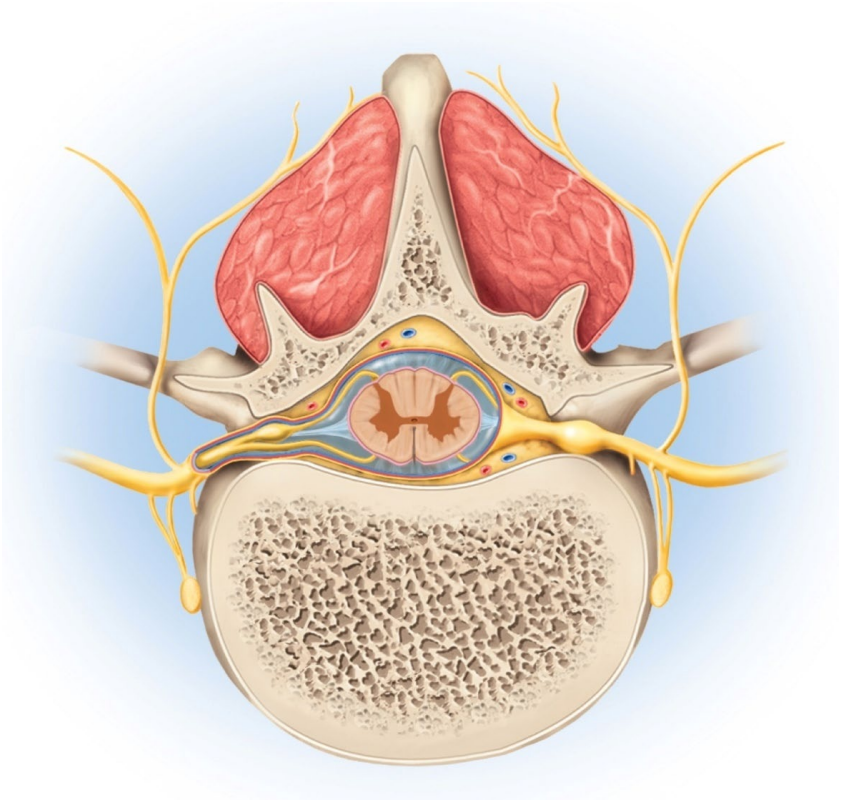
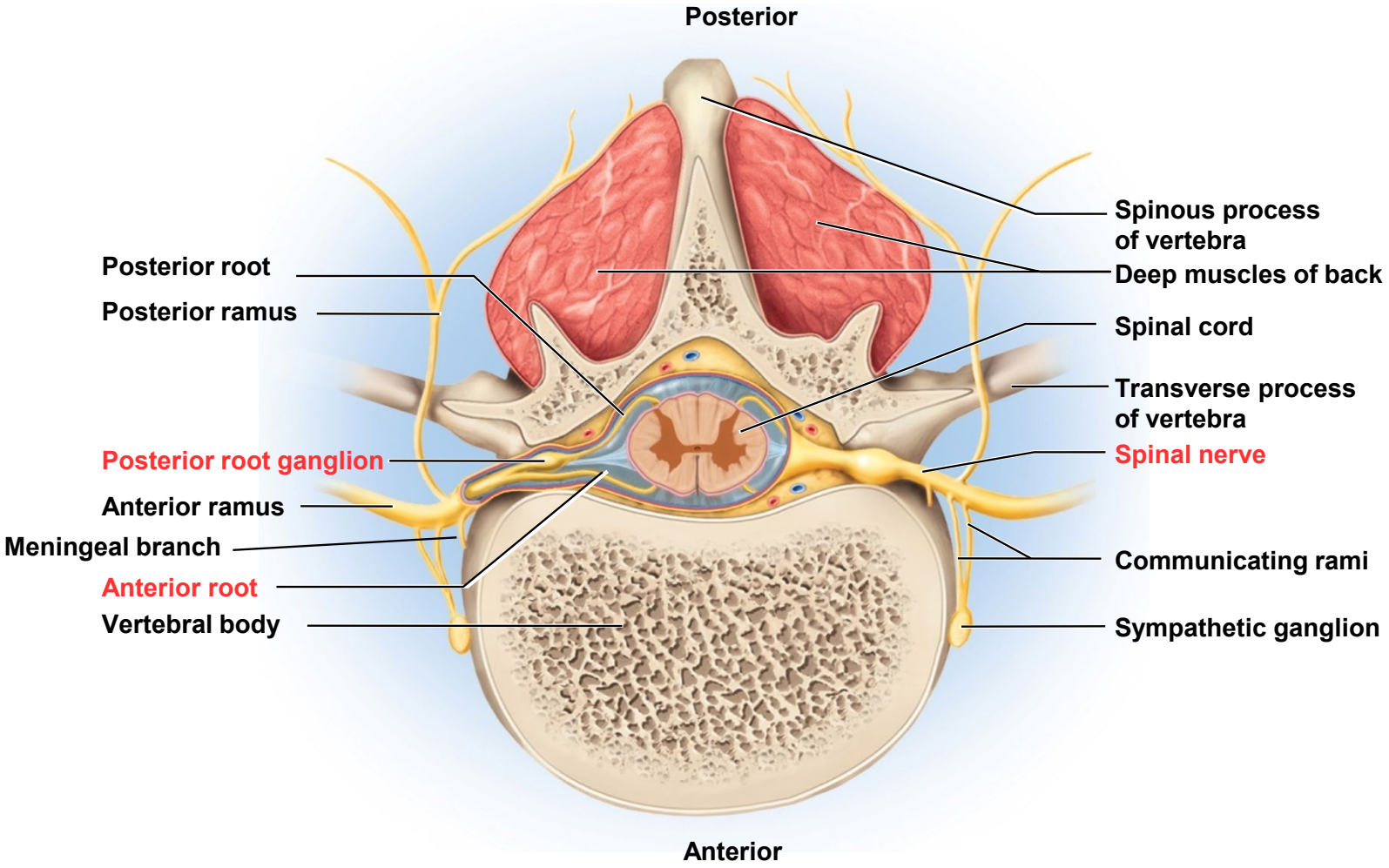
Chapter 13.2

# Spinal Nerves, Ganglia, and Nerve Plexus



# Spinal Nerves



# General Anatomy of Nerves and Ganglia

Spinal cord communicates with the rest of the body by way of spinal nerves

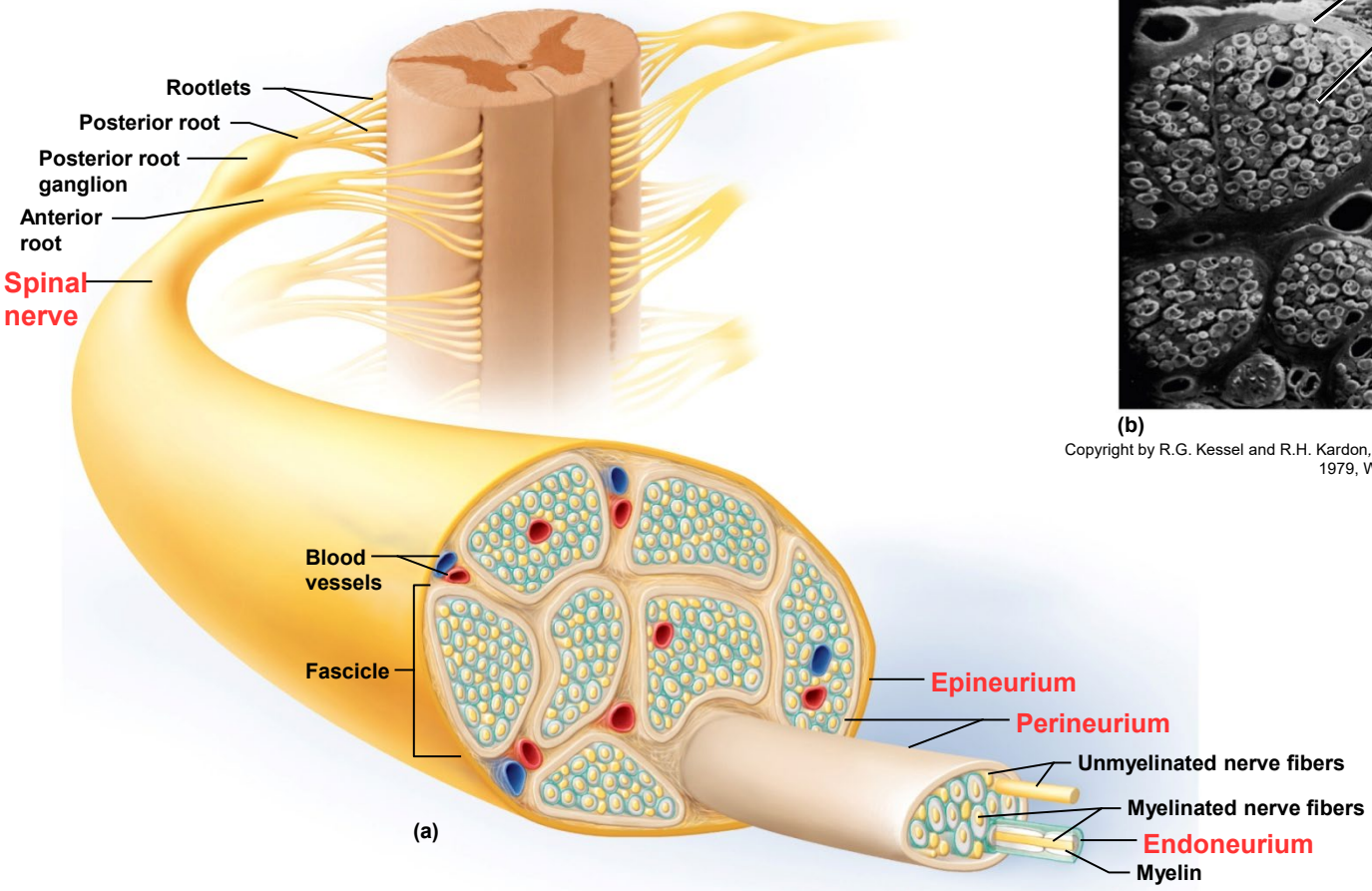
Nerve = a cordlike organ composed of numerous nerve axons bound together by connective tissue

