SPORTS PHYSICAL THERAPY

PERIPHERAL NERVE INJURIES

(PART "A")

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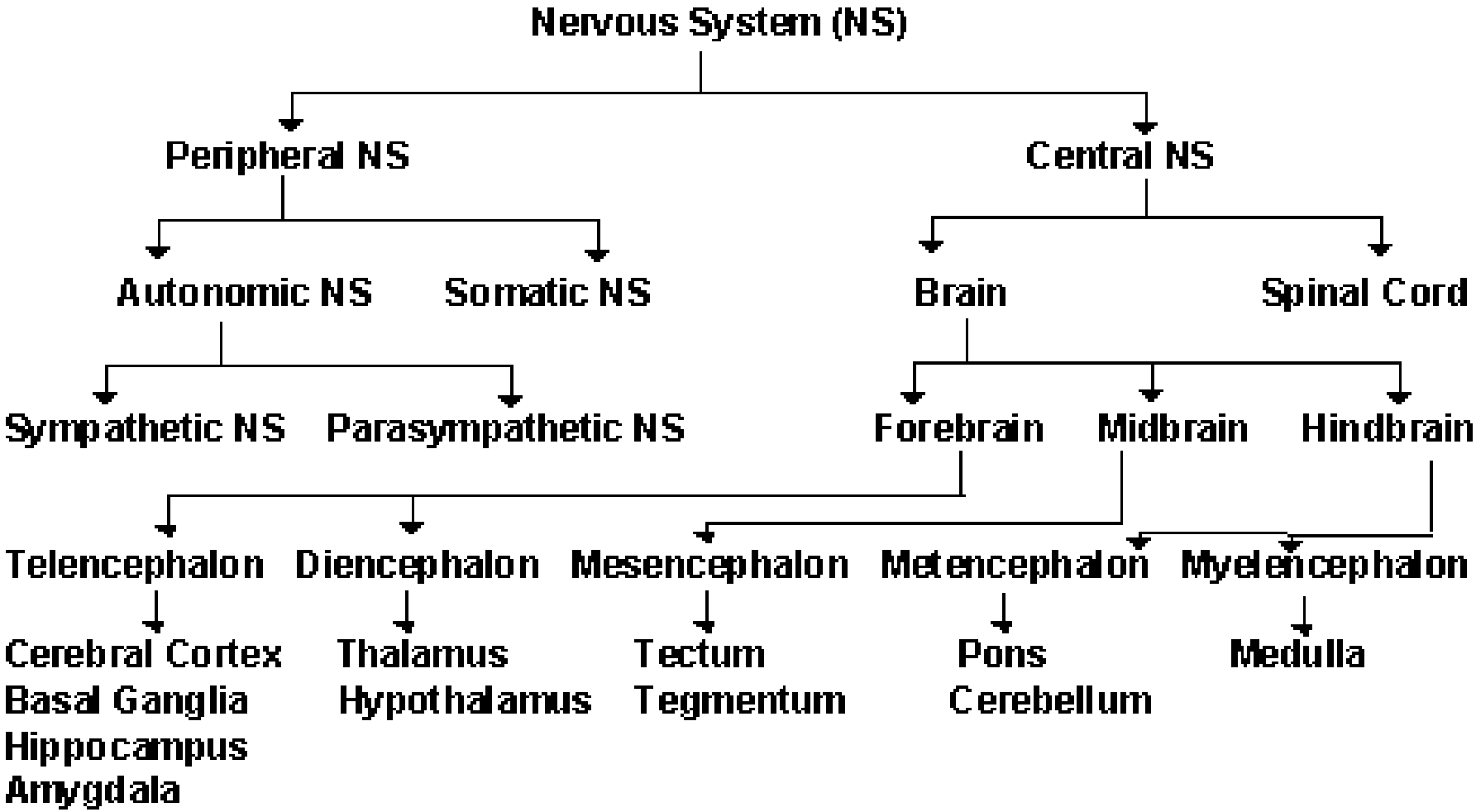
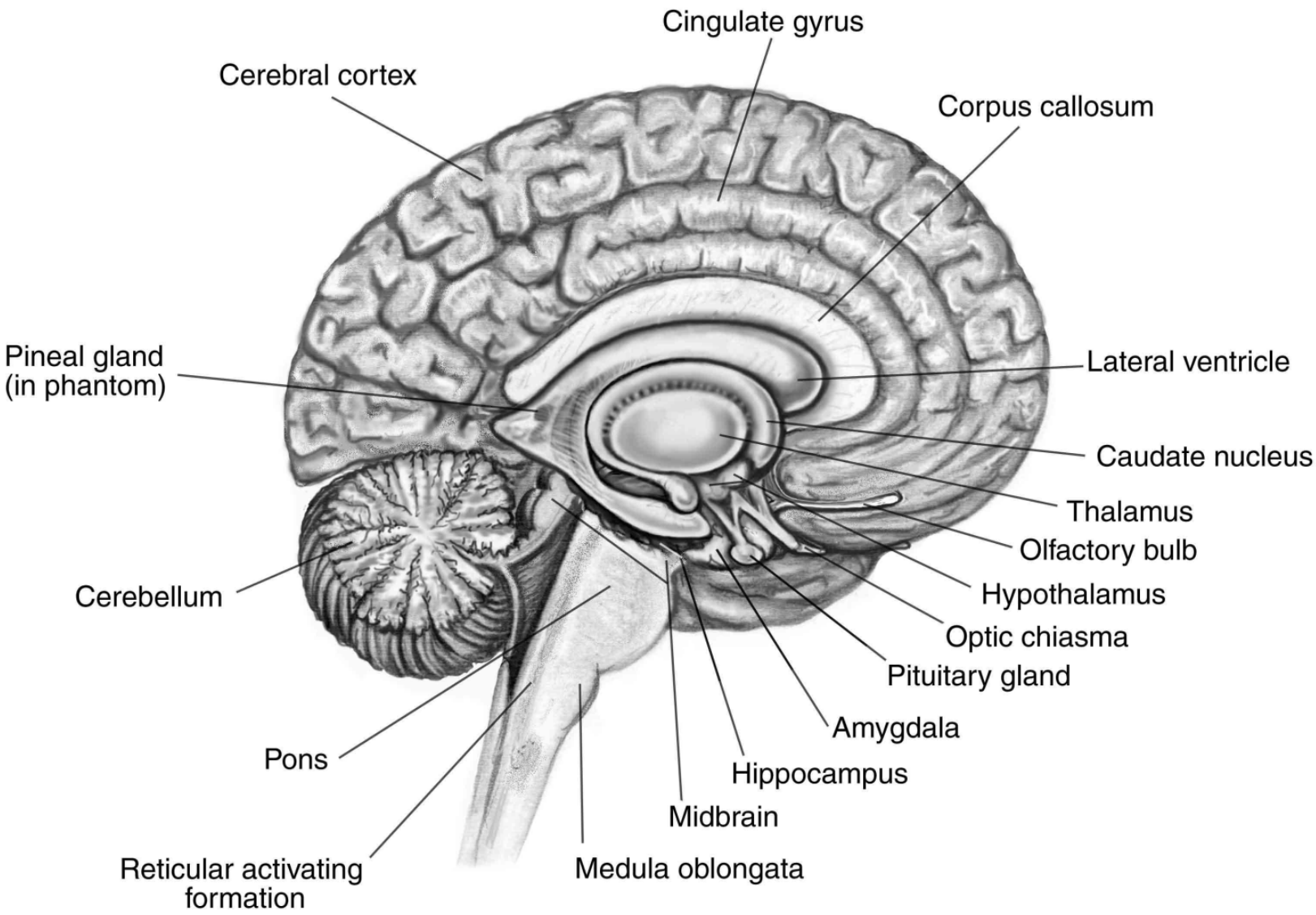
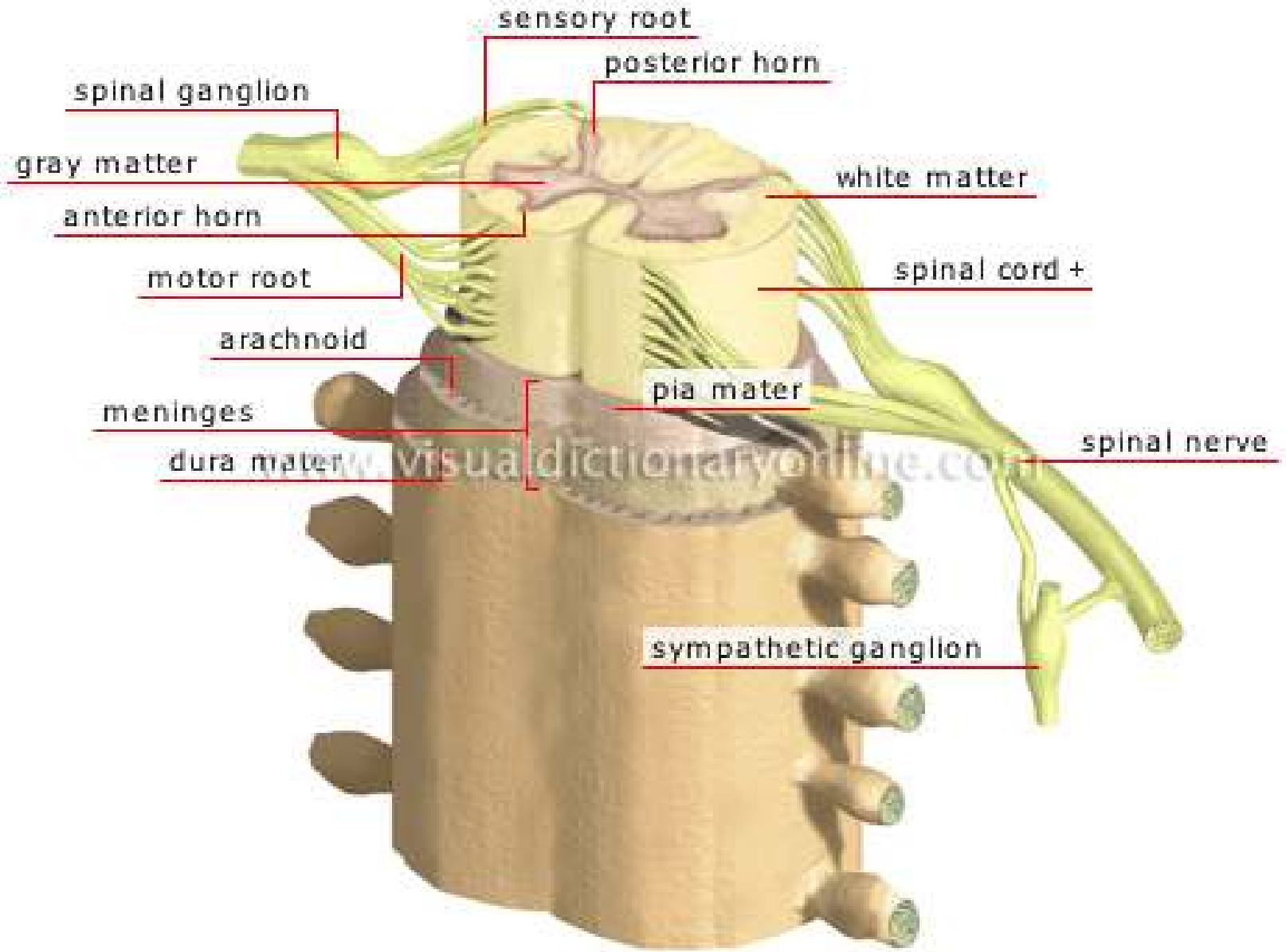
PERIPHERAL NERVE INJURIES

