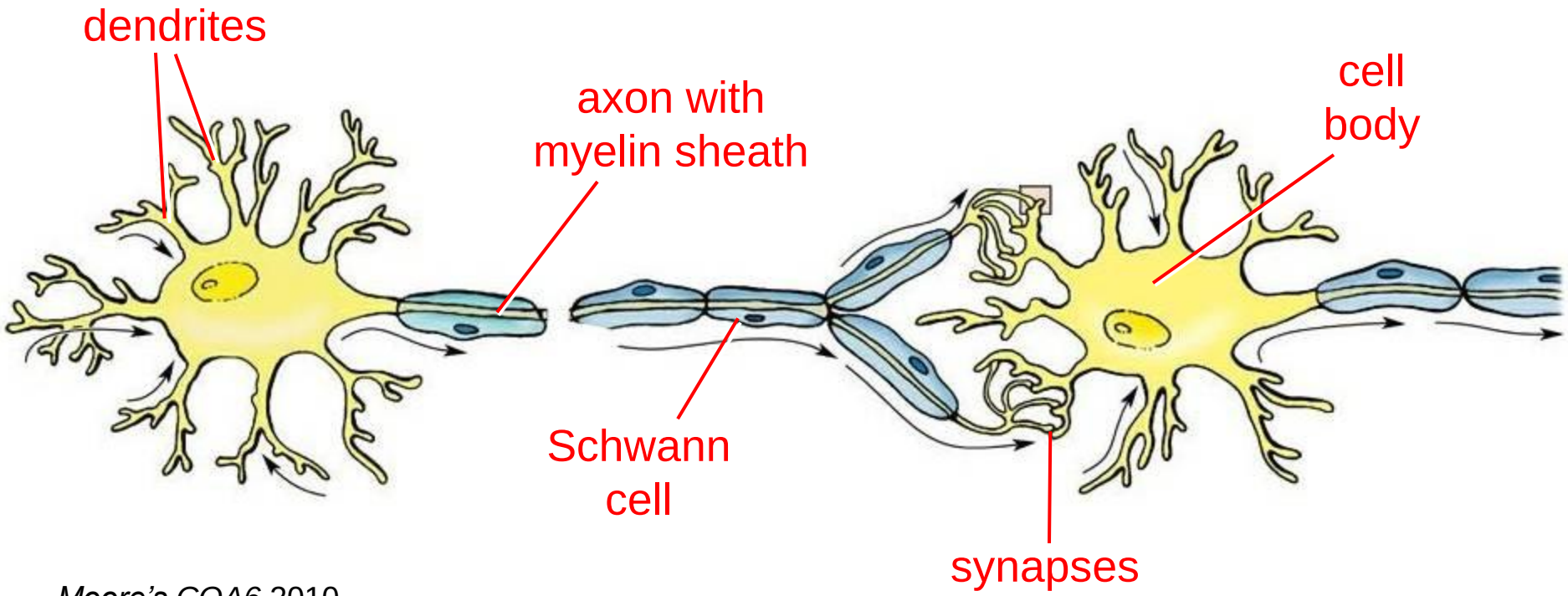


1. Tissues: neurons vs. glia
2. Position: CNS vs. PNS
3. Function 1: sensory vs. motor
4. Function 2: somatic vs. visceral

Gray's Anatomy 38 1999

Neurons

- Dendrites: carry nerve impulses toward cell body
- Axon: carries impulses away from cell body
- Synapses: site of communication between neurons using chemical neurotransmitters
- Myelin & myelin sheath: lipoprotein covering produced by glial cells (e.g., Schwann cells in PNS) that increases axonal conduction velocity
- Demyelinating diseases: e.g., Multiple Sclerosis (MS) in CNS or Guillain-Barré Syndrome in PNS



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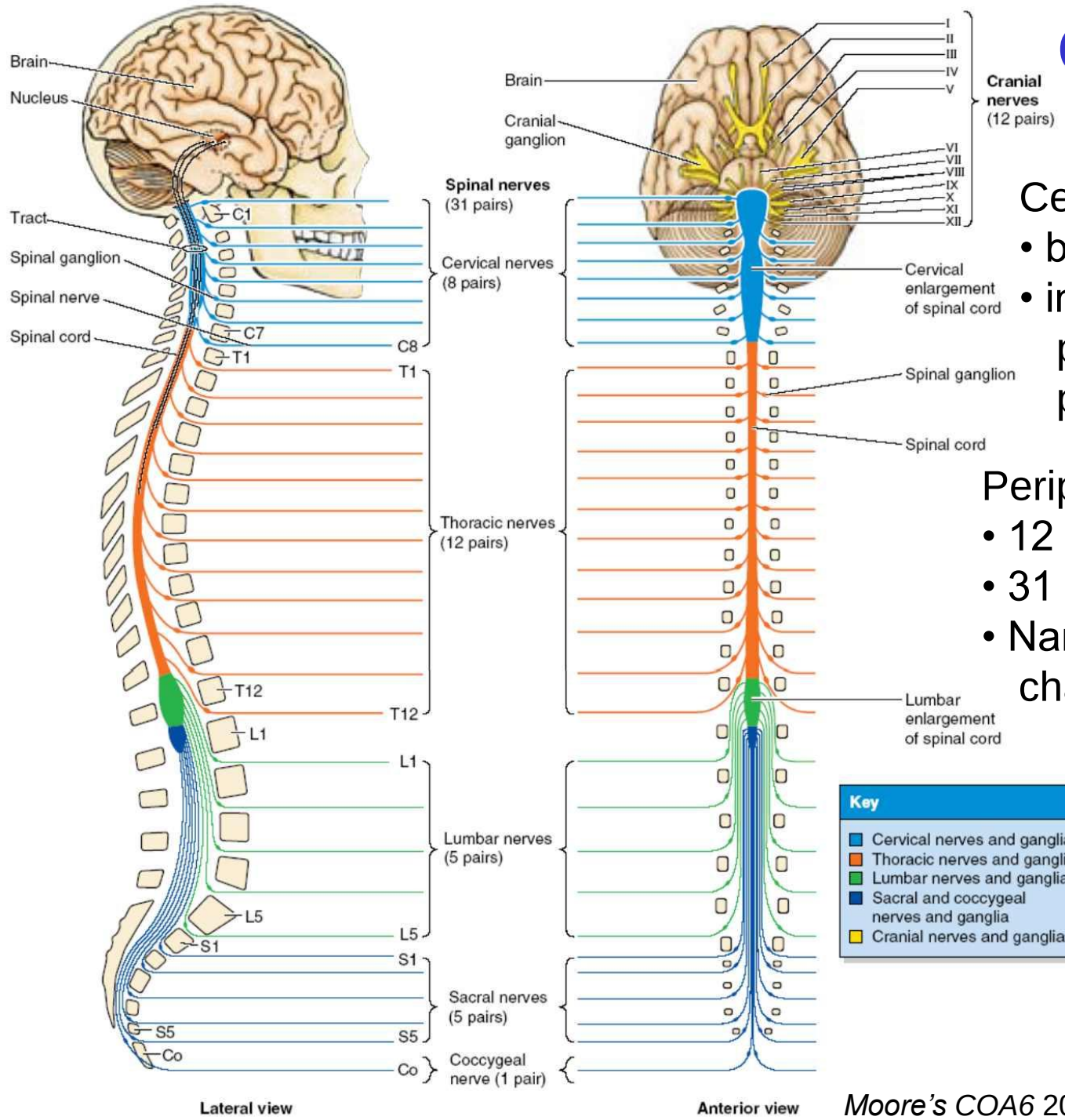
CNS vs. PNS



Central Nervous System
- brain & spinal cord
- integration of info passing to & from the periphery

Peripheral Nervous System
- 12 cranial nerves
- 31 pairs of spinal nerves
- Naming convention changes at C7/T1

Collection of nerve cell bodies:
- CNS: nucleus
- PNS: ganglion

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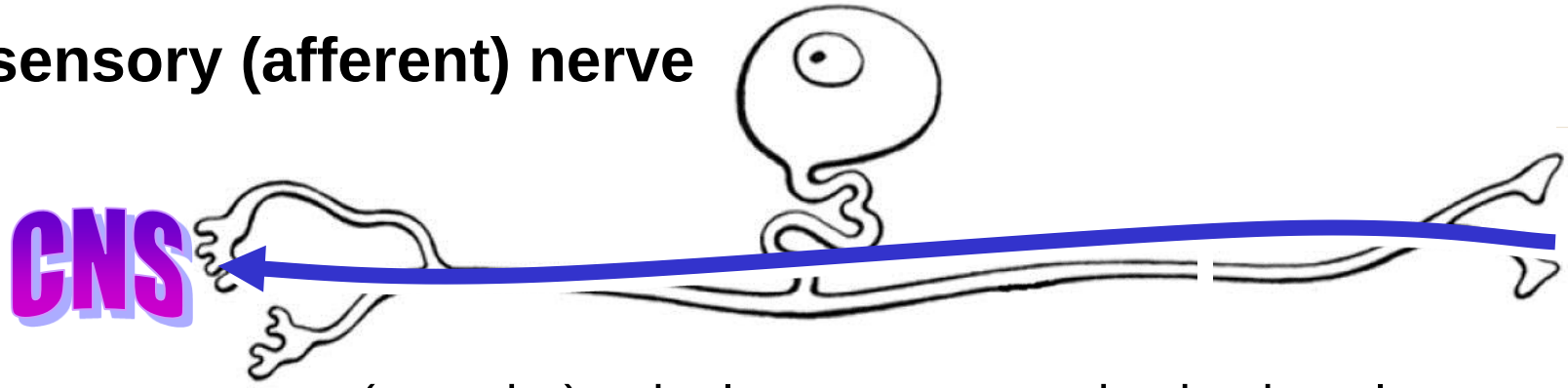
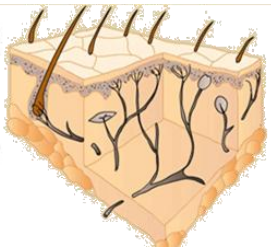
Sensory (Afferent) vs. Motor (Efferent)