Spinal nerves = mixed nerves - contain both afferent (sensory) and efferent (motor) fibers

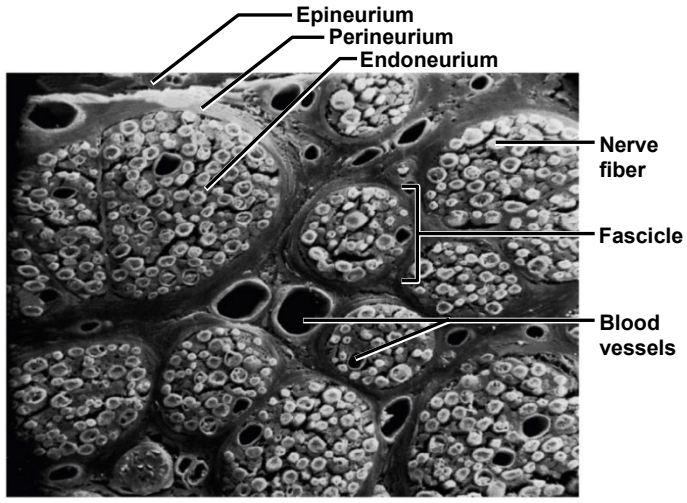
Spinal nerves composed of thousands of axons carrying action potentials in opposite directions

# Connective Tissue in the Anatomy of a Nerve







# General Anatomy of Nerves and Ganglia

•nerves of peripheral nervous system are en-sheathed in Schwann cells

–forms neurilemma /// a myelin sheath around the axon

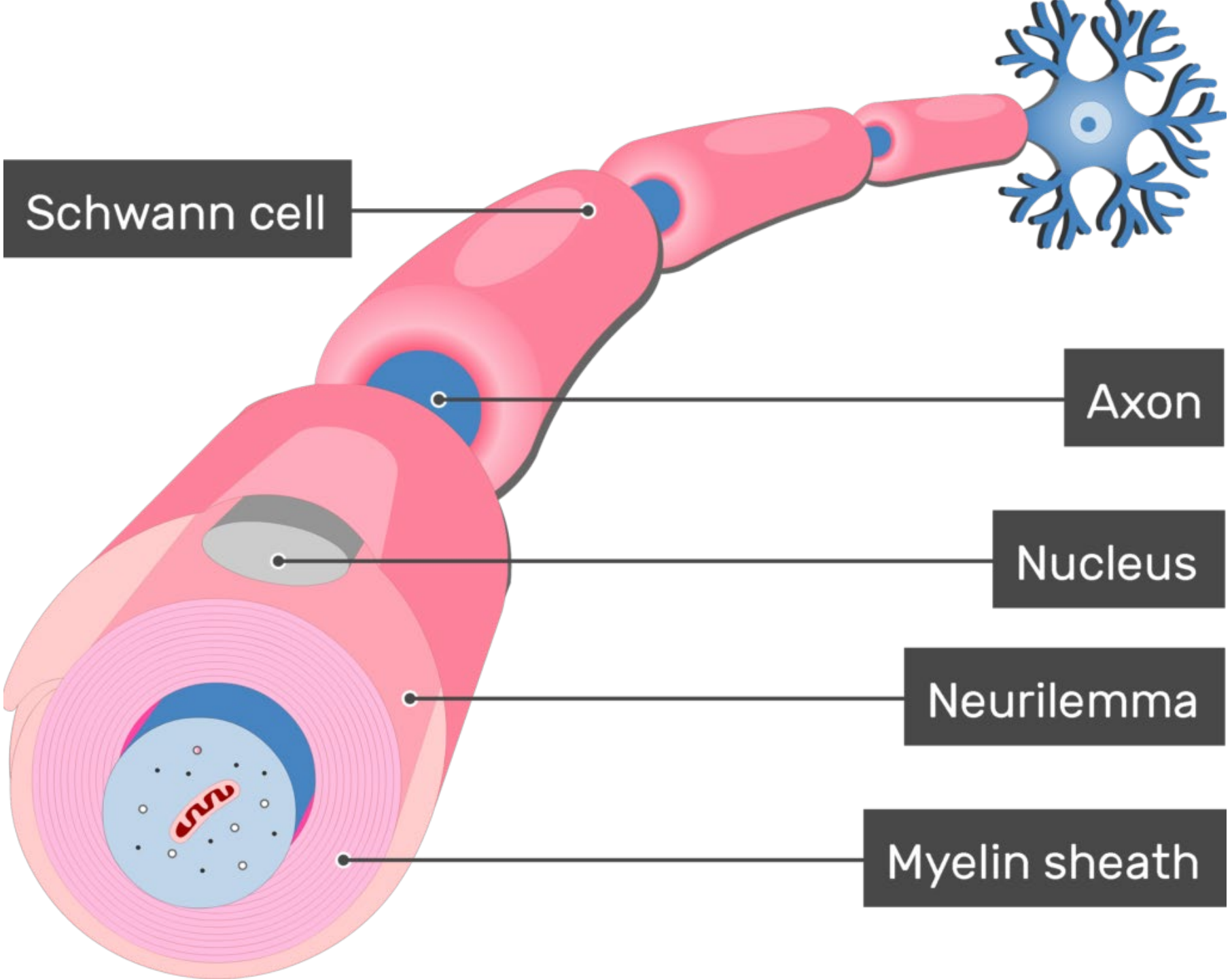
–external to neurilemma, each fiber is surrounded by basal lamina and then a thin sleeve of loose connective tissue – endoneurium

–fascicles – nerve fibers gathered in bundles

–perineurium – wraps fascicles // composed of up to 20 layers of overlapping, squamous , epithelium-like cells

–epineurium – bundles numerous fascicles that constitutes whole nerve // composed of dense irregular connective tissue // protects nerve from stretching and injury

•blood vessels penetrate connective tissue coverings // nerves have high metabolic rate and need plentiful blood supply


Schwann cell
Axon
Nucleus
Neurilemma
Myelin sheath

# Functional Classification of Nerve Fibers

**sensory (afferent) nerves**

–carry signals from sensory receptors to the CNS

**motor (efferent) nerves**

–carry signals from CNS to muscles and glands

**mixed nerves**

–consists of both afferent and efferent fibers

–conduct signals in two directions

both sensory and motor fibers can also be described as: **somatic** or **visceral** // **general** or **special**



**TABLE 13.2** The Classification of Nerve Fibers

| Class | Description |
|---|---|
| Afferent fibers | Carry sensory signals from receptors to the CNS |
| Efferent fibers | Carry motor signals from the CNS to effectors |
| Somatic fibers | Innervate skin, skeletal muscles, bones, and joints |
| Visceral fibers | Innervate blood vessels, glands, and viscera |
| General fibers | Innervate widespread organs such as muscles, skin, glands, viscera, and blood vessels |
| Special fibers | Innervate more localized organs in the head, including the eyes, ears, olfactory and taste receptors, and muscles of chewing, swallowing, and facial expression |

# Spinal Nerves

31 pairs of spinal nerves (mixed nerves)

–8 cervical nerves (C1 – C8) C1 between skull and atlas // others exiting at intervertebral foramen

–12 thoracic nerves (T1 – T12)

– 5 lumbar nerves (L1 – L5)

– 5 sacral nerves (S1 – S5)

– 1 coccygeal nerve (Co)

# Spinal Nerves

Spinal cord rootlets (i.e. axons) from posterior horn and anterior horn of spinal cord connect spinal cord to posterior root and anterior root

The roots come together to form the spinal nerve

–posterior (dorsal) root /// sensory input to spinal cord /// six to eight rootlets that emerge from the posterior horn of cord

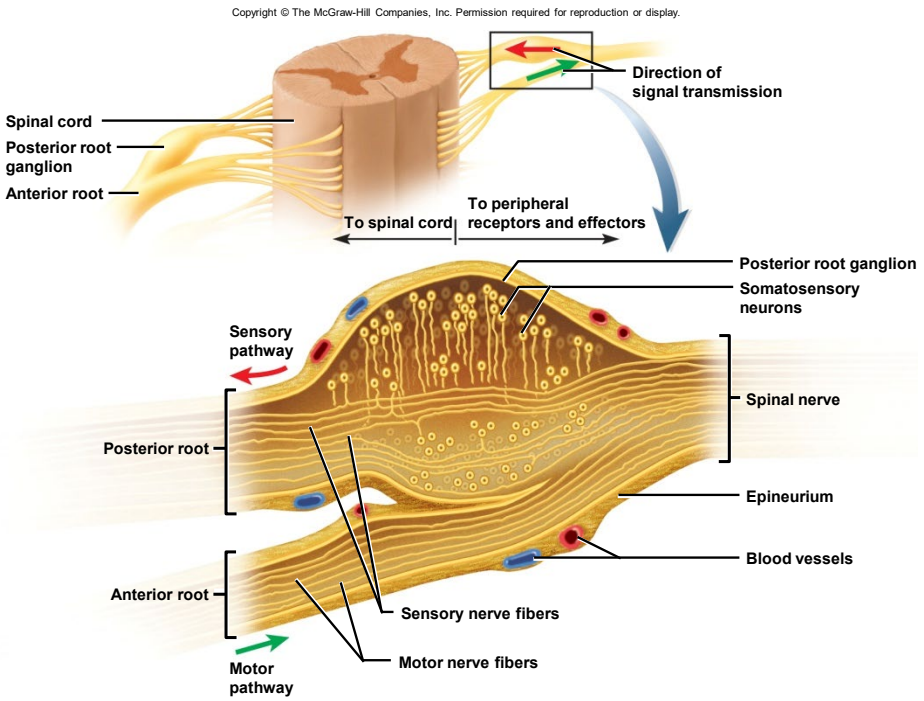
–dorsal root ganglion – contains the somas of sensory neurons carrying signals to the spinal cord /// these neurons are unipolar neurons!