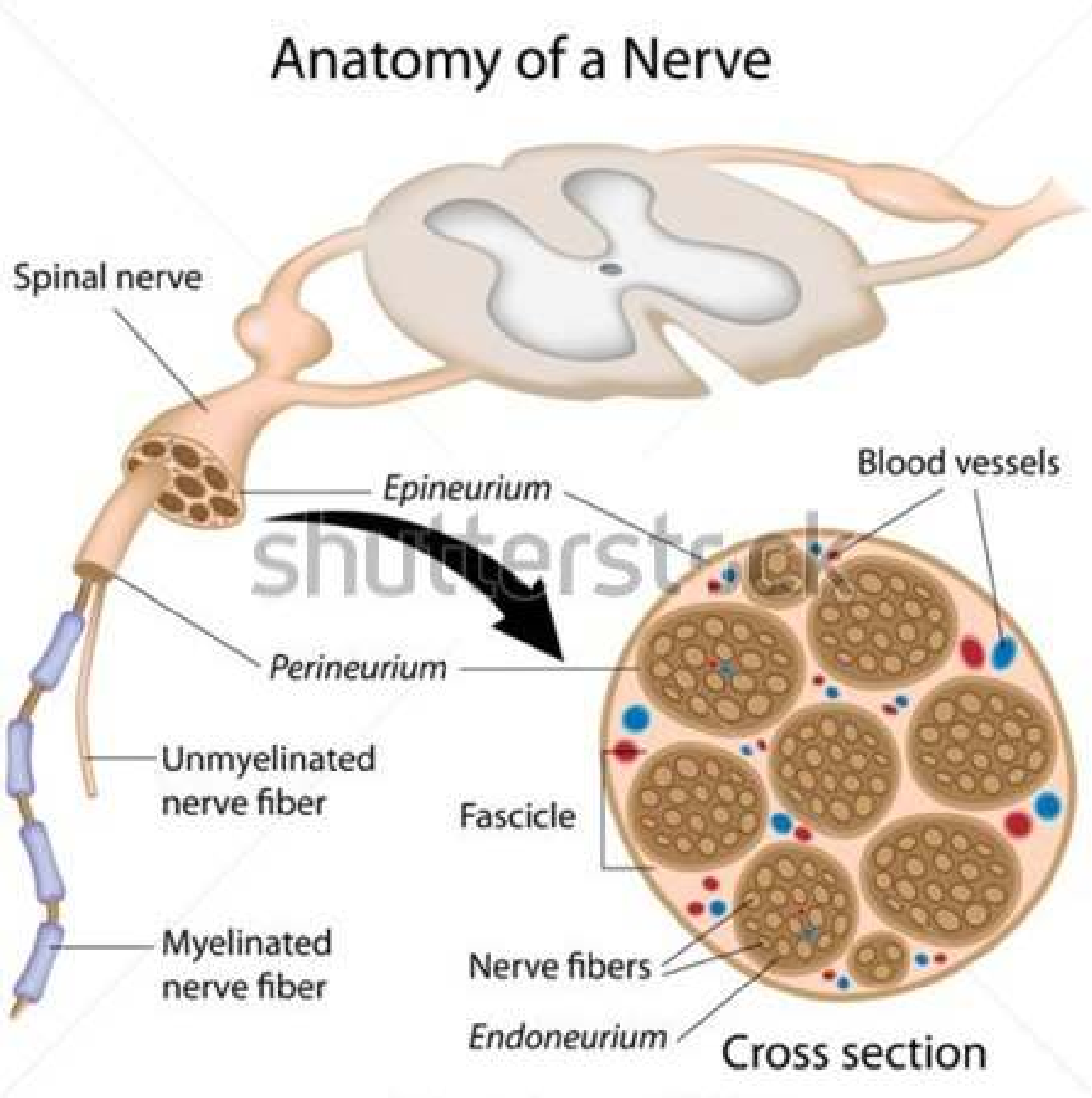
CHAPTER OBJECTIVES

This chapter aims to introduce the structure and function of nerves and the neurological system, and the pathophysiology of common nerve injuries. The chapter also reviews some common nerve injuries, their assessment and evidence based treatment