sensory (afferent) nerve

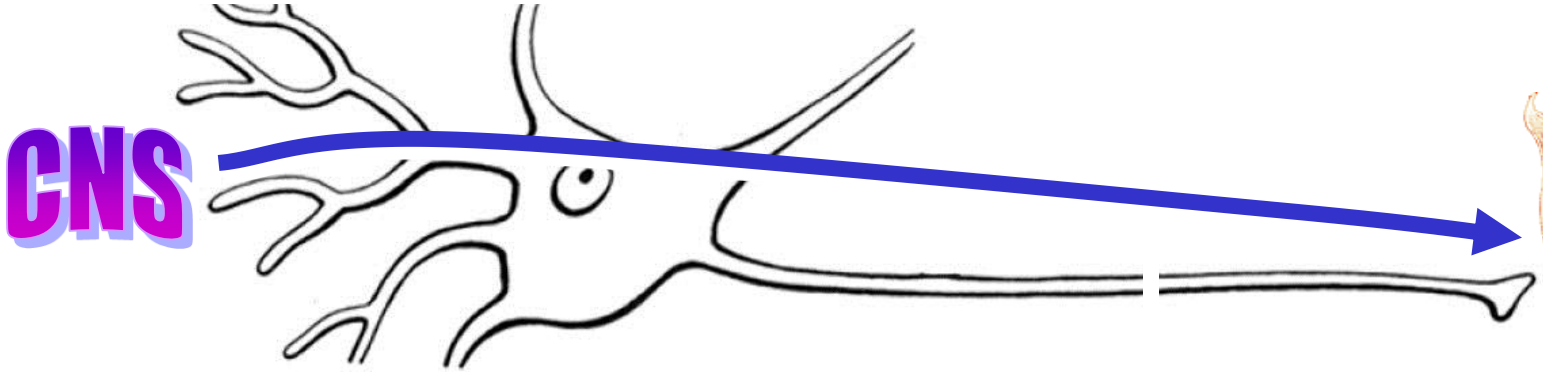


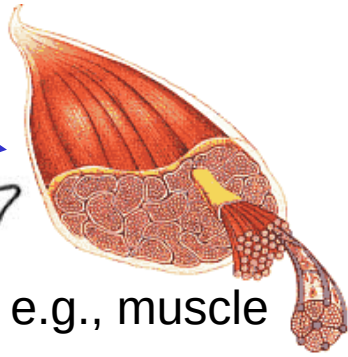


e.g., skin

(pseudo-) unipolar neurons conducting impulses
from sensory organs to the CNS

motor (efferent) nerve





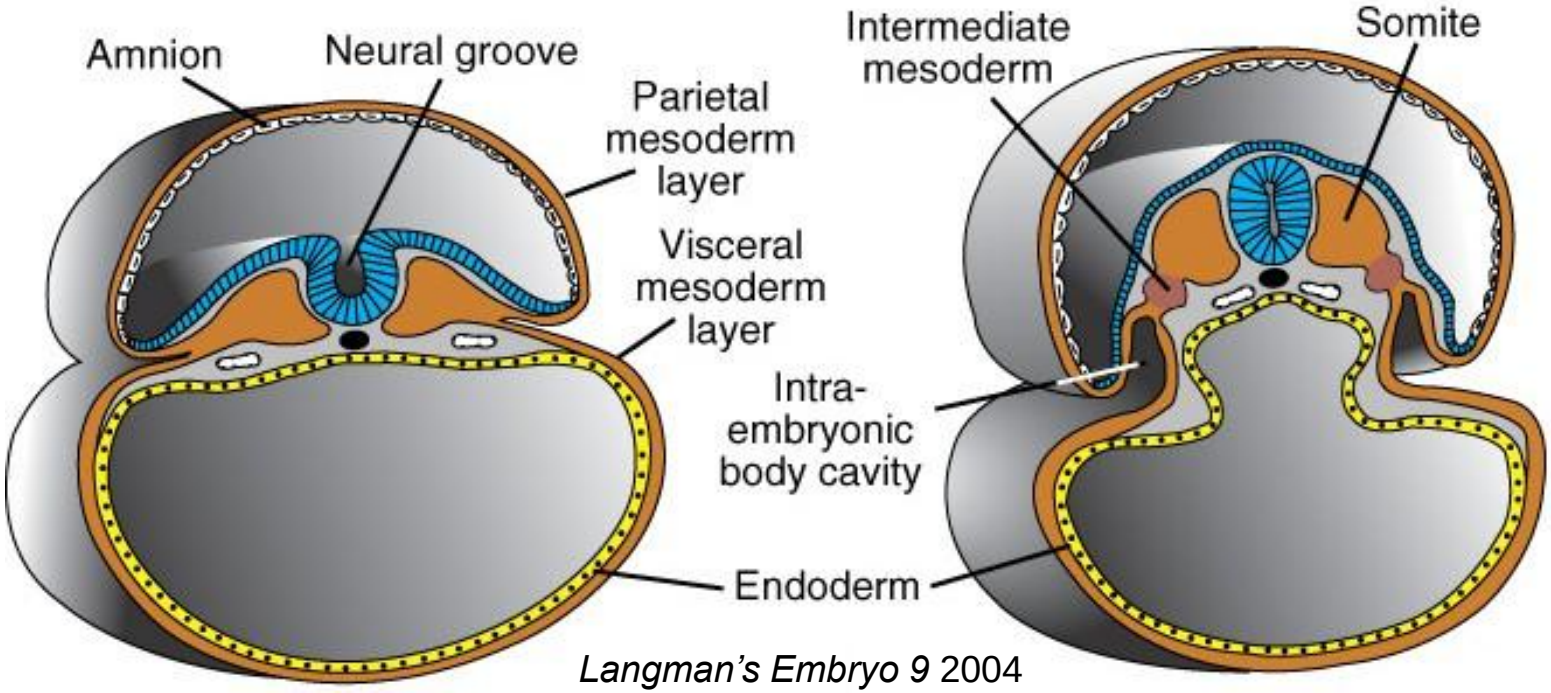
e.g., muscle

multipolar neurons conducting impulses
from the CNS to effector organs (muscles & glands)

Gray's Anatomy 38 1999

Somatic vs. Visceral

attribute	Somatic System	Visceral System
embryological origin of tissue	“body wall:” somatic (parietal) mesoderm (dermatome, myotome)	“organs:” splanchnic (visceral) mesoderm, endoderm
examples of adult tissues	dermis of skin, skeletal muscles, connective tissues	glands, cardiac muscle, smooth muscle
perception	conscious, voluntary	unconscious, involuntary



Langman’s Embryo 9 2004

Sensory/Motor + Somatic/Visceral

	Somatic	Visceral
Sensory (Afferent)	*somatic sensory* [General Somatic Afferent (GSA)]	*visceral sensory* [General Visceral Afferent (GVA)]
Motor (Efferent)	*somatic motor* [General Somatic Efferent (GSE)]	*visceral motor* [General Visceral Efferent (GVE)]

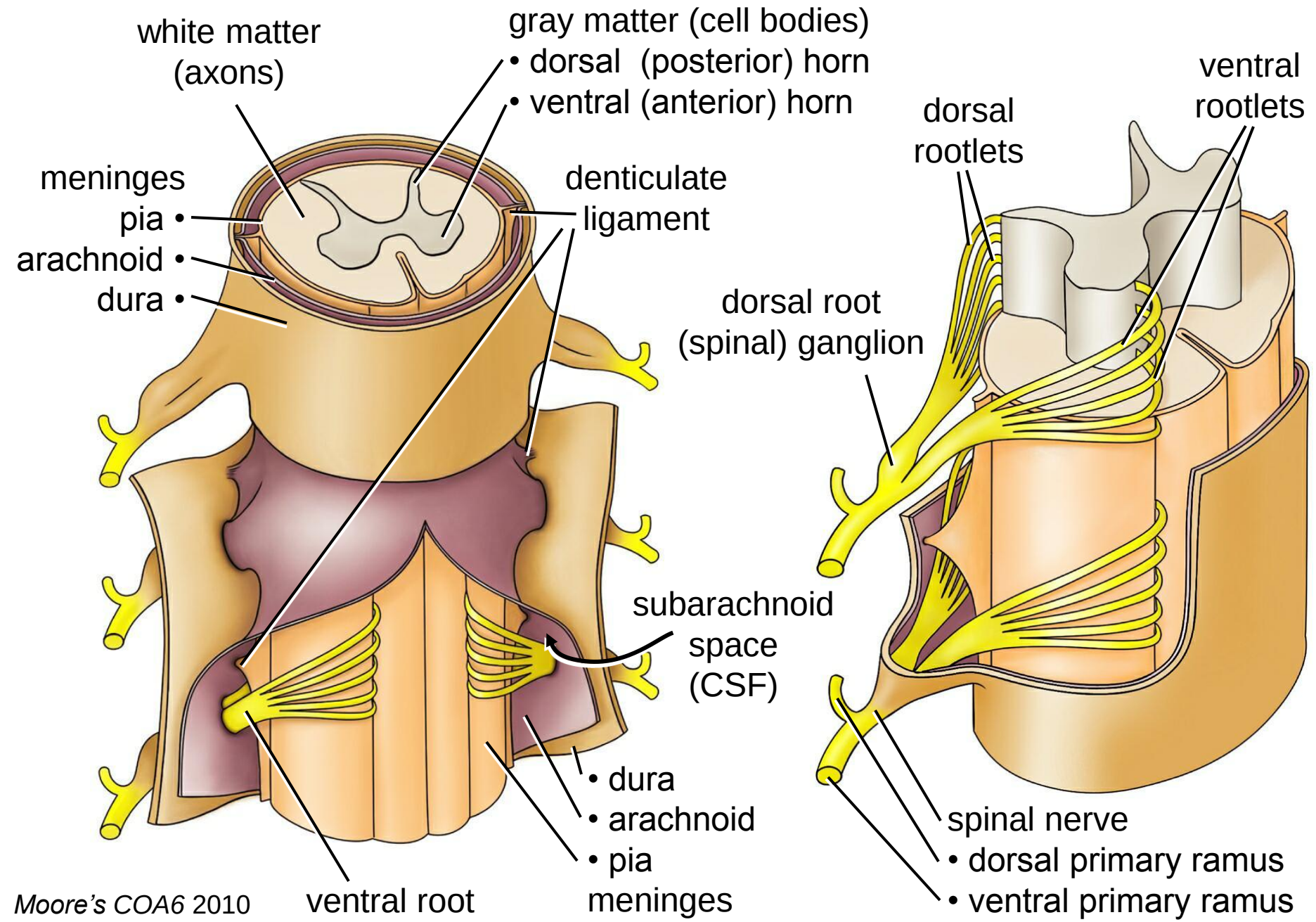
Somatic Nervous System

(today)