# Spinal Nerves

anterior (ventral) root /// motor output /// exit out of spinal cord - six to eight rootlets leave spinal cord and converge to form anterior root

cauda equina // formed by rootlets (axons) that arise from L2 to Co (end of spinal cord – at conus medularis (occupy lumbar cisterna)

# Anatomy of Dorsal Root Ganglia




ganglion - cluster of neurosomas outside the CNS // enveloped in an endoneurium continuous with that of the nerve

among neurosomas are bundles of nerve fibers leading into and out of the ganglion // posterior root ganglion associated with spinal nerves

# Spinal Nerves

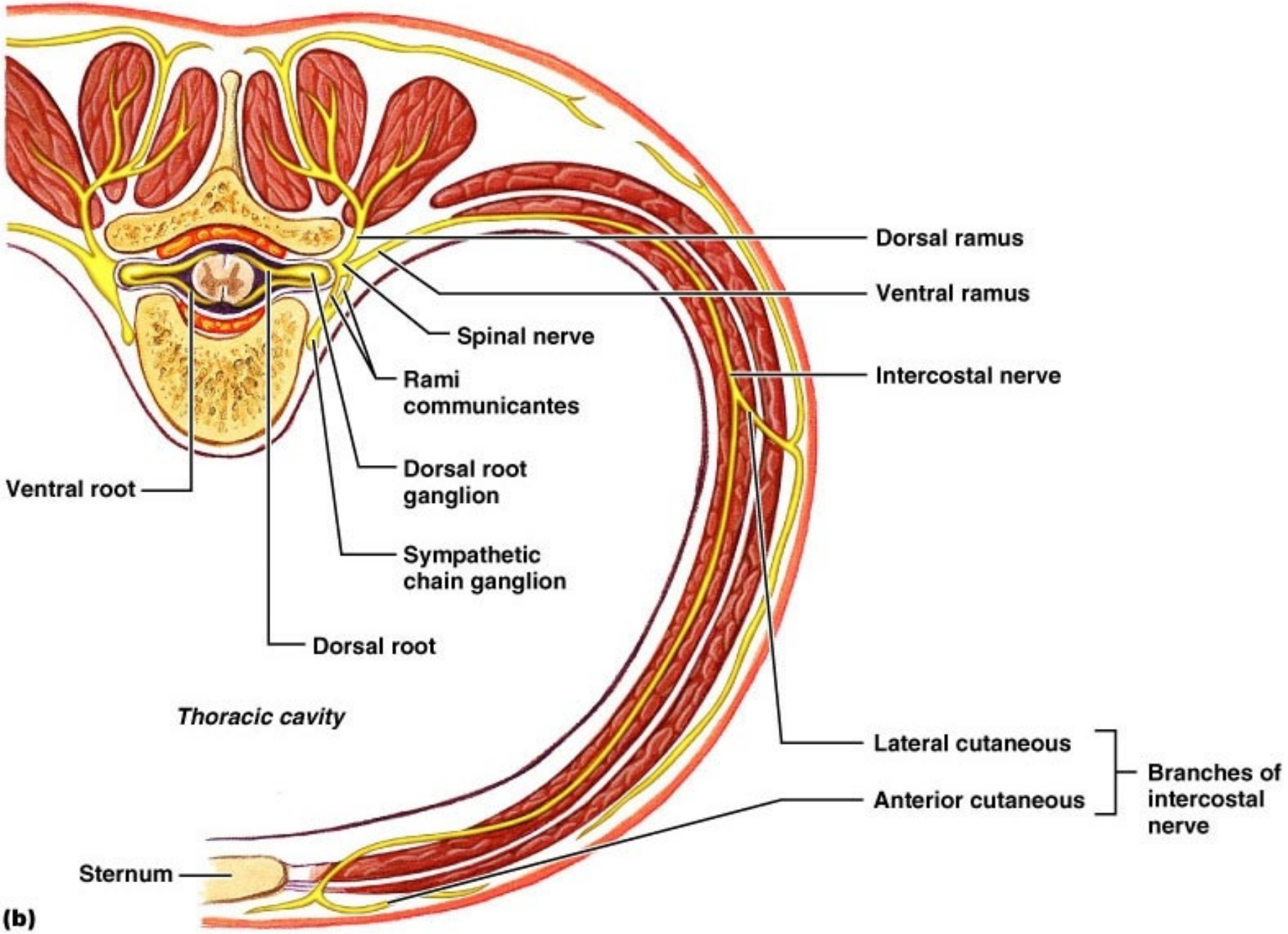
Posterior and anteror roots merge to form SN just distal to vertebral foramen – they divide into three branches:

- anterior ramus – innervates the anterior and lateral skin and muscles of the trunk // gives rise to nerves of the limbs

- posterior ramus – innervates the muscles and joints in that region of the spine and the skin of the back

- meningeal branch (rami communicantes) – re-enters the vertebral canal and innervates the meninges, vertebrae and spinal ligaments

- Note: the anterior ramus then form four nerve plexus (cervical, brachial, lumbar, sacral, coccygeal)