Nervous System (NS)
Peripheral NS
Central NS
Autonomic NS
Somatic NS
Brain
Spinal Cord
Sympathetic NS
Parasympathetic NS
Forebrain
Midbrain
Hindbrain
Telencephalon
Diencephalon
Mesencephalon
Metencephalon
Myelencephalon
Cerebral Cortex
Basal Ganglia
Hippocampus
Amygdala
Thalamus
Hypothalamus
Tectum
Tegmentum
Pons
Cerebellum
Medulla


Cingulate gyrus
Cerebral cortex
Corpus callosum
Pineal gland
(in phantom)
Lateral ventricle
Caudate nucleus
Thalamus
Olfactory bulb
Hypothalamus
Optic chiasma
Pituitary gland
Amygdala
Hippocampus
Midbrain
Medula oblongata
Reticular activating
formation
Pons
Cerebellum


sensory root
posterior horn
spinal ganglion
gray matter
white matter
anterior horn
motor root
spinal cord +
arachnoid
pia mater
meninges
spinal nerve
dura mater
sympathetic ganglion


Anatomy of a Nerve
Spinal nerve
Epineurium
Blood vessels
Perineurium
Unmyelinated nerve fiber
Fascicle
Myelinated nerve fiber
Nerve fibers
Endoneurium
Cross section
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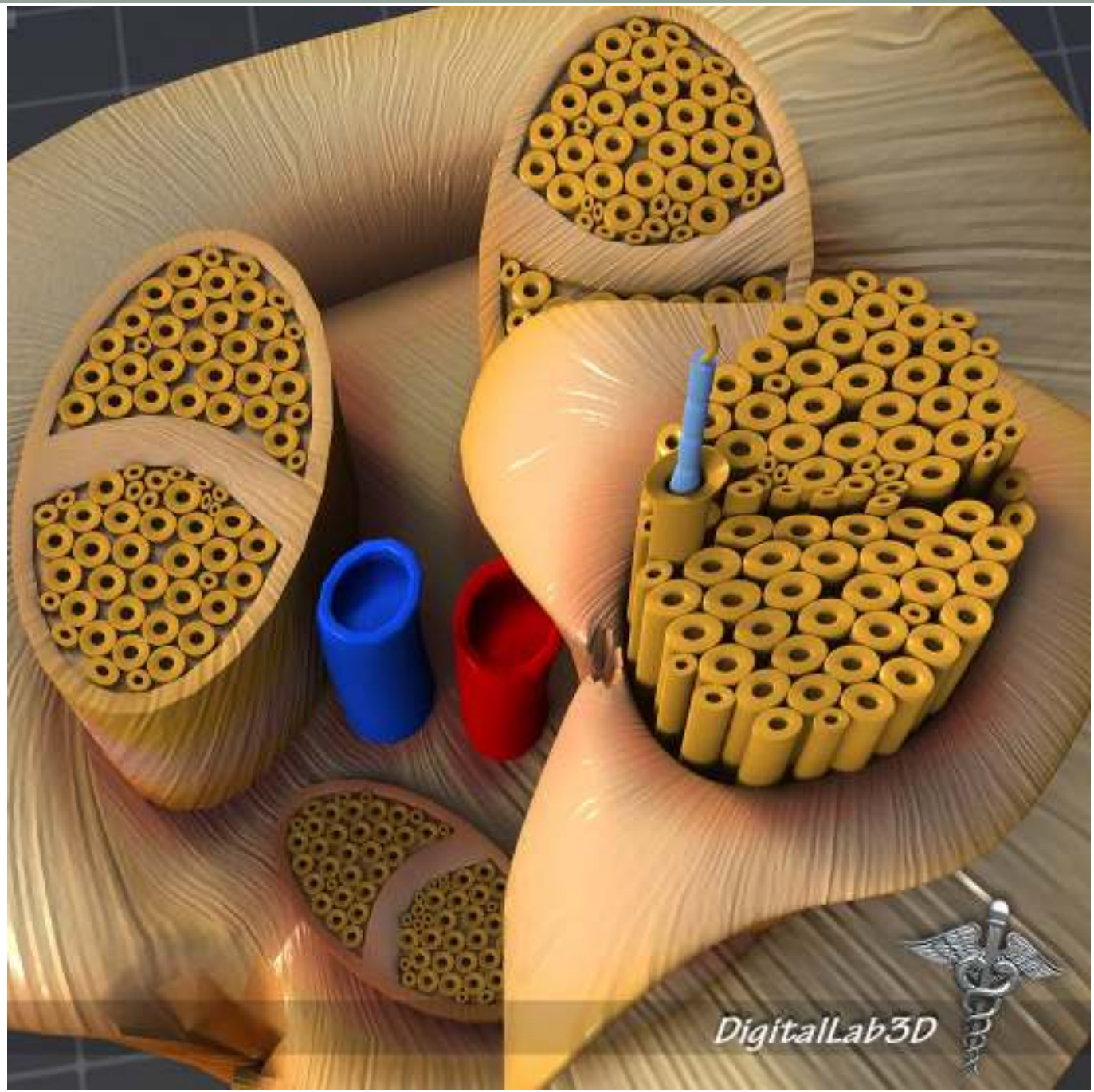
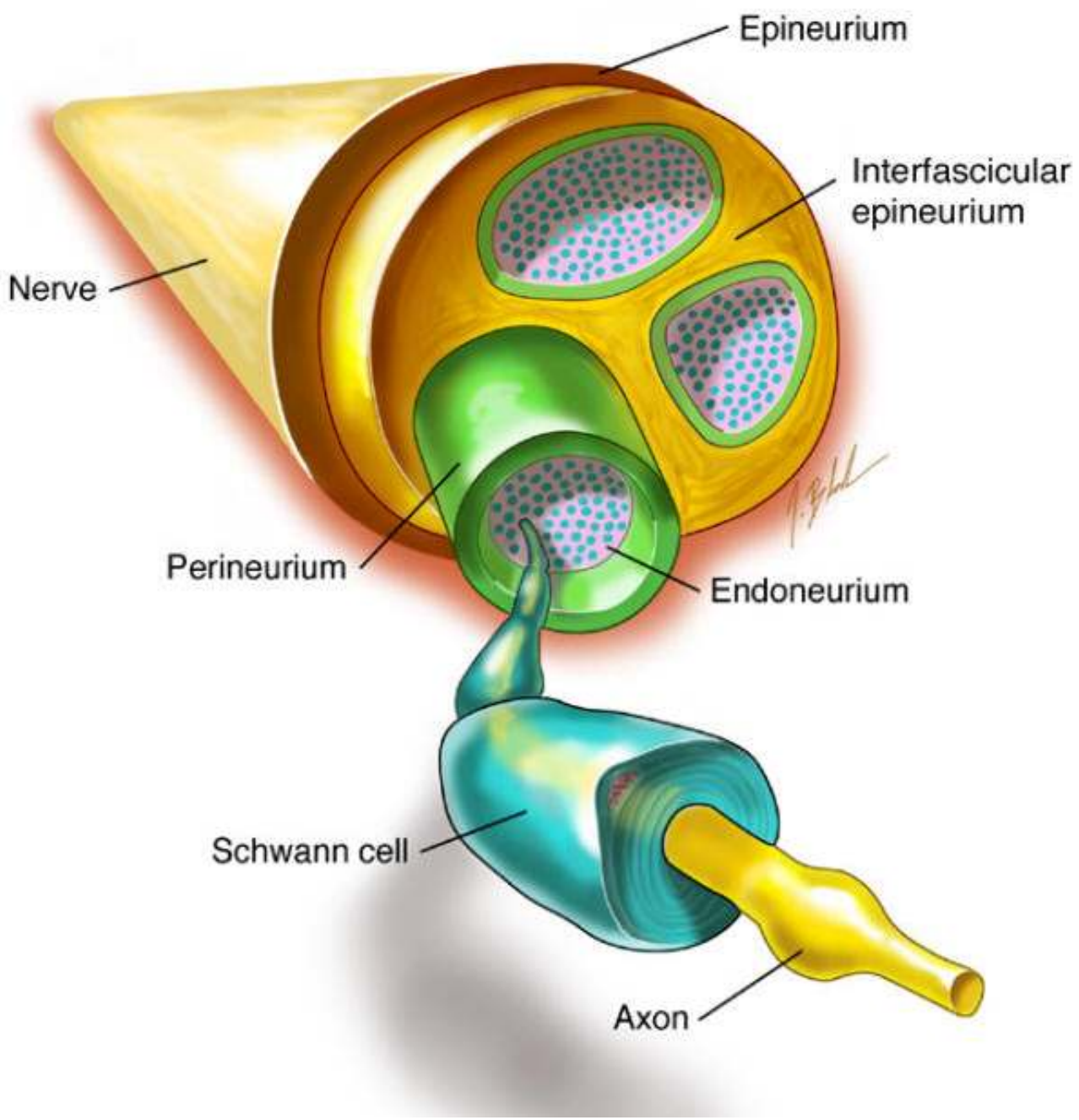