Autonomic Nervous System

(Aug 15)

Structure of the Spinal Cord



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Rootlet Damage

Upper Brachial Plexus Injuries

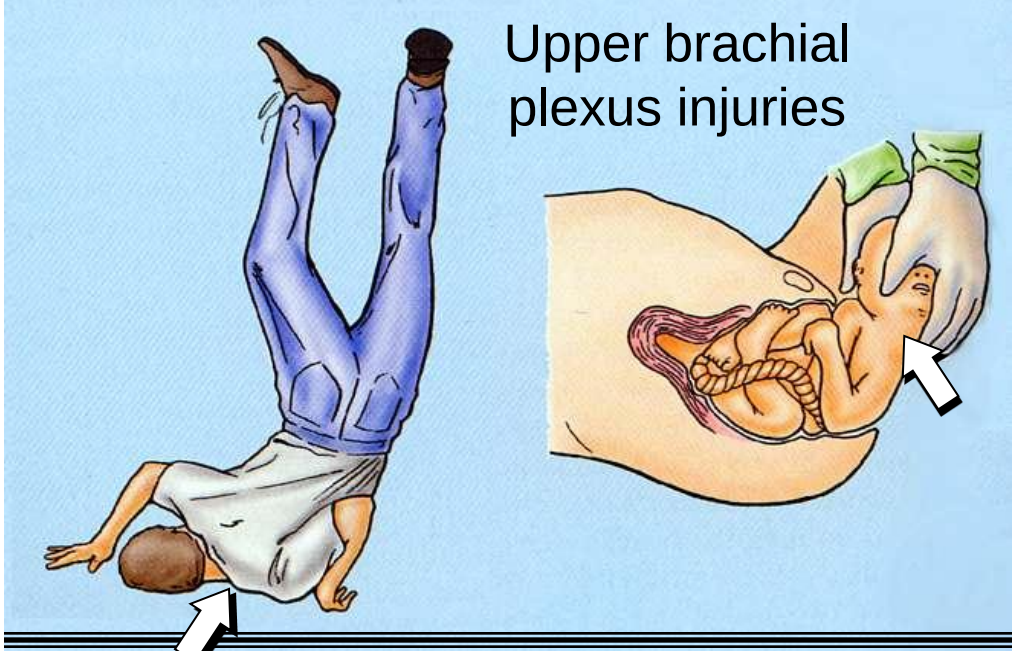
- Increase in angle between neck & shoulder
- Traction (stretching or avulsion) of upper rootlets (e.g., C5,C6)
- Produces Erb's Palsy

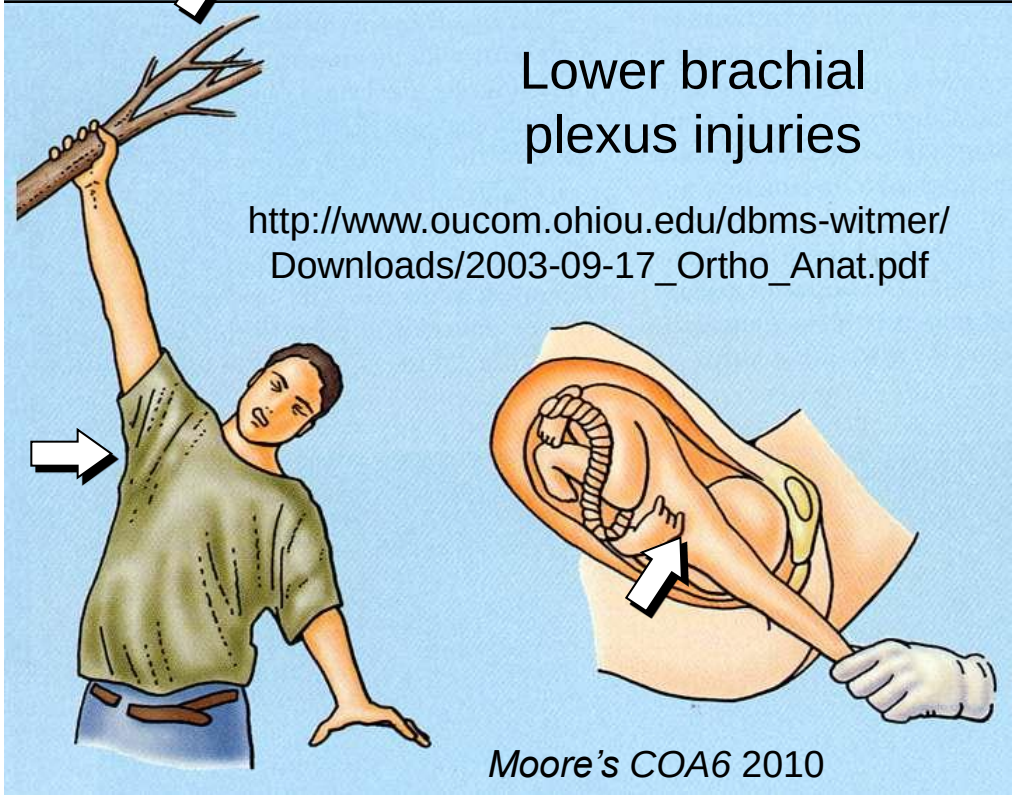
Lower Brachial Plexus Injuries

- Excessive upward pull of limb
- Traction (stretching or avulsion) of lower rootlets (e.g., C8, T1)
- Produces Klumpke's Palsy

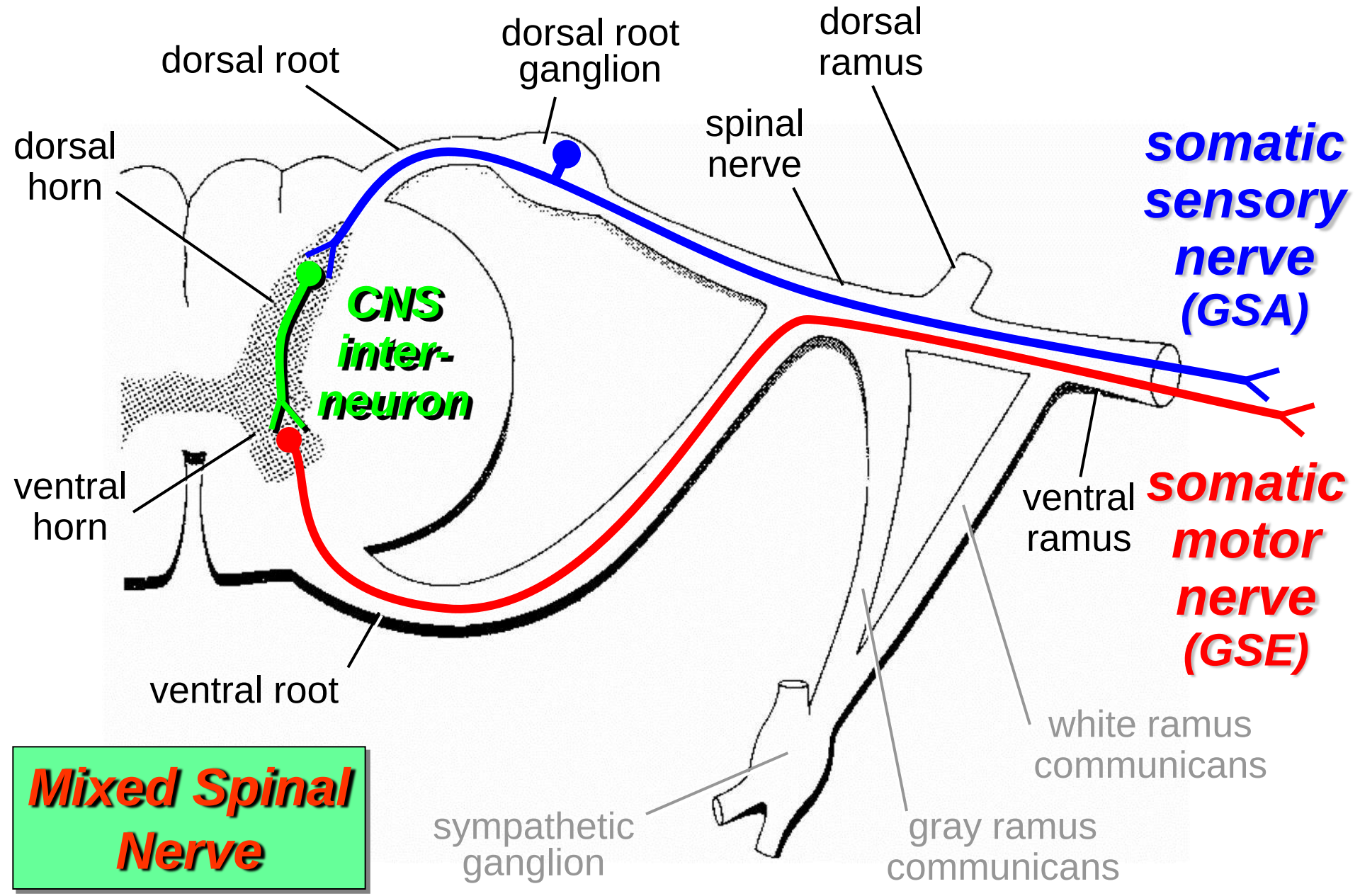
"Obstetrical" or "Birth palsy"

- Becoming increasingly rare
- Categorized on basis of damage
  - Type I: Upper (C5,6), Erb's
  - Type II: All (C5-T1), both palsies
  - Type III: Lower (C8, T1), Klumpke's Palsy