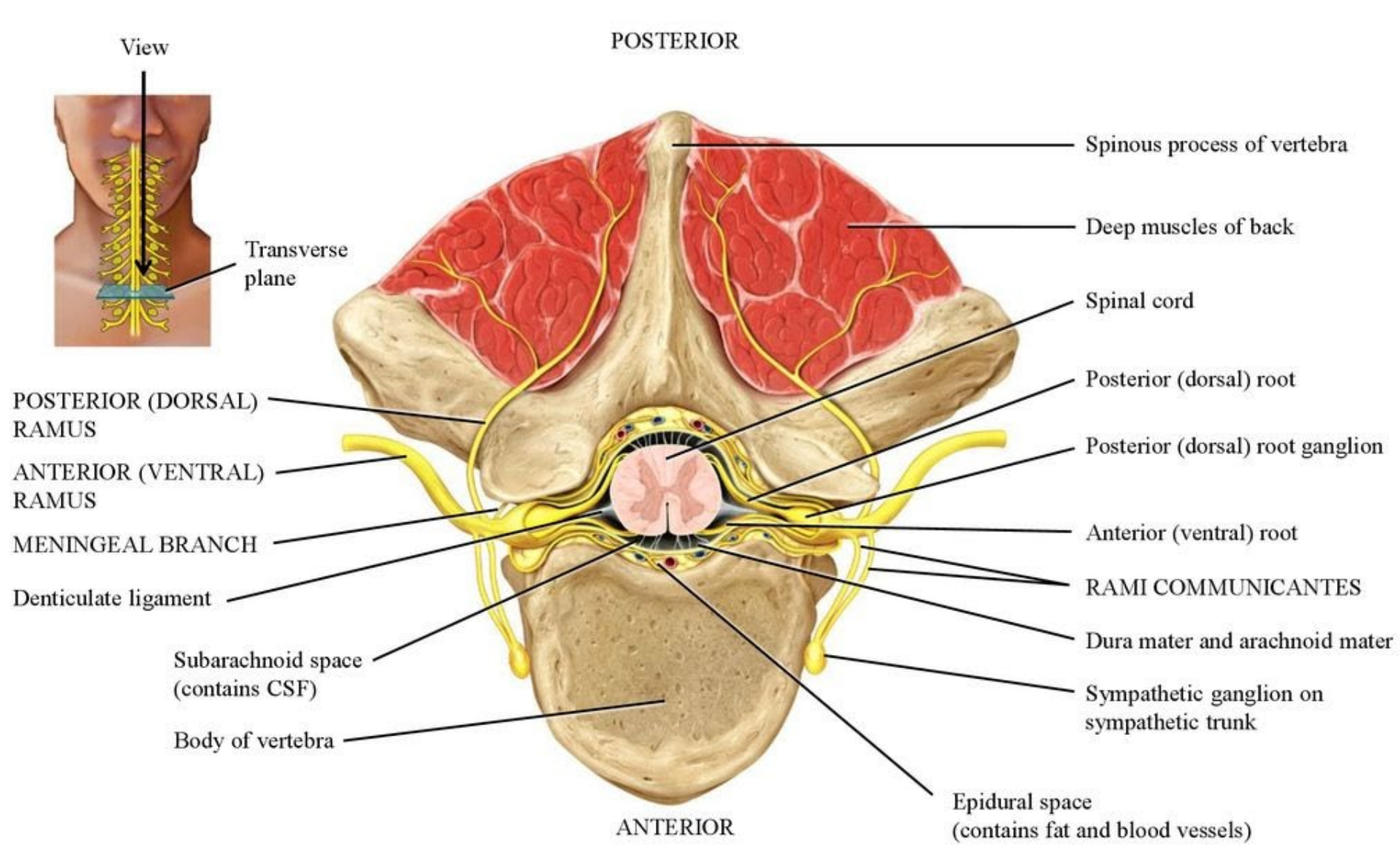
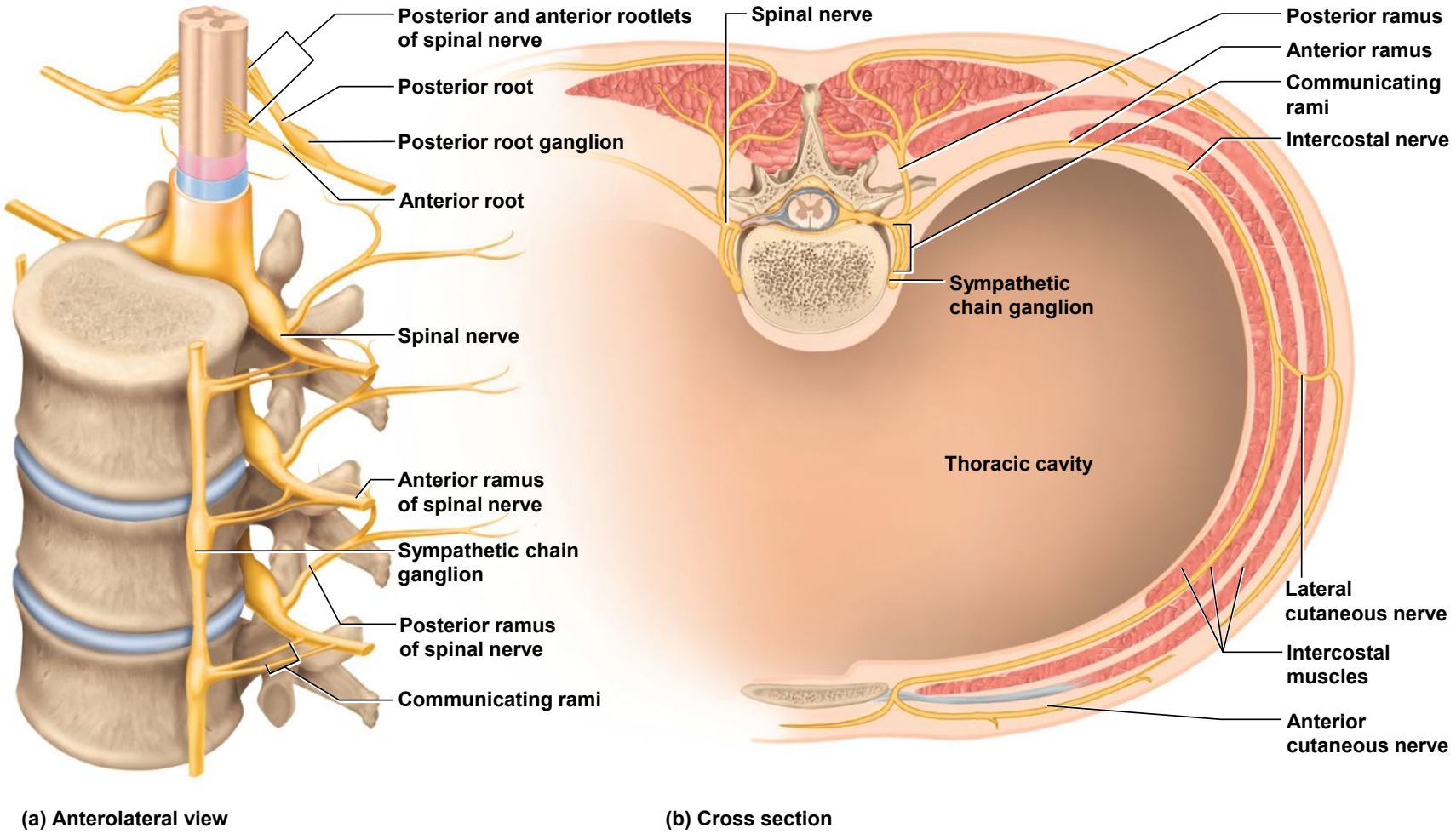



Figure 13.6 (a) Superior view

# Branches of a Spinal Nerve

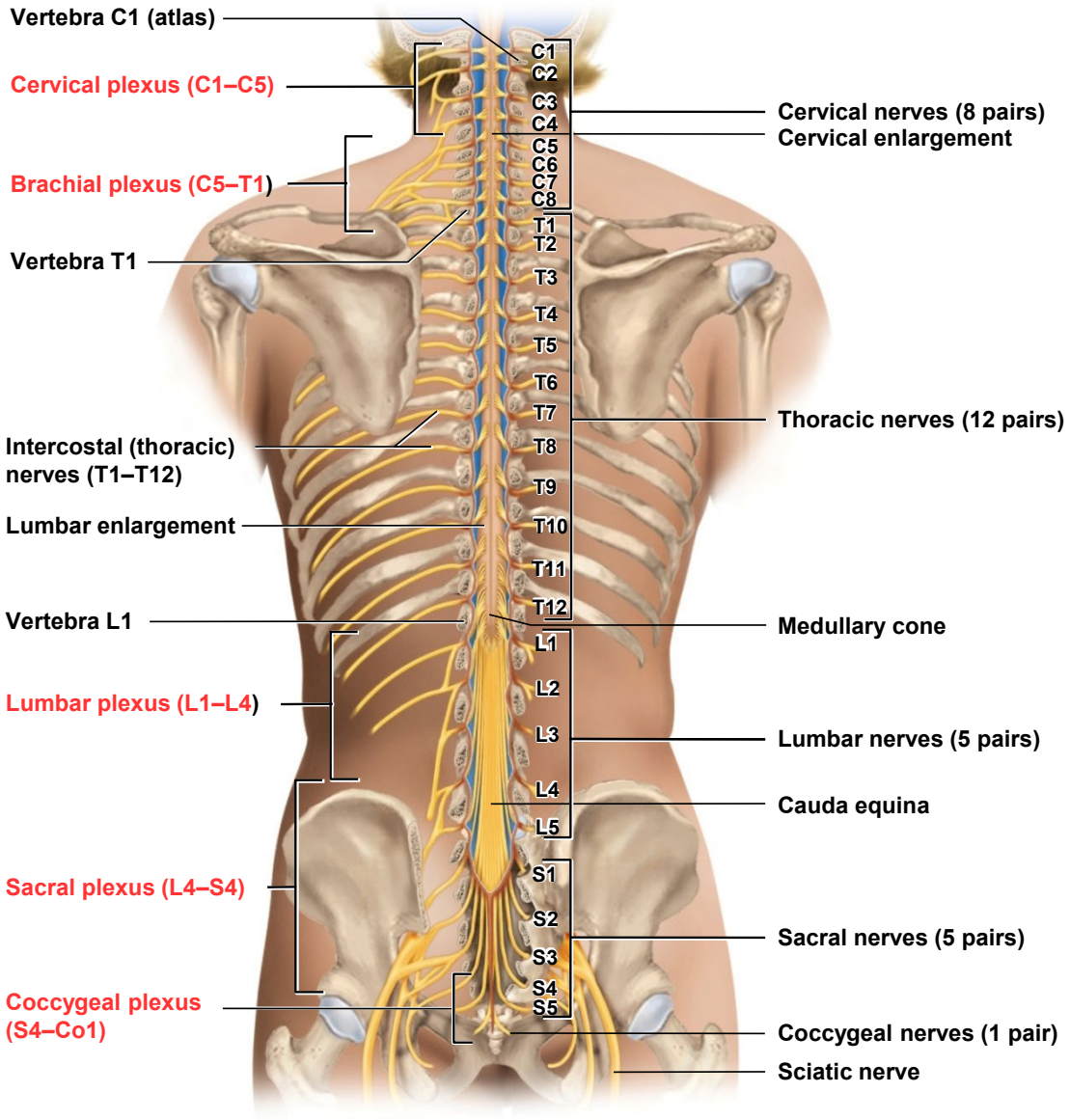
Posterior Rami  Anterior Rami  Meningeal Branch  Rami communicantes