DigitalLab3D

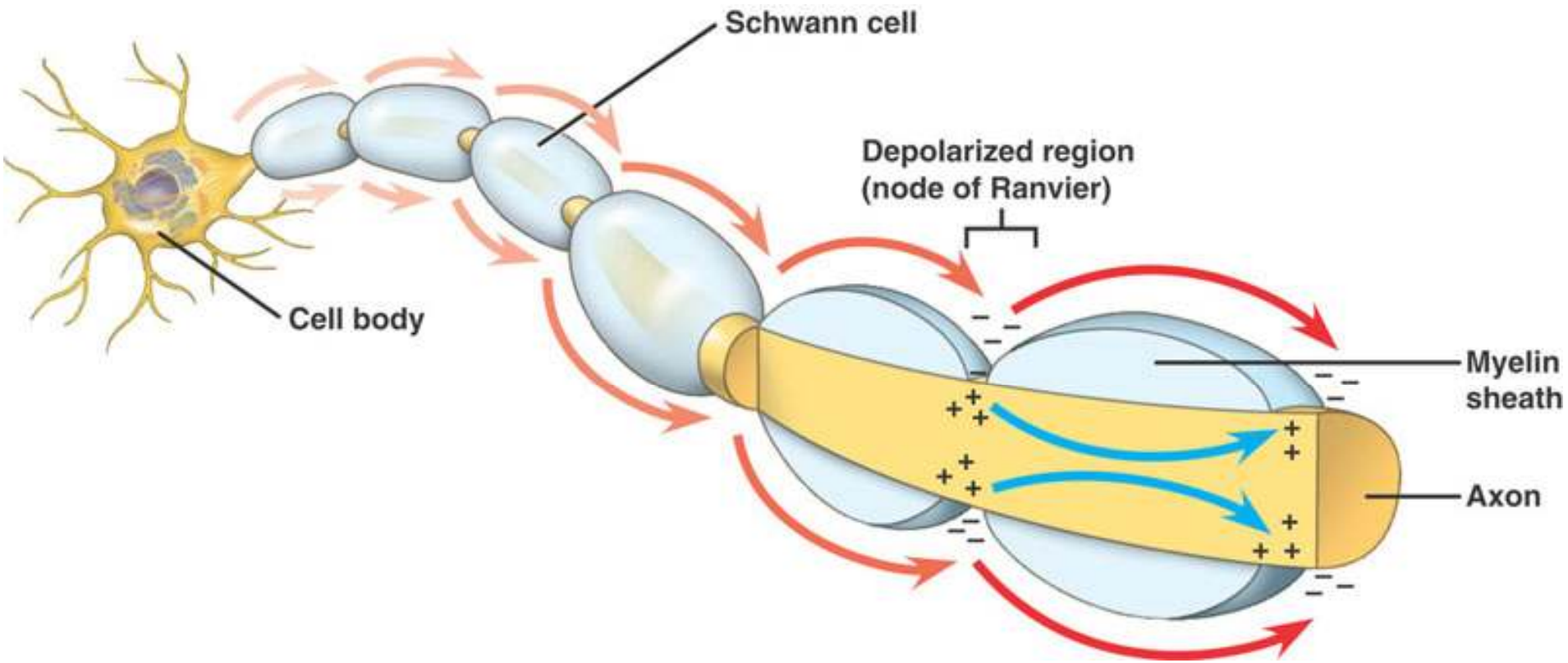

Epineurium
Interfascicular epineurium
Nerve
Perineurium
Endoneurium
Schwann cell
Axon