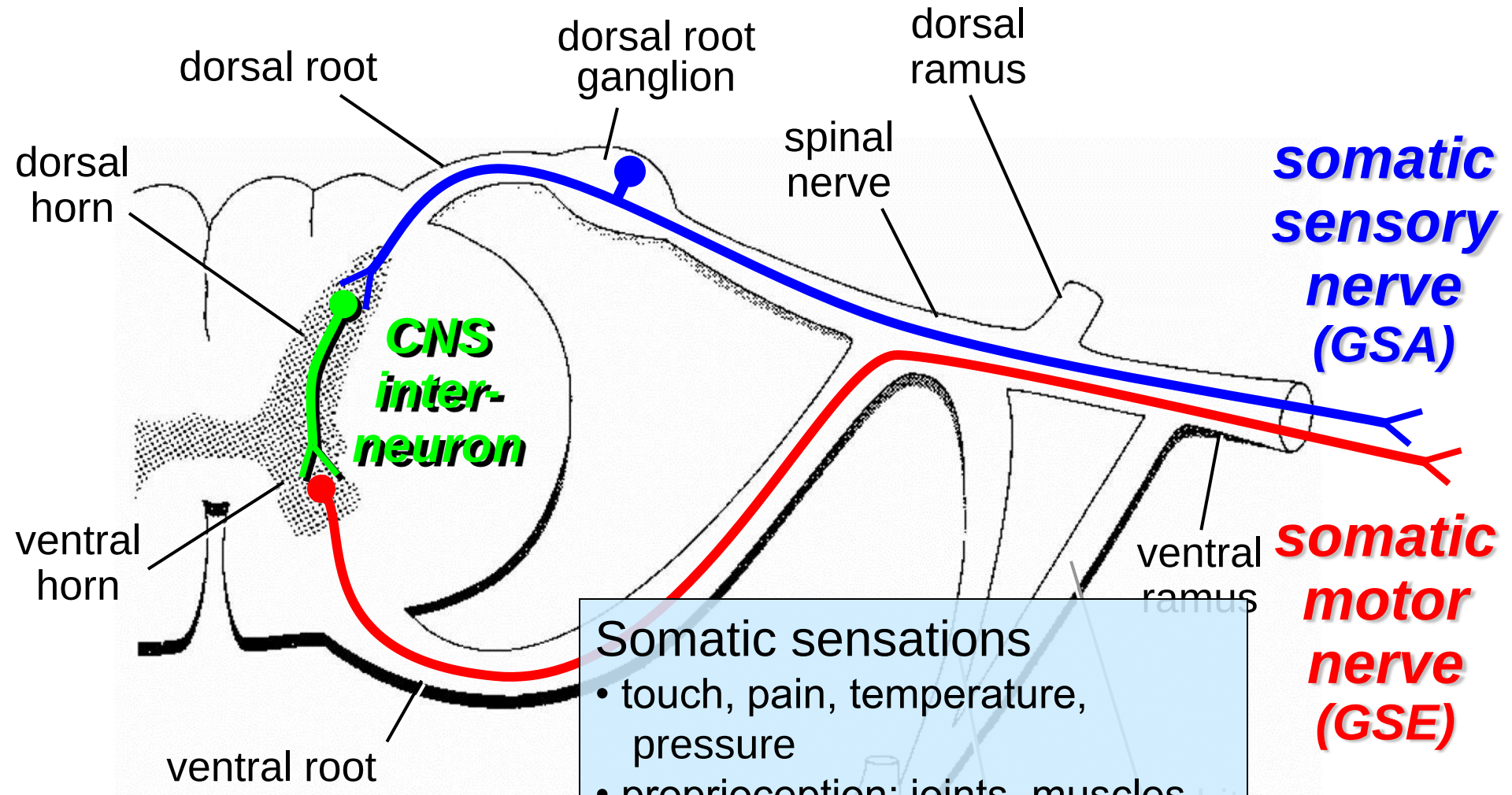


Structure of Spinal Nerves: Somatic Pathways



Mixed Spinal Nerve

Structure of Spinal Nerves: Somatic Pathways

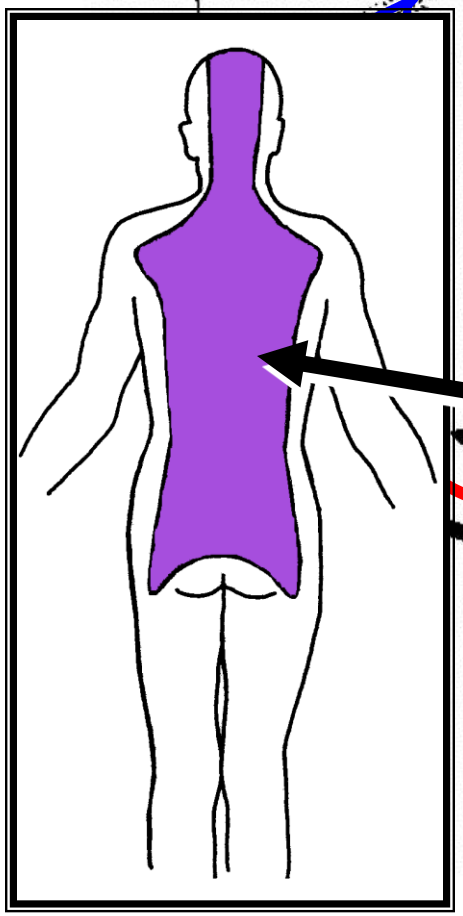


Mixed Spinal Nerve

Somatic sensations
- touch, pain, temperature, pressure
- proprioception: joints, muscles

Somatic motor activity:
- innervate skeletal muscles

Structure of Spinal Nerves: Dorsal & Ventral Rami



dorsal ramus

spinal nerve

somatic sensory nerve (GSA)

somatic motor nerve (GSE)

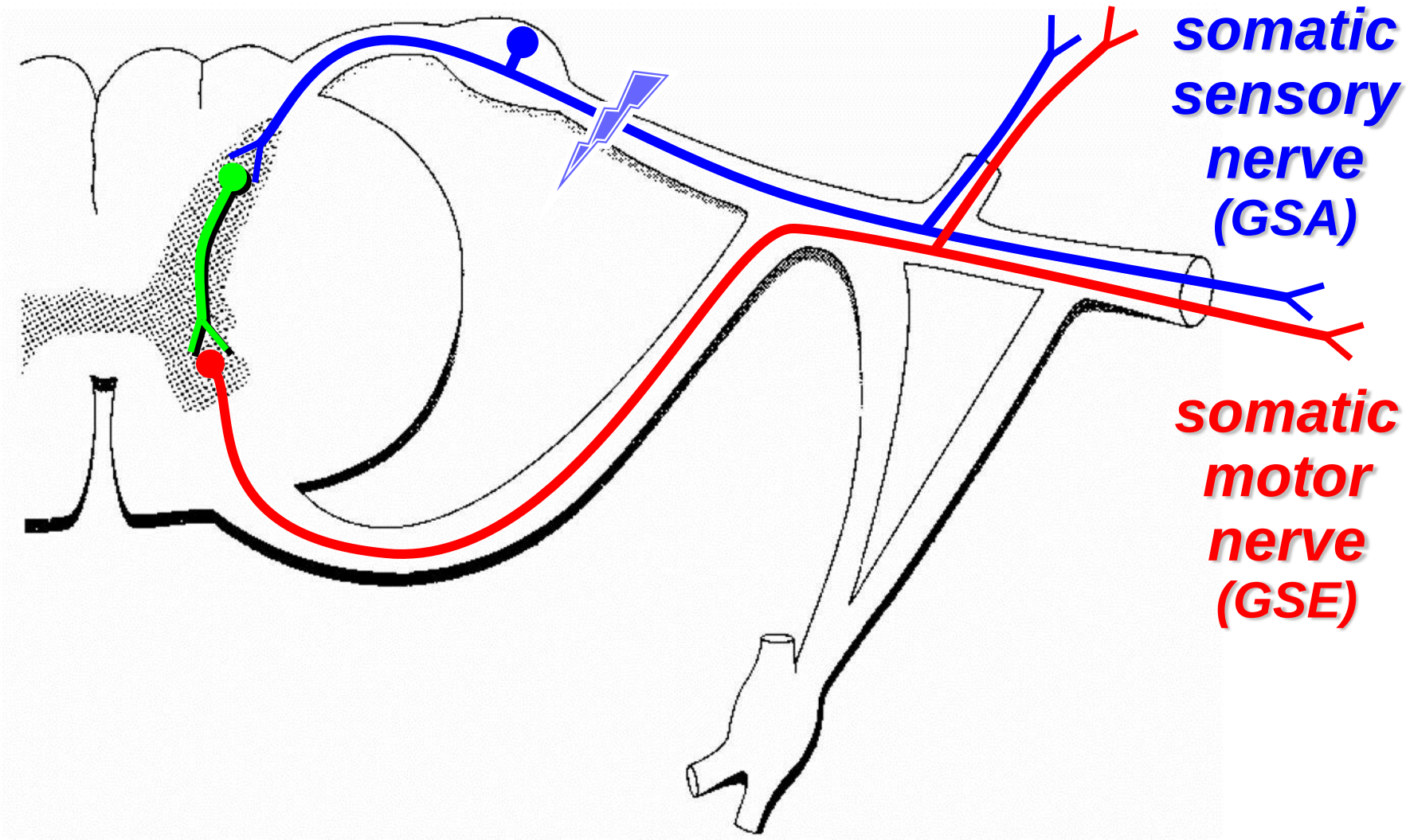
ventral ramus

Territory of Dorsal Rami
(everything else, but head, innervated by ventral rami)