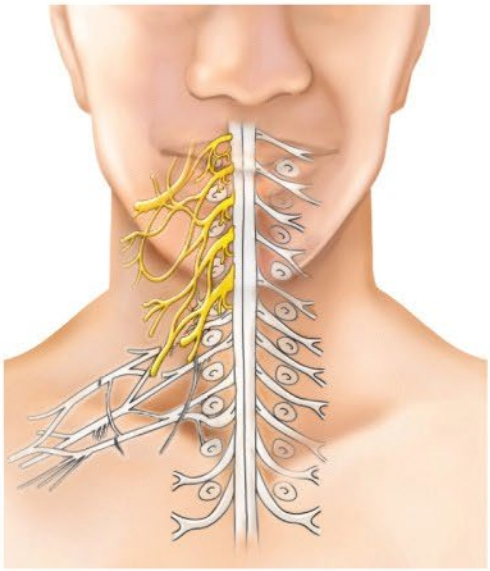
# Anterior Rami Form Nerve Plexuses



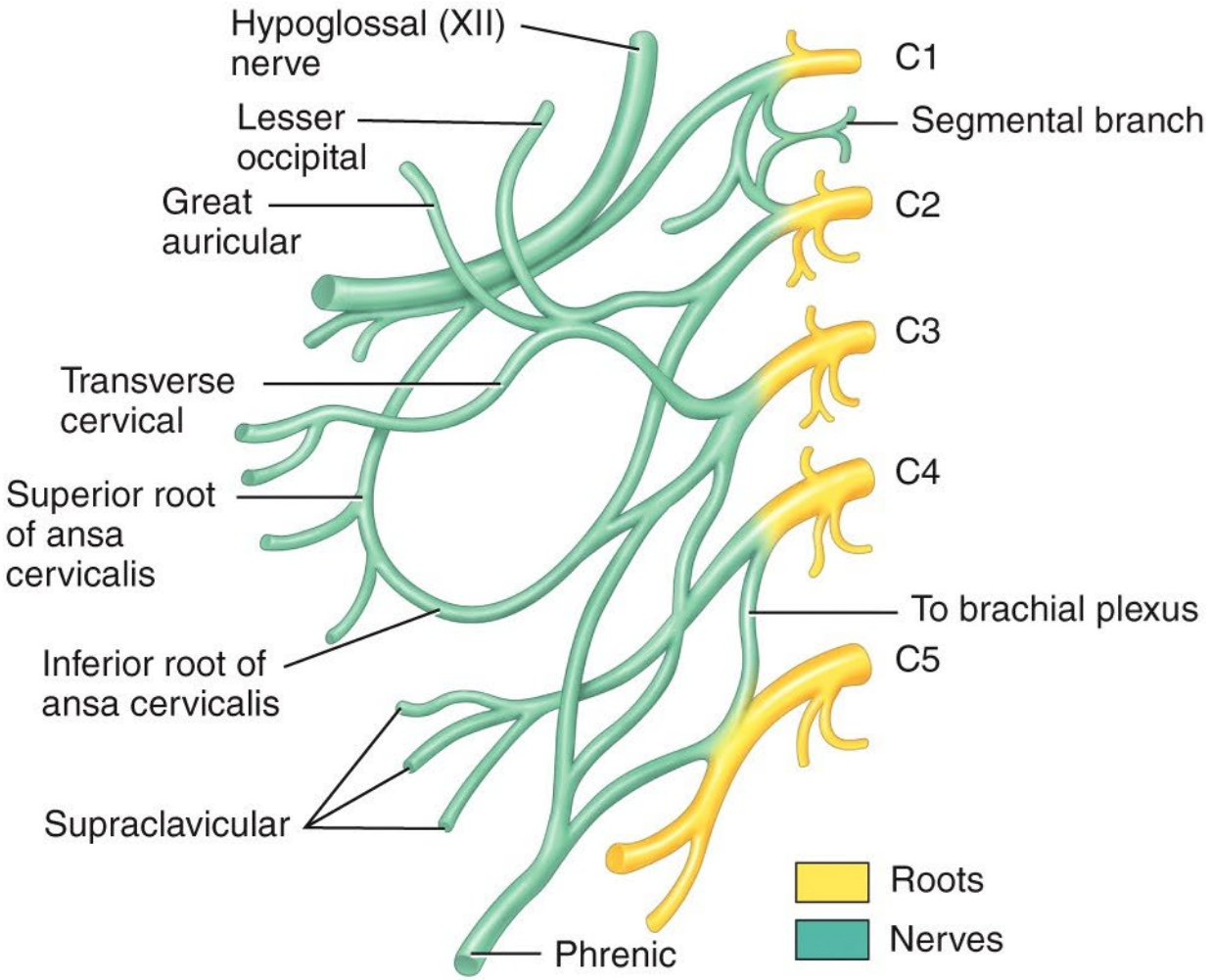

Cervical – Brachial – Lumbar – Sacral – Coccygeal

# Nerve Plexuses



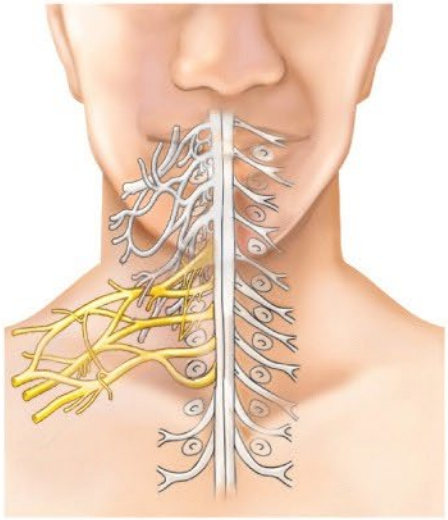


Cervical plexus projected to surface

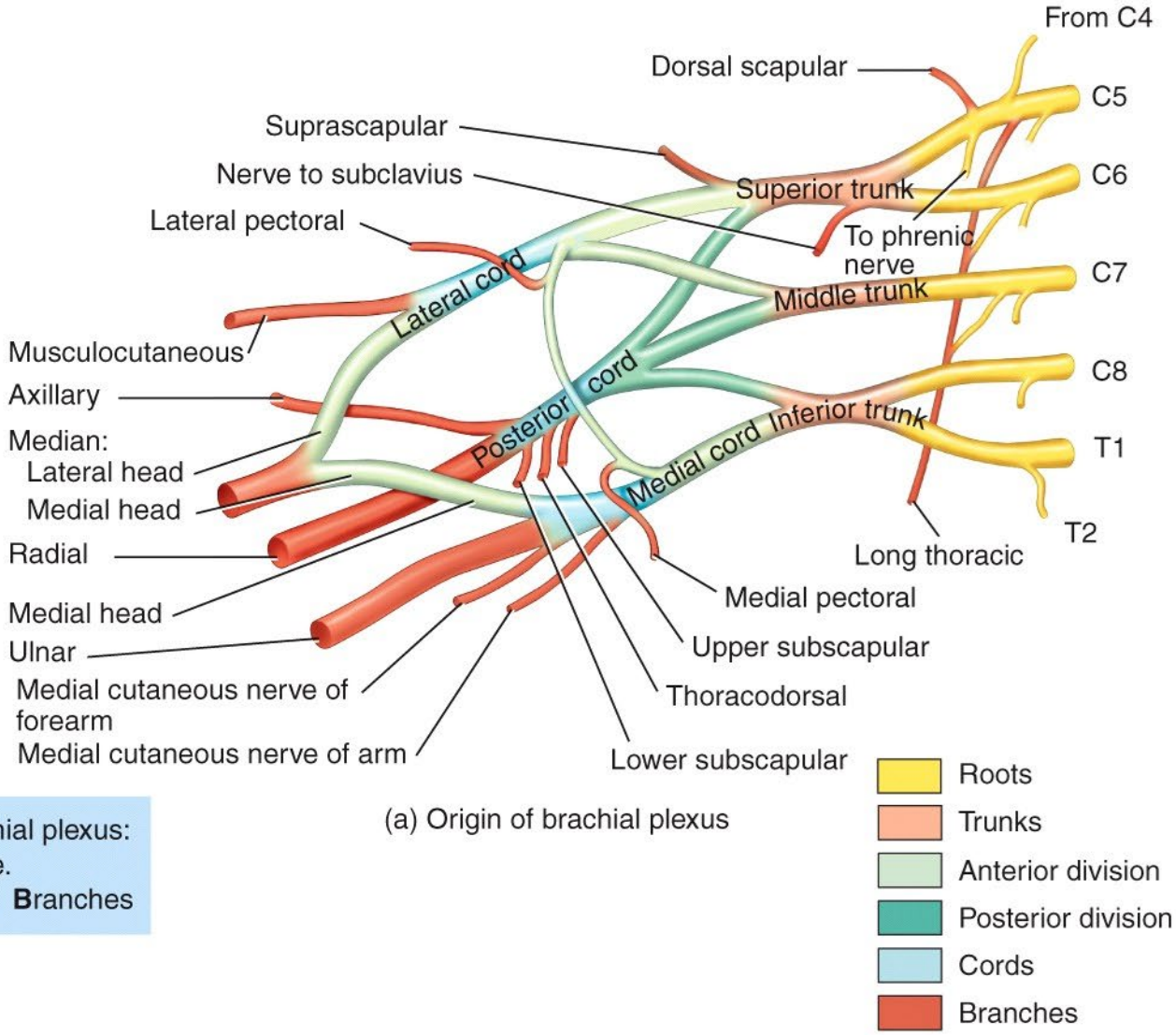



Origin of cervical plexus

What is the significance of a nerve plexus?