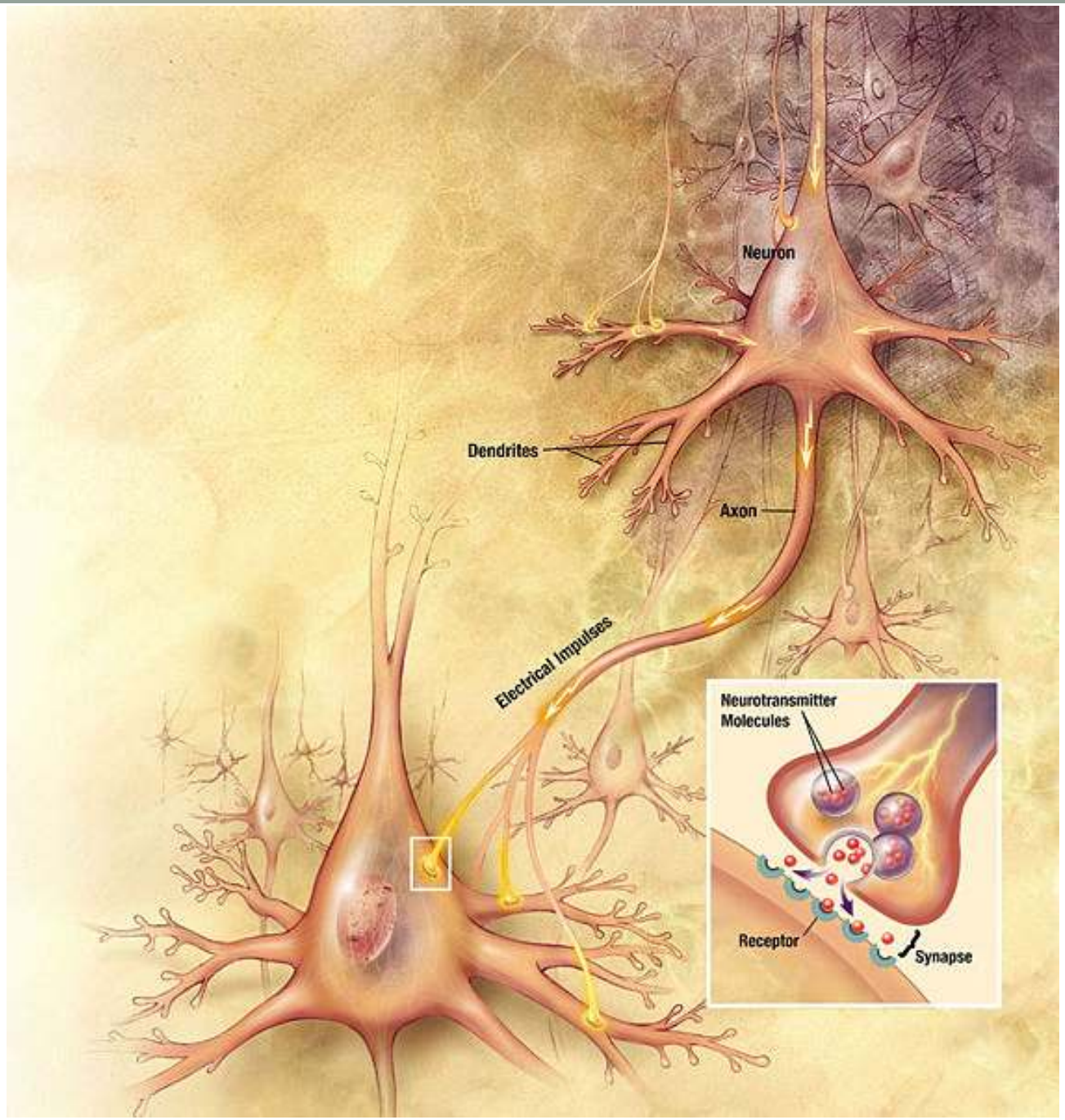
THREE CONNECTIVE TISSUE LAYERS

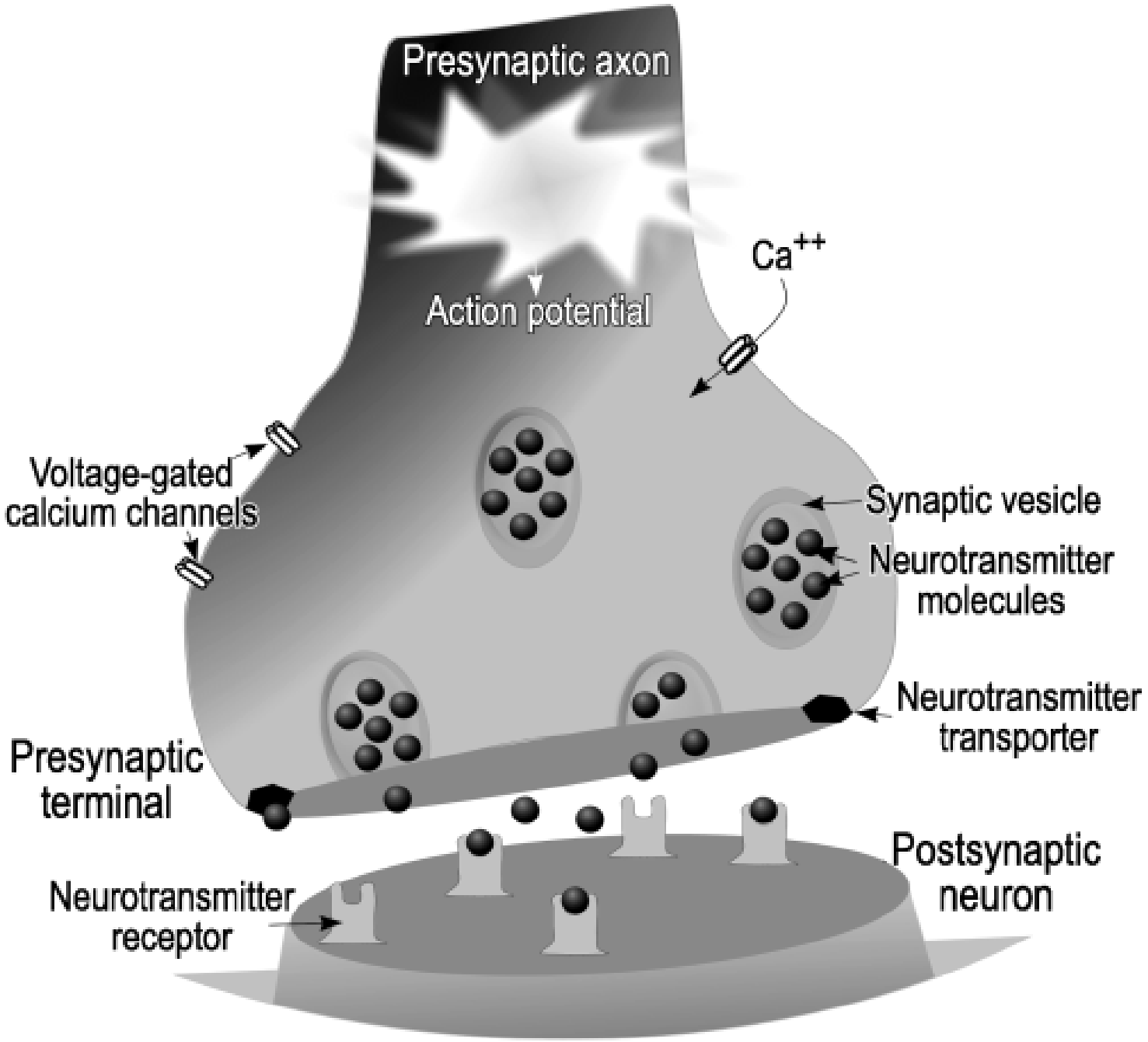
The innermost connective tissue layer is the Endoneurium, which is composed of longitudinally aligned collagen fibres and therefore, plays an important role in protecting the axon from tensile forces (Butler 1991).