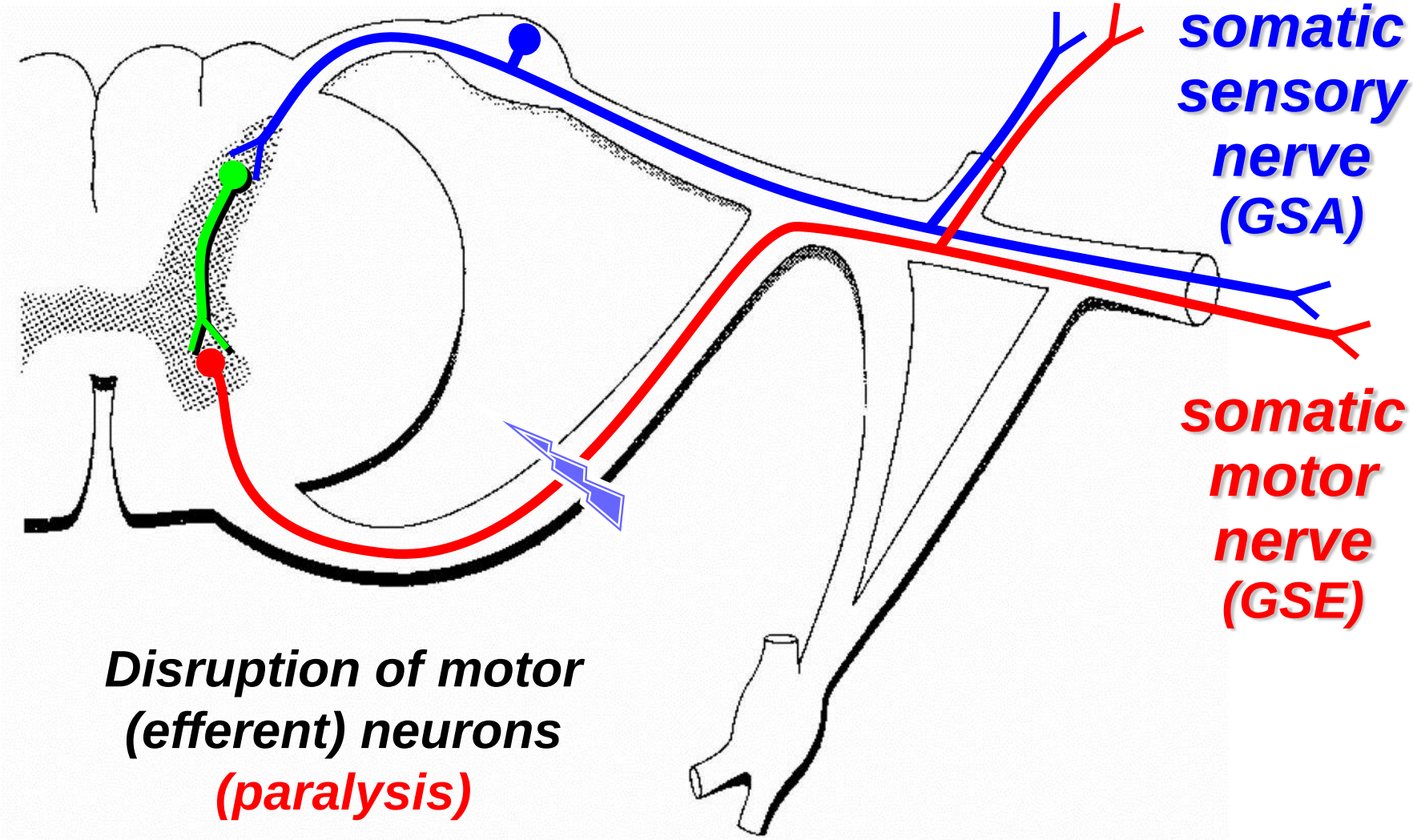
Stern *Essentials of Gross Anatomy*

Impact of Lesions

Disruption of sensory (afferent) neurons (paresthesia)

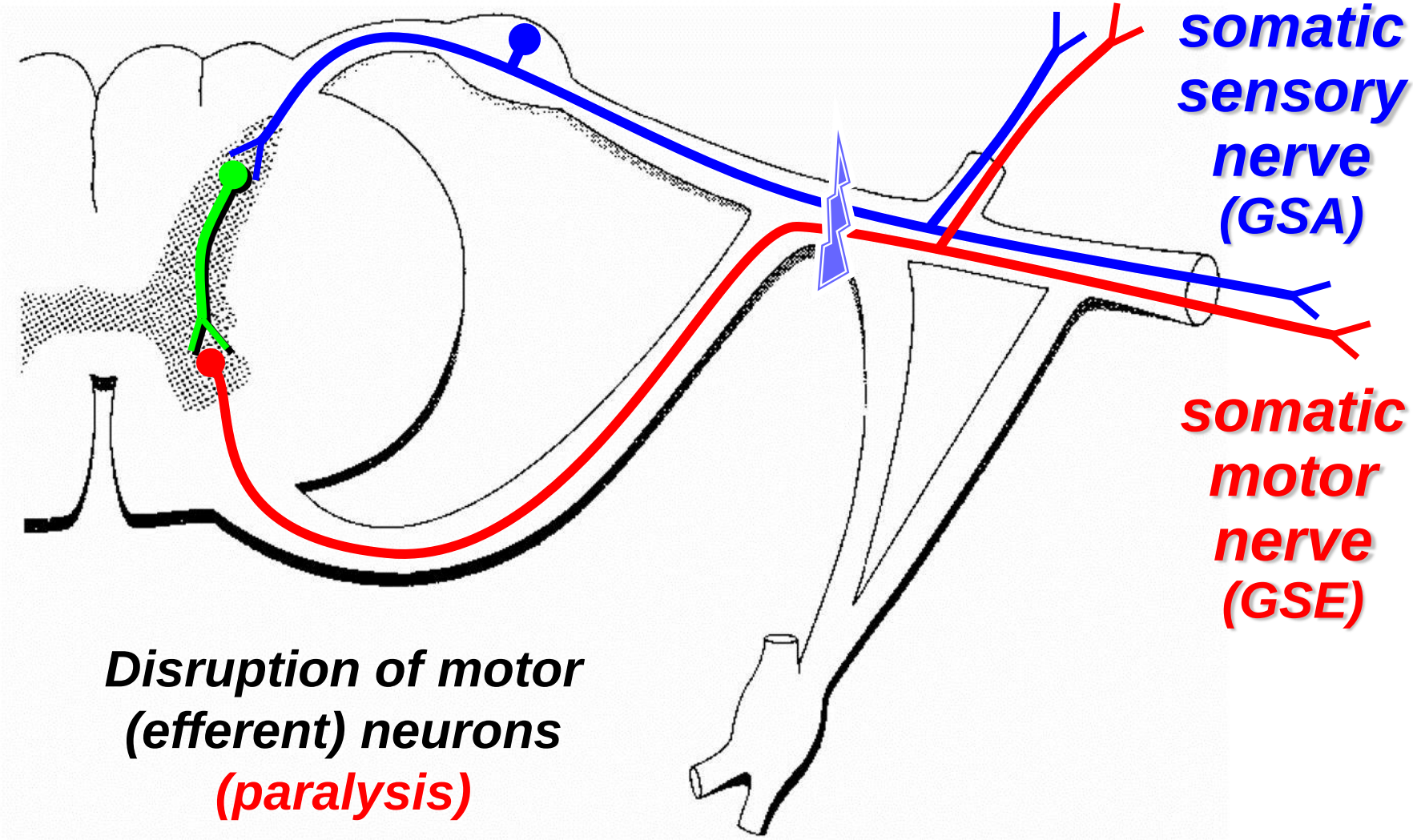


Impact of Lesions



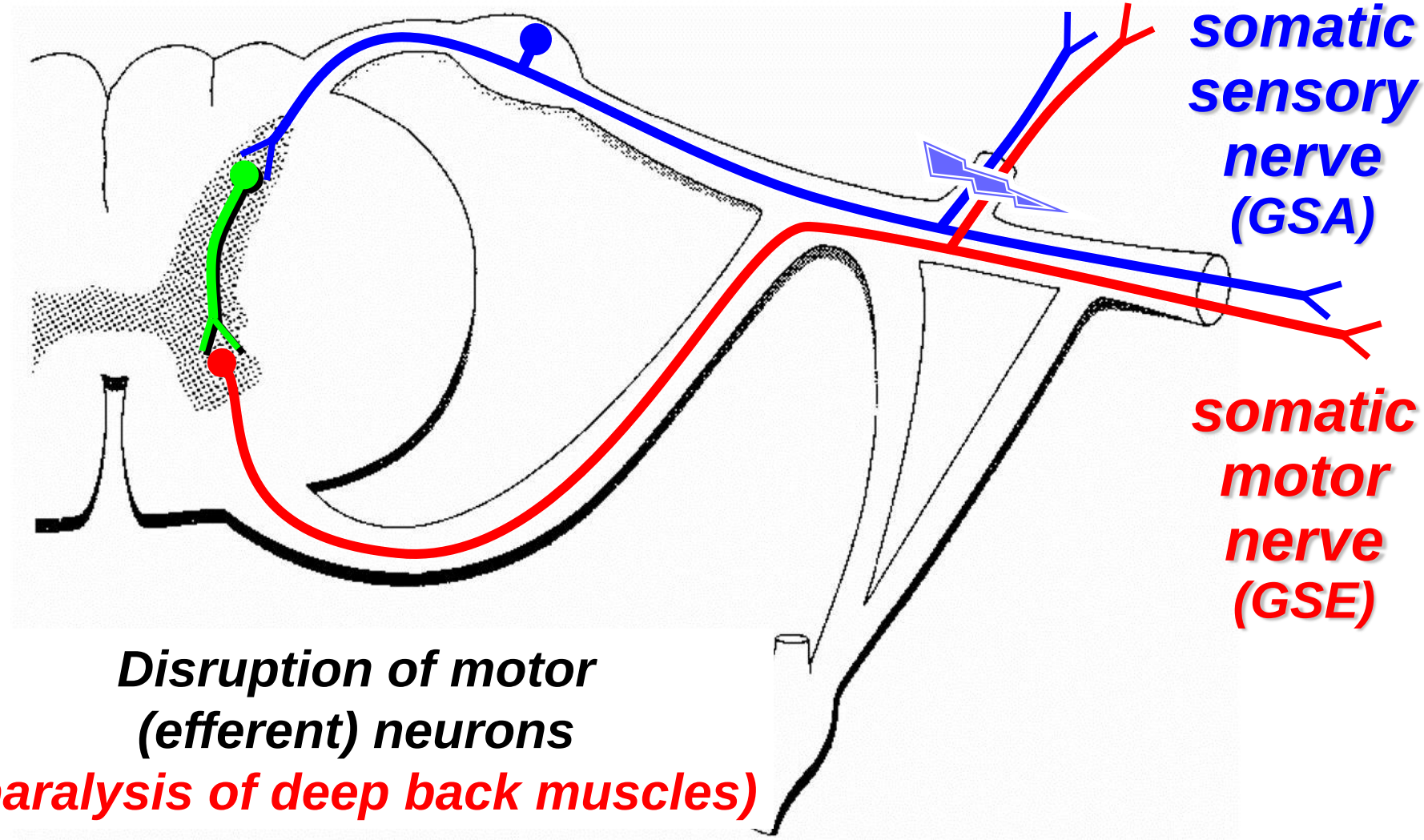
Impact of Lesions

Disruption of sensory (afferent) neurons (paresthesia)