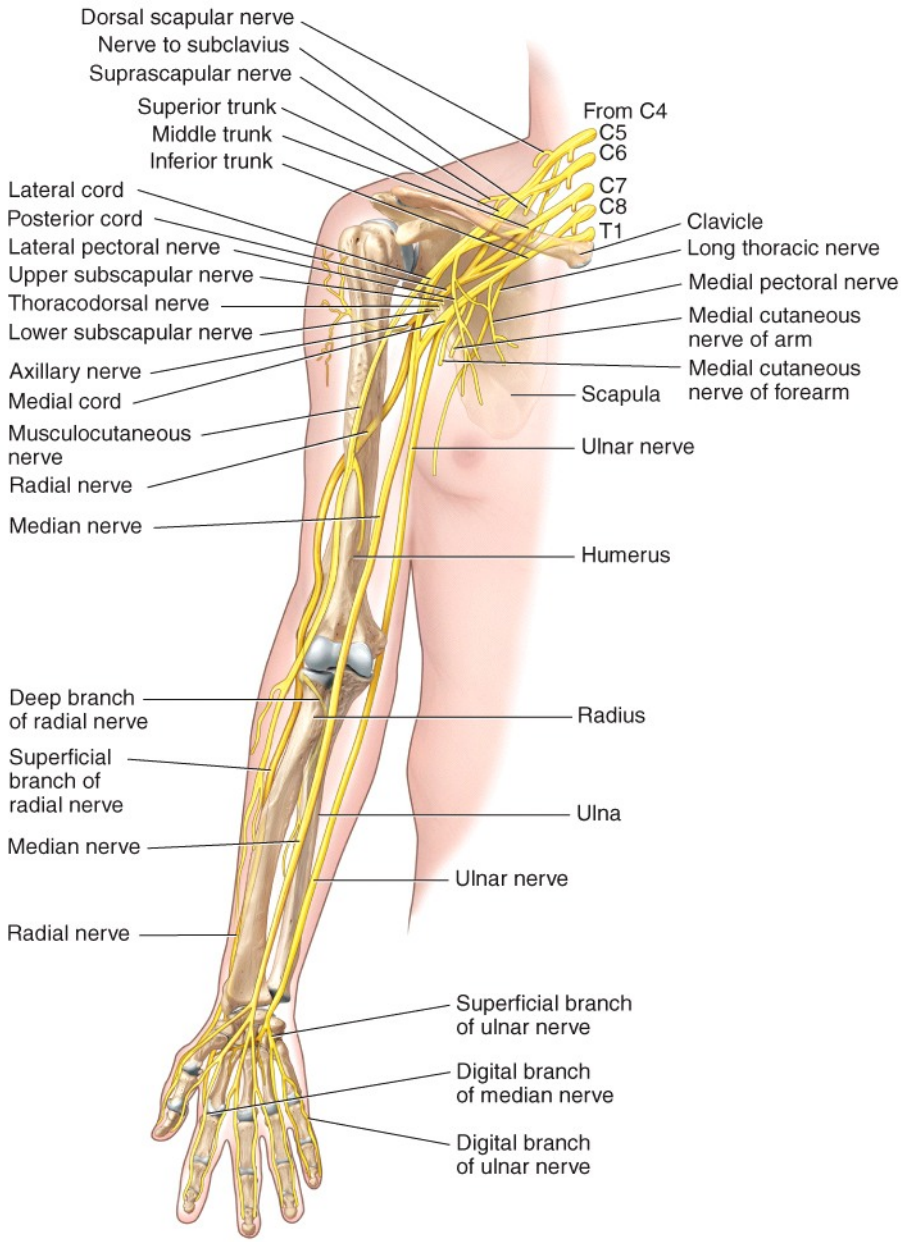


Brachial plexus projected to surface

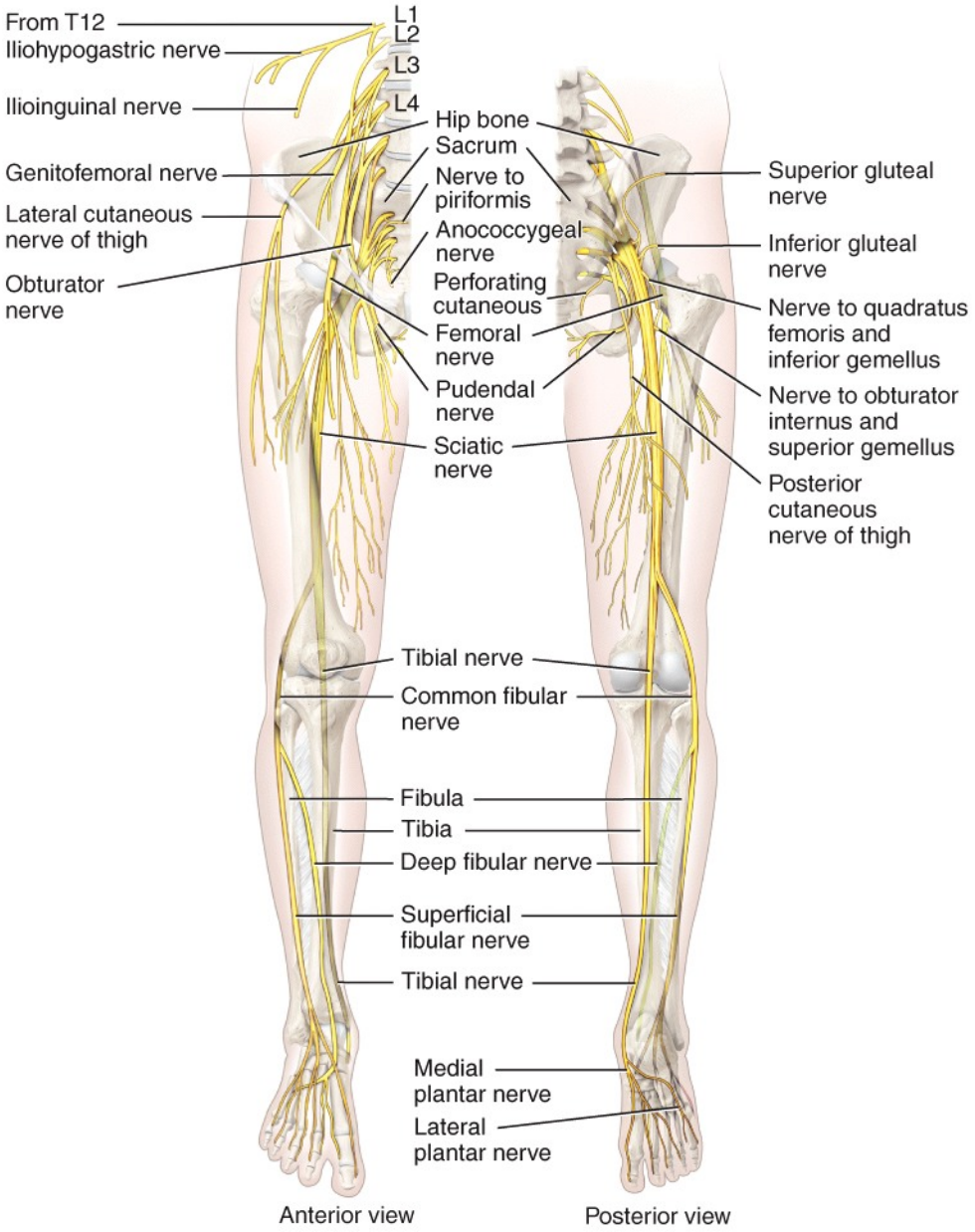



(a) Origin of brachial plexus

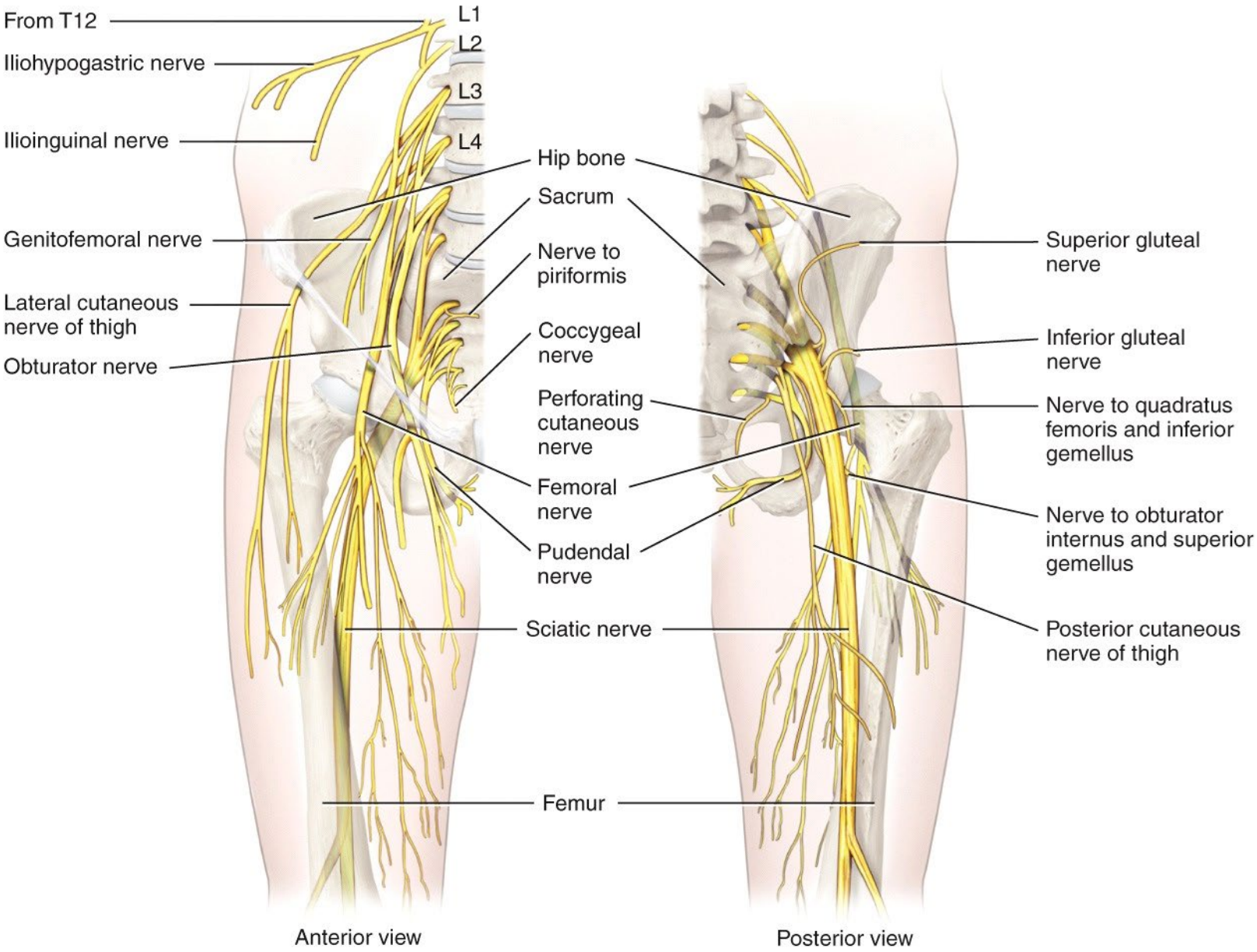
MNEMONIC for subunits of the brachial plexus:
**R**isk **T**akers **D**on't **C**autiously **B**ehave.
**R**oots, **T**runks, **D**ivisions, **C**ords, **B**ranches