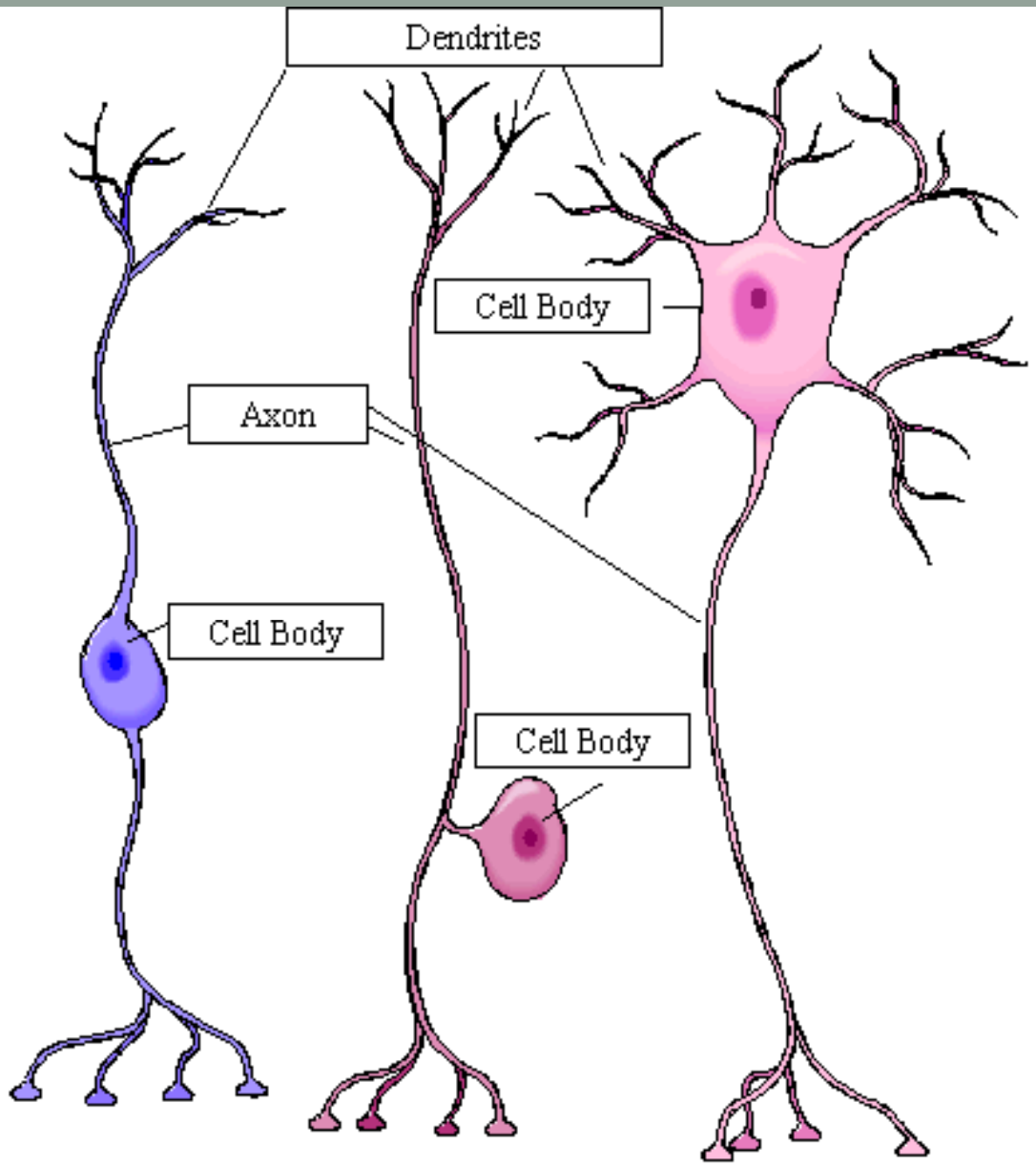
Encompassing the Endoneurial components, axon and Schwann cells is the Perineurium, the second layer of connective tissue, whose primary responsibility is to act as a primary barrier to external forces (Lundborg 1988).

The Epineurium is regarded as the most resistant connective layer to tensile forces (Sunderland 1978) as it surrounds, protects and cushions the nerve fascicles (Butler 1991).


Schwann cell
Depolarized region
(node of Ranvier)
Cell body
Myelin
sheath
Axon


Neuron
Dendrites
Axon
Electrical Impulses
Neurotransmitter Molecules
Receptor
Synapse


Presynaptic axon
Action potential
Ca++
Voltage-gated calcium channels
Synaptic vesicle
Neurotransmitter molecules
Neurotransmitter transporter
Presynaptic terminal
Postsynaptic neuron
Neurotransmitter