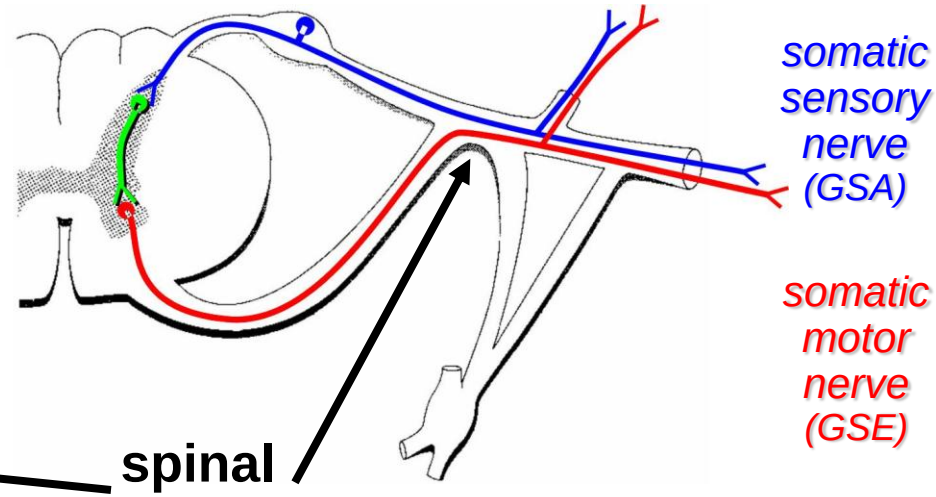
Impact of Lesions

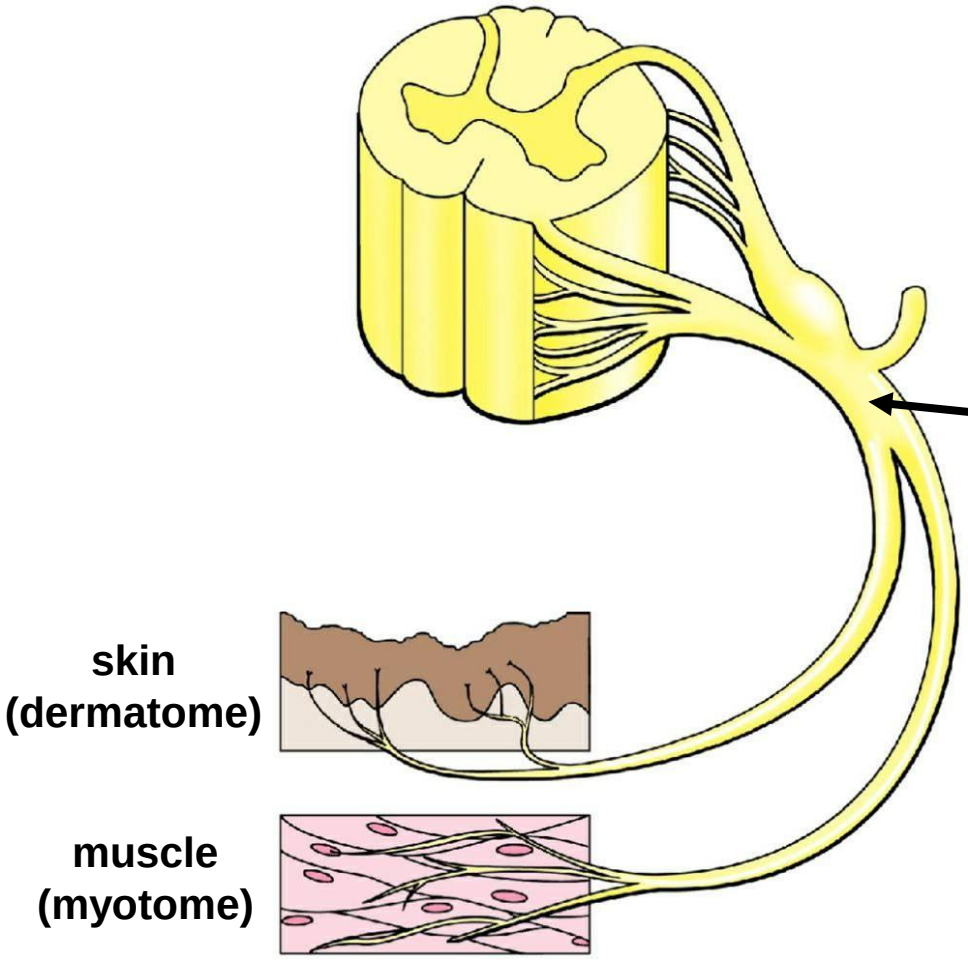
Disruption of sensory (afferent) neurons (back paresthesia)



Disruption of motor (efferent) neurons (paralysis of deep back muscles)

Segmental Innervation: Dermatomes & Myotomes





Dermatome: cutaneous (skin) sensory territory of a single spinal nerve

Myotome: mass of muscle innervated by a single spinal nerve

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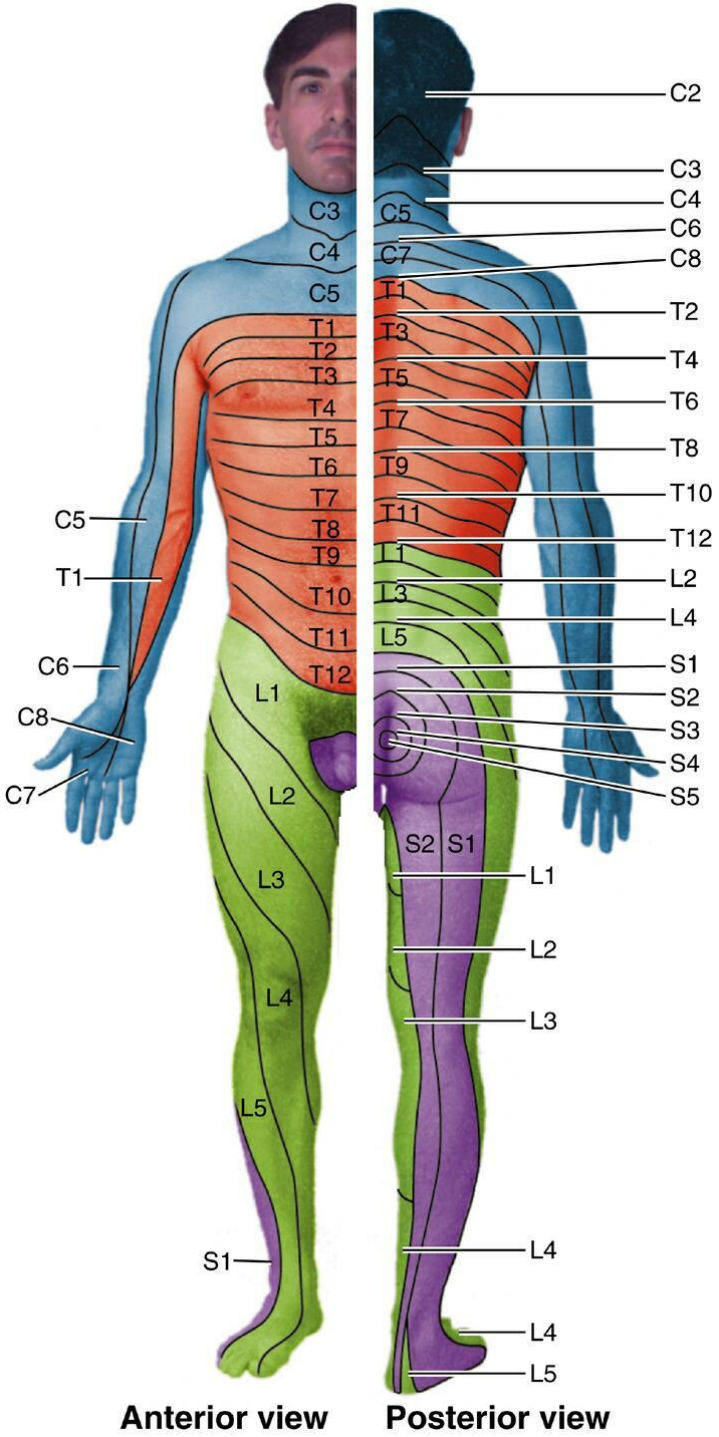
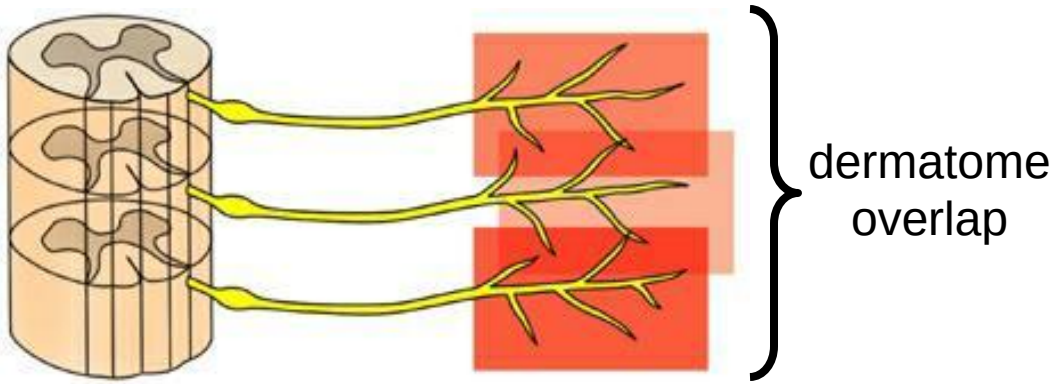
Segmental Innervation: Dermatome Maps



- Based on clinical findings of deficits in cutaneous sensation
- Diagnostic aids: localization of lesions to cord levels
- Limits to specificity due to overlap of dermatomes