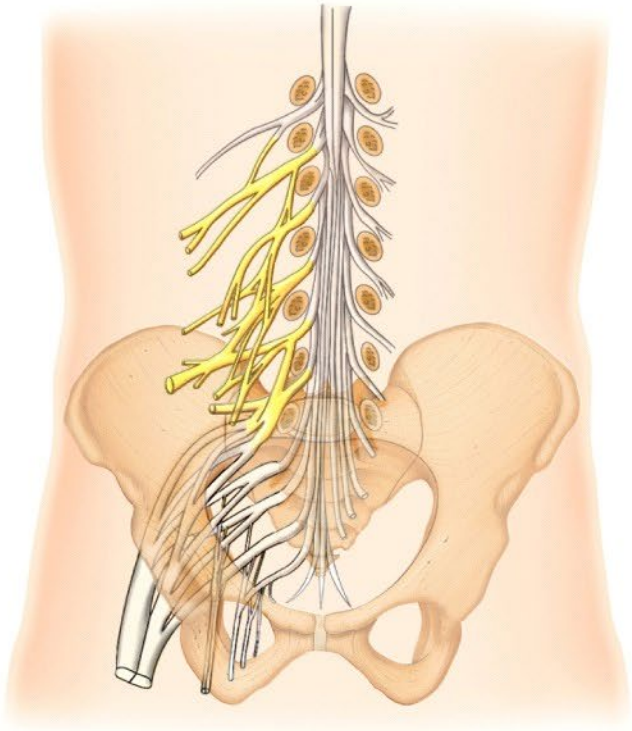

(b) Distribution of nerves from brachial plexus



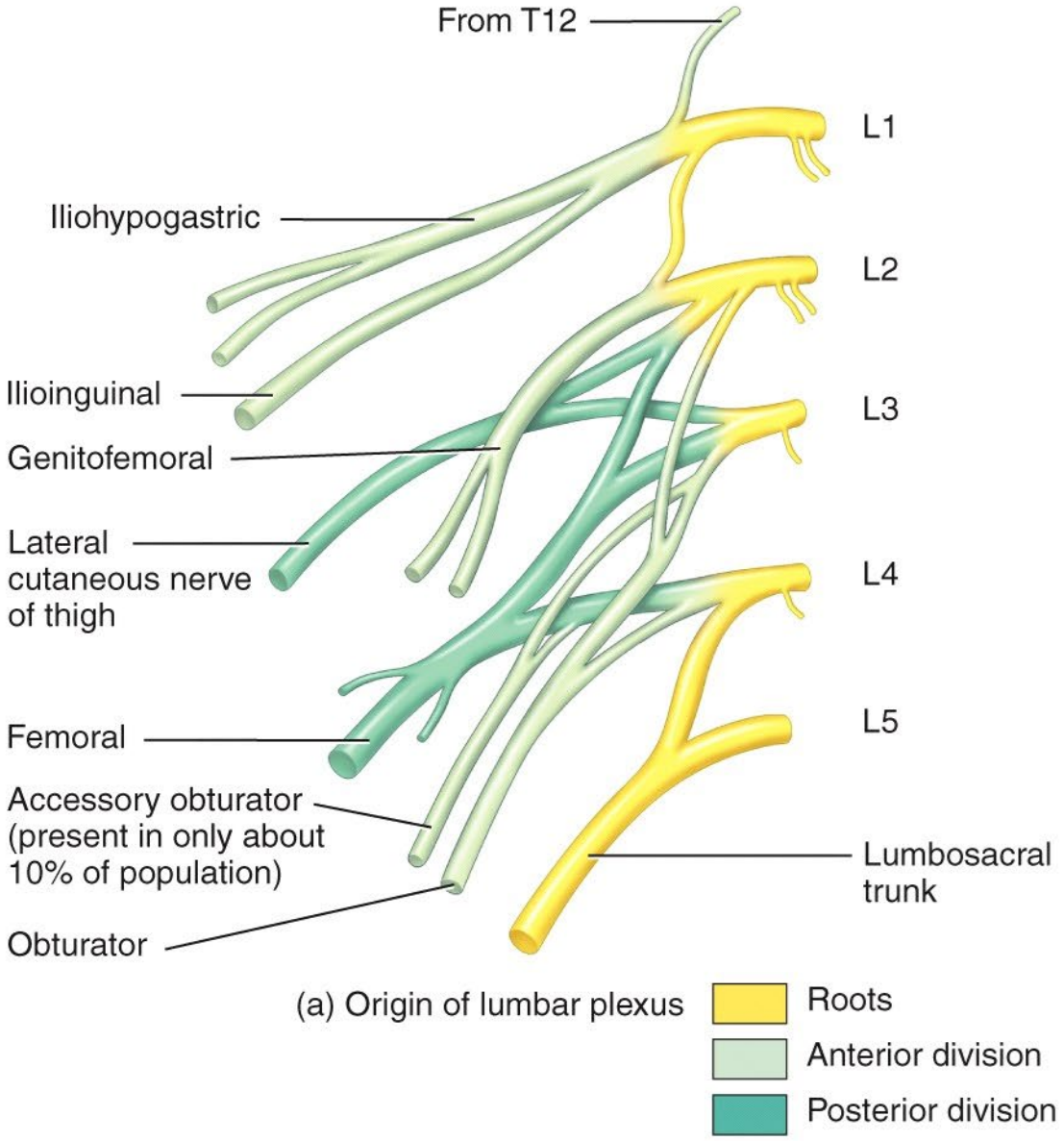

(b) Distribution of nerves from the sacral and coccygeal plexuses

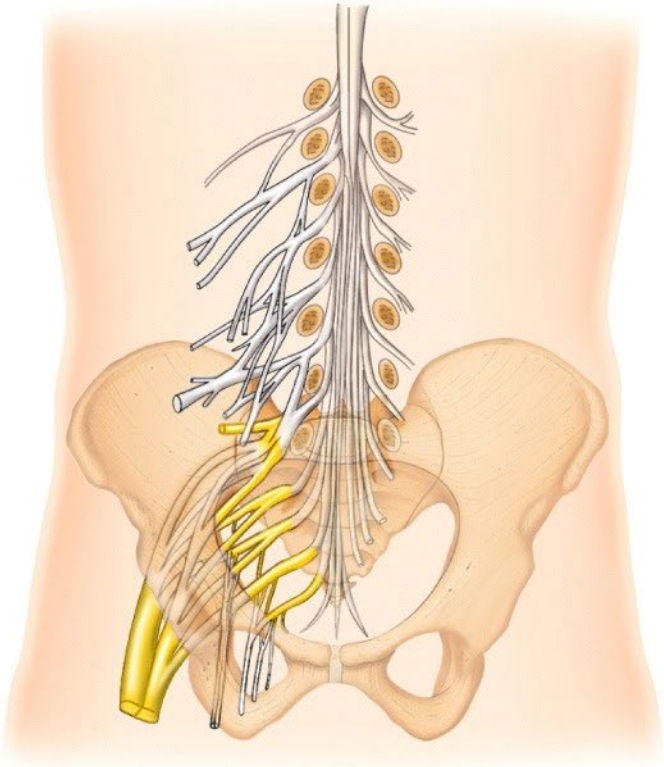



(b) Distribution of nerves from lumbar plexus

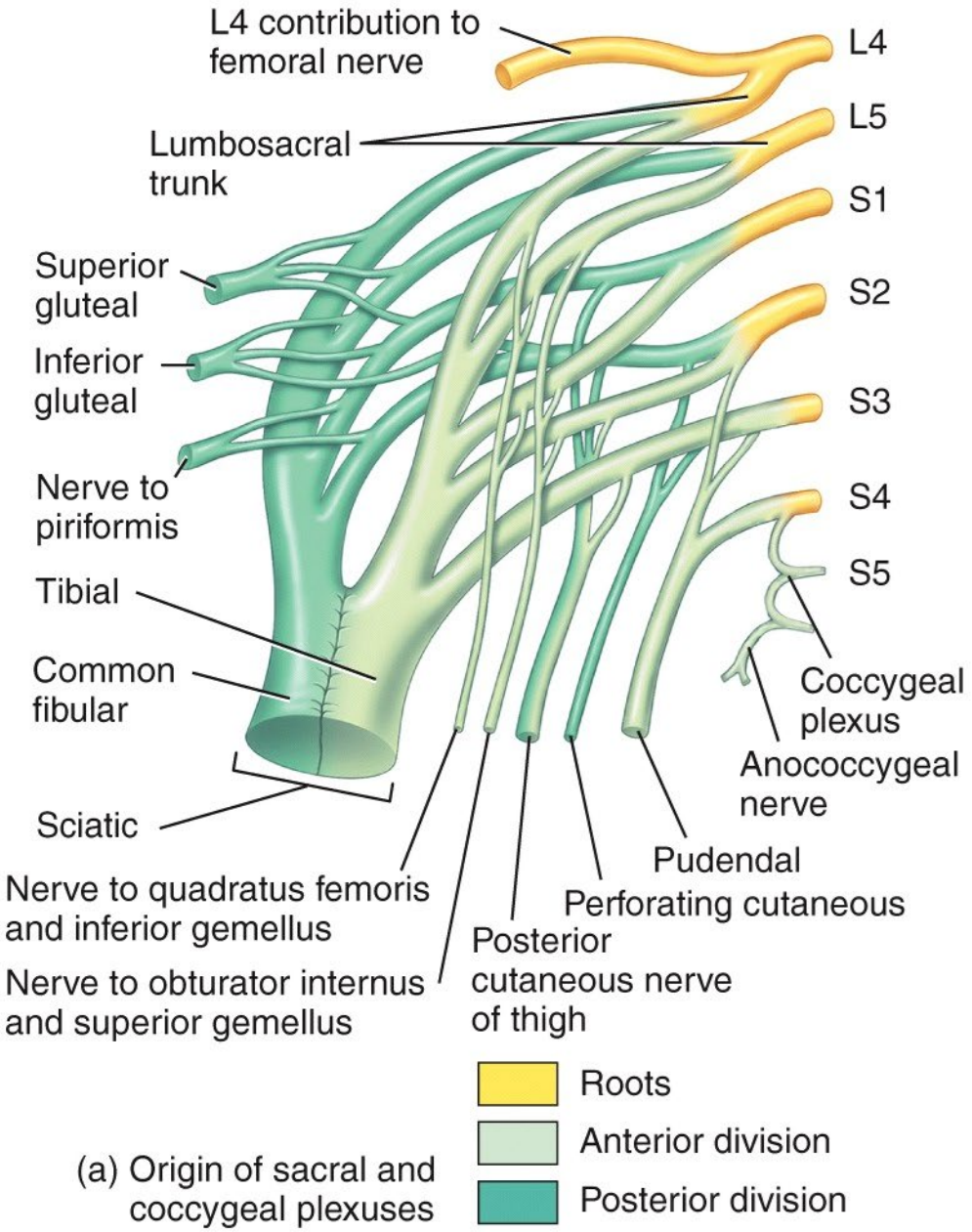


Lumbar plexus projected to surface

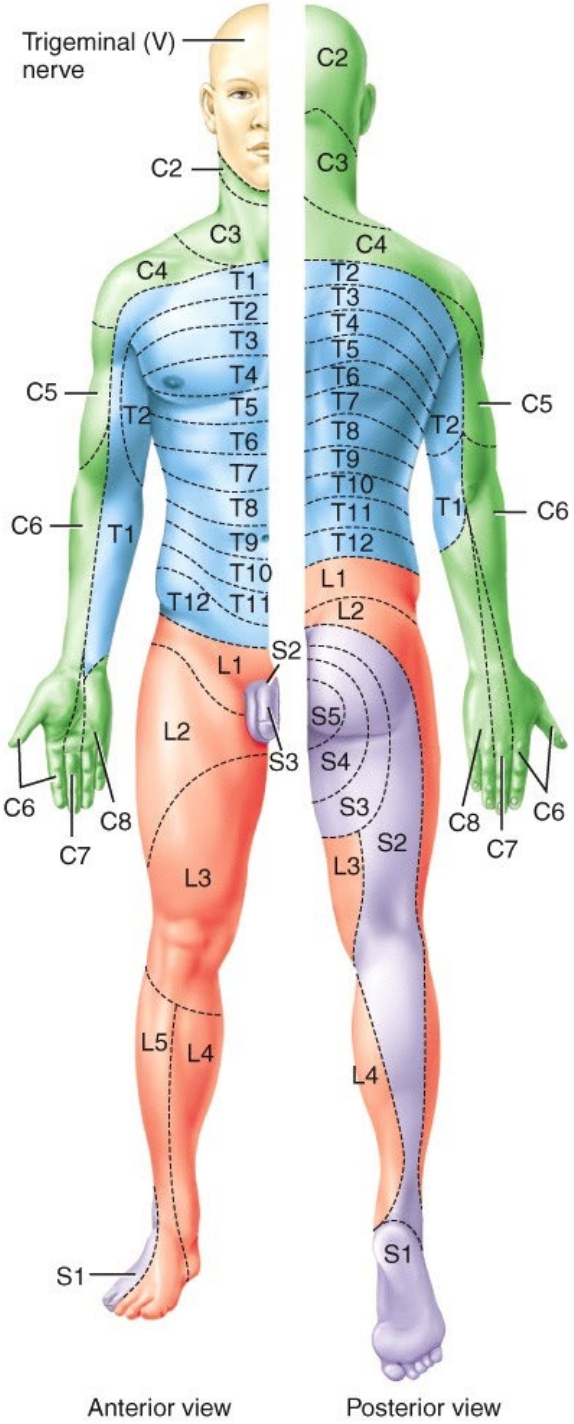




Sacral and coccygeal plexuses projected to surface




(a) Origin of sacral and coccygeal plexuses


Trigeminal (V) nerve
C2
C3
C4
T1
T2
T3
T4
T5
T6
T7
T8
T9
T10
T11
T12
C5
C6
C7
C8
L1
L2
L3
L4
L5
S1
S2
S3
S4
S5
Anterior view
Posterior view