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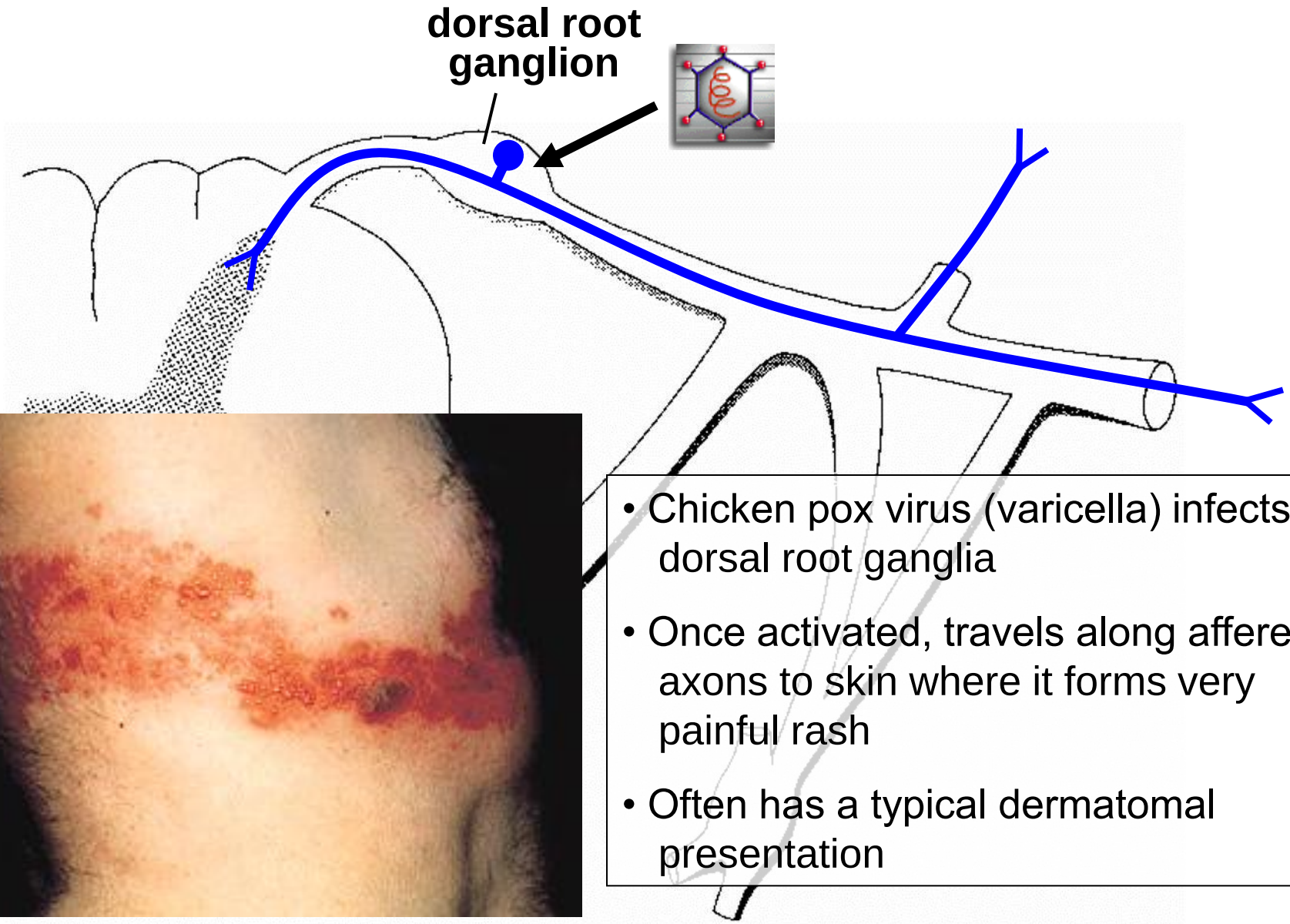
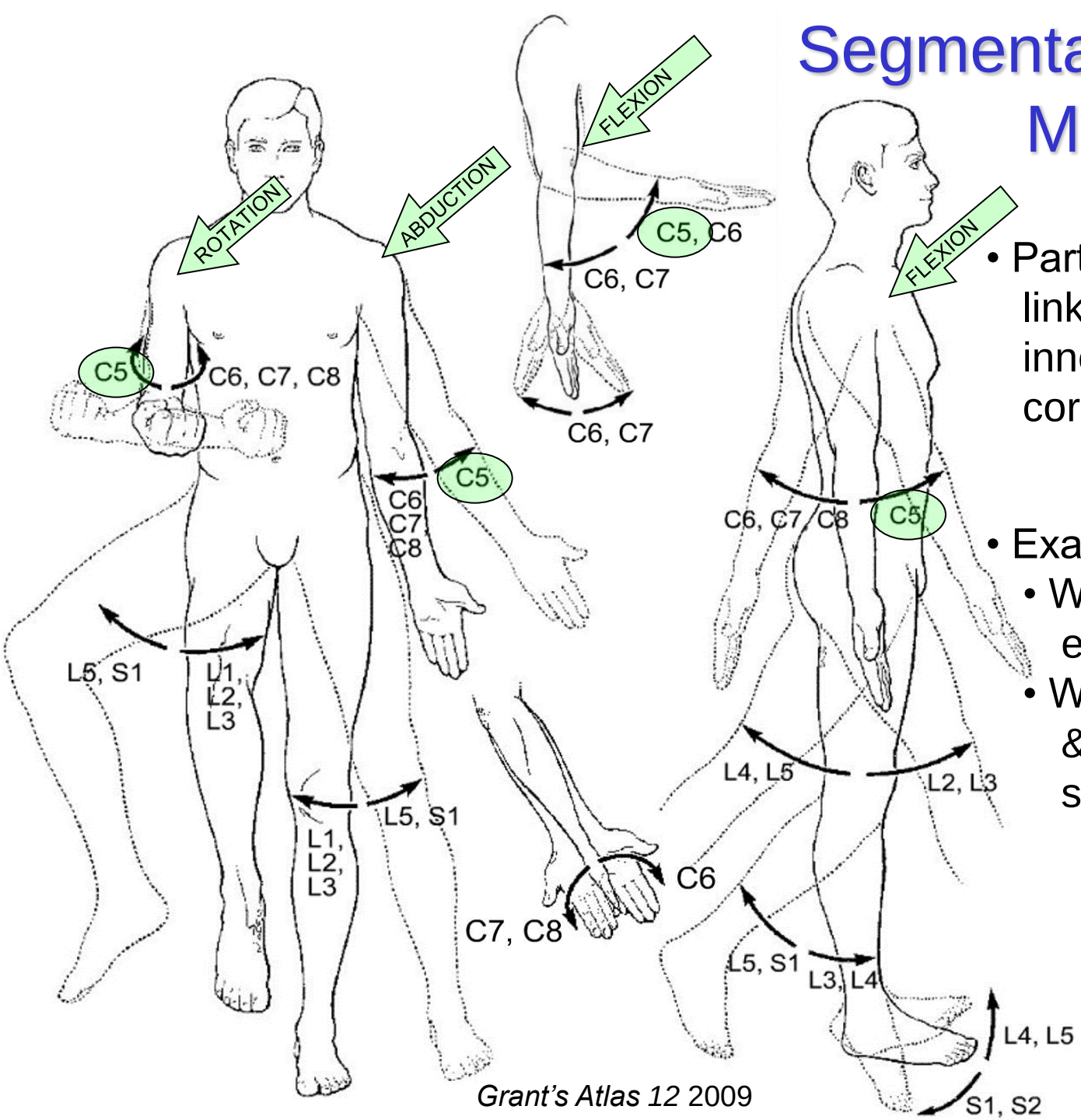
Dermatomes & Herpes Zoster ("Shingles)"



- Chicken pox virus (varicella) infects dorsal root ganglia
- Once activated, travels along afferent axons to skin where it forms very painful rash
- Often has a typical dermatomal presentation

Segmental Innervation: Myotome Maps



- Particular functions are linked to muscles innervated by particular cord levels
- Example: C5 lesion
  - Weakness in flexion of elbow & shoulder
  - Weakness in abduction & lateral rotation of shoulder

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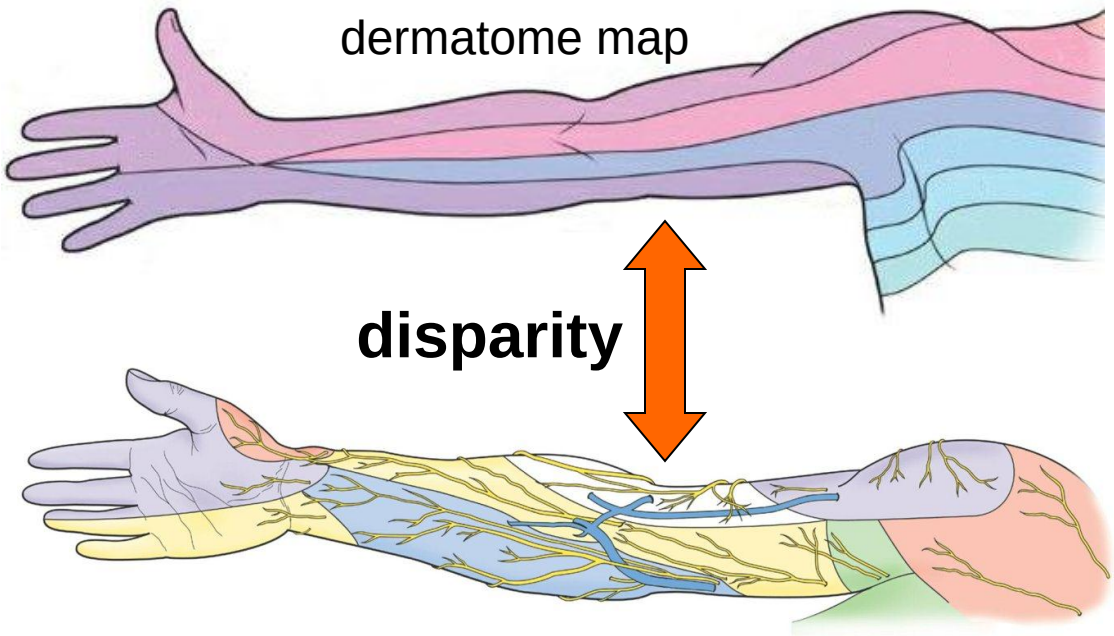
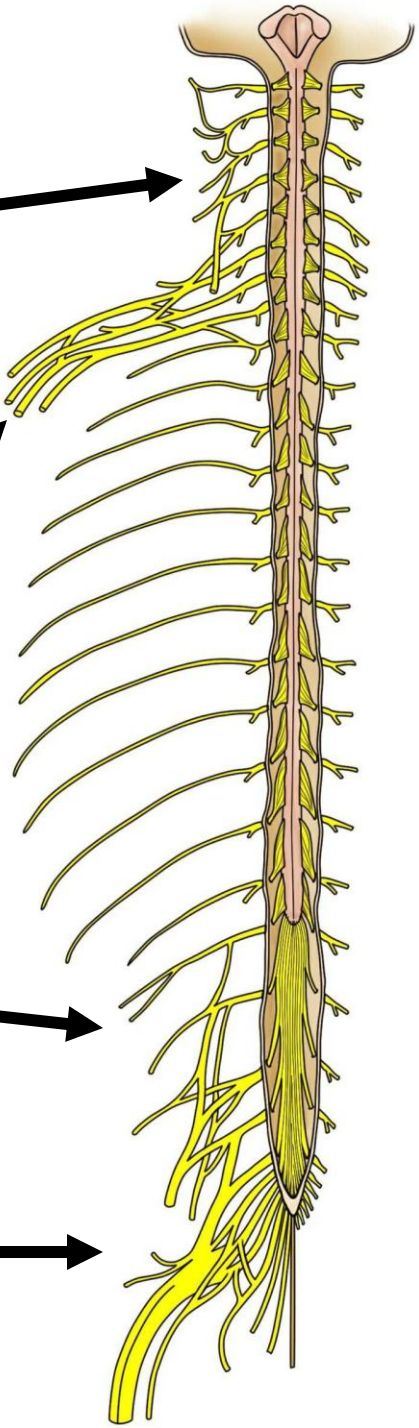
PNS Plexus Formation

- Dermatomes: single spinal nerve
- Peripheral nerves: multiple spinal nerves from different cord levels
- Plexus formation: mixing of nerves from different cord levels by union and division of bundles



map of named peripheral nerves



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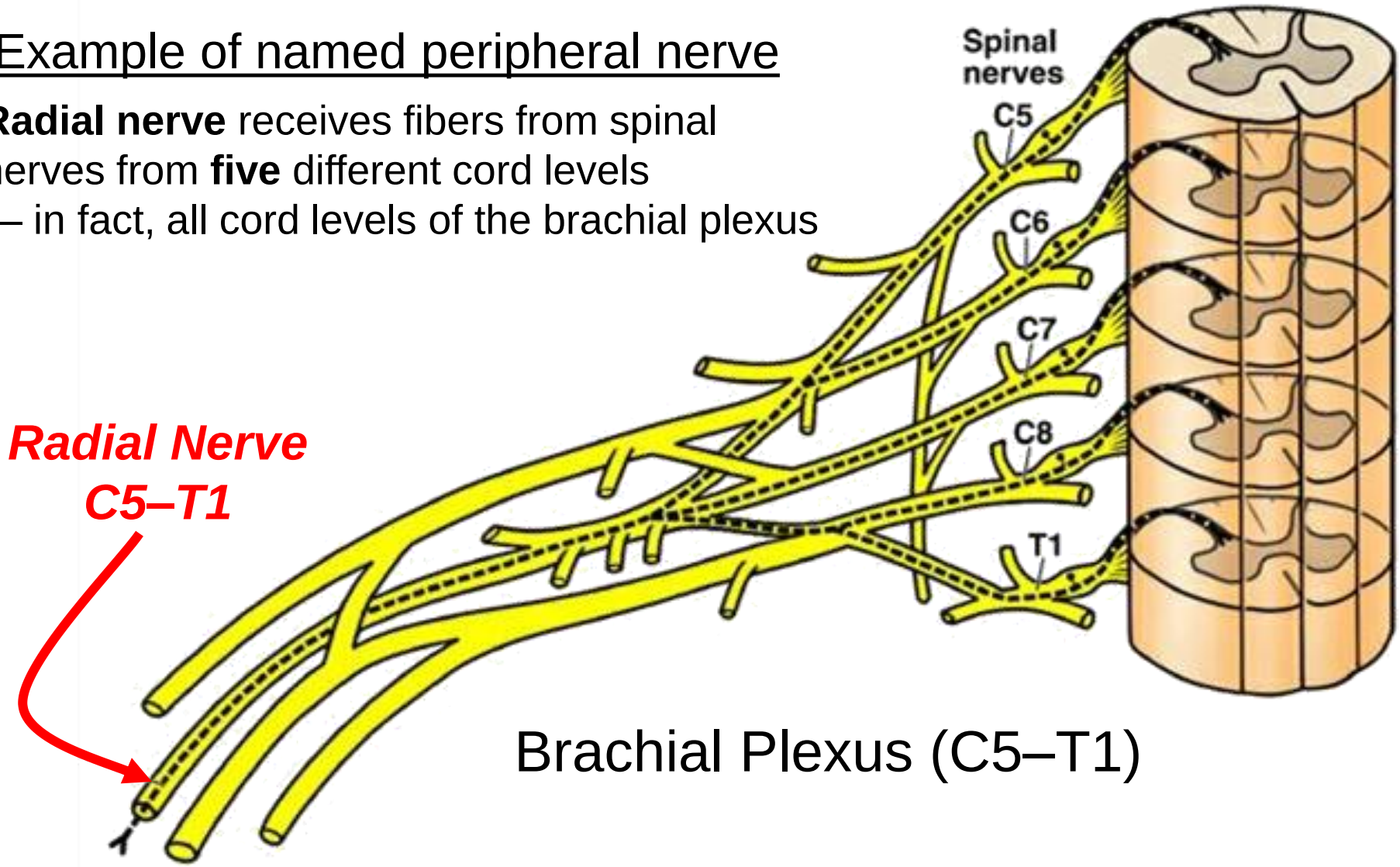
PNS Plexus Formation

Example of named peripheral nerve

Radial nerve receives fibers from spinal nerves from **five** different cord levels
— in fact, all cord levels of the brachial plexus



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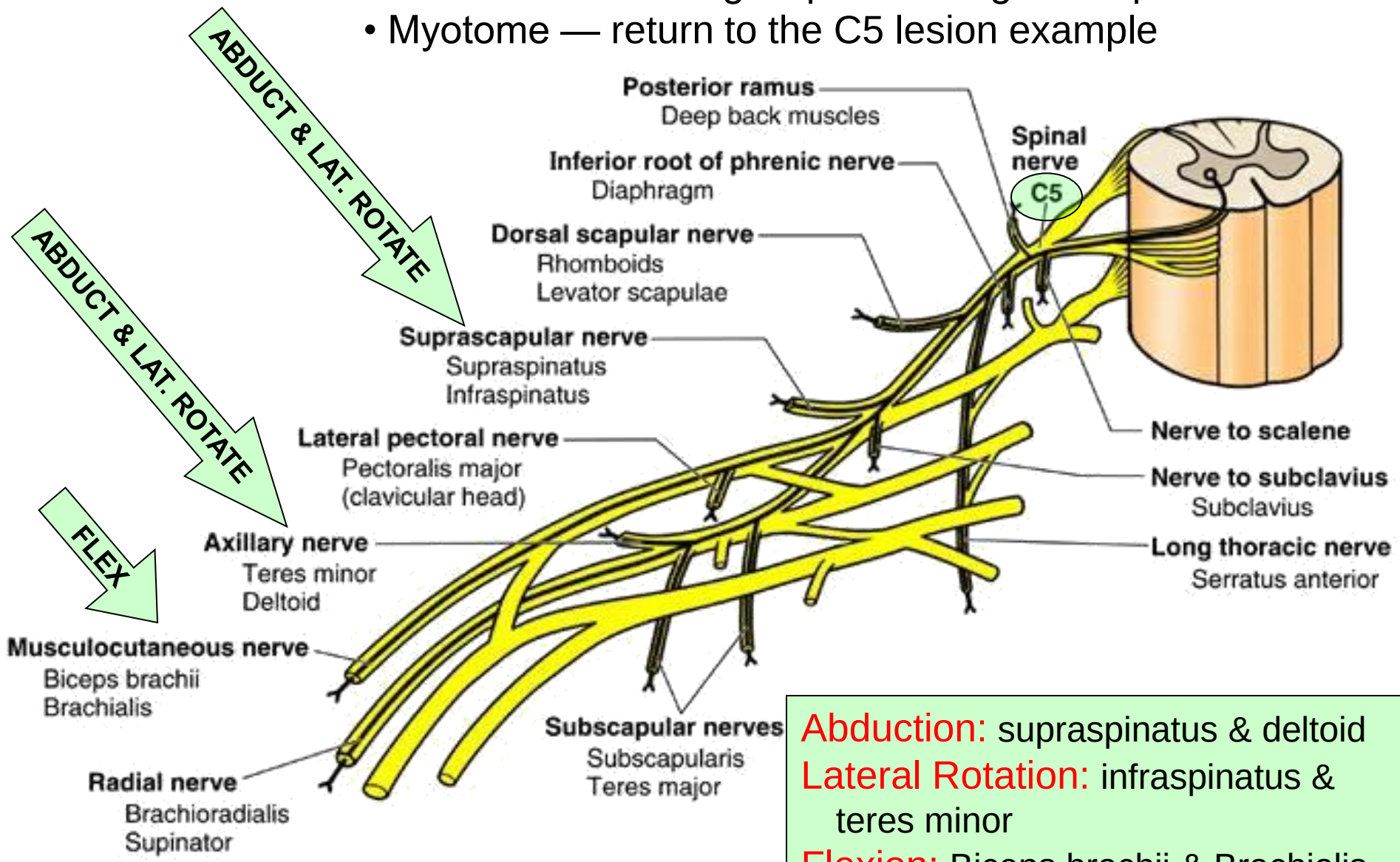
PNS Plexus Formation

- Distribution of a single spinal throughout a plexus
- Myotome — return to the C5 lesion example



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Abduction: supraspinatus & deltoid
Lateral Rotation: infraspinatus & teres minor
Flexion: Biceps brachii & Brachialis

References

Agur, A. M. R. and A. F. Dalley. 2009. *Grant's Atlas of Anatomy, 121th Edition*. Lippincott, Williams & Wilkins, New York.

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