# Spinal Nerve Injuries

Radial nerve injury //  passes through axilla

–***crutch paralysis***

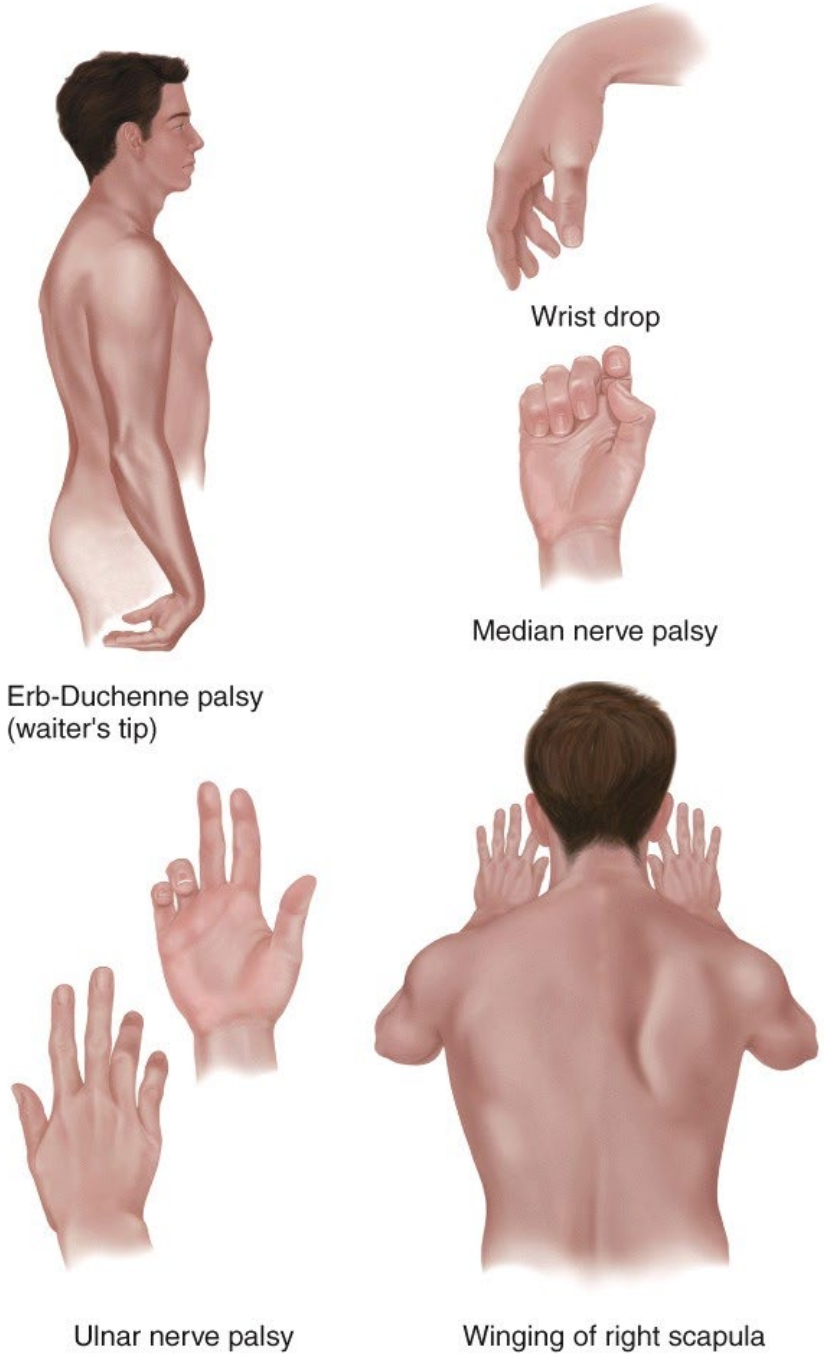
–***wrist drop***

Sciatic nerve injury

–***sciatica*** – sharp pain that travels from gluteal region along the posterior side of the thigh and leg to ankle

–ninety percent of cases result from herniated intervertebral disc or osteoporosis of lower spine

–sometimes caused by men “sitting” on their wallets



(c) Injuries to the brachial plexus

If a spinal nerve is “compressed” then it may result in paralysis to the skeletal muscle it innervates.

# Dissection of Spinal Nerve


(see Web site to view spinal cord dissection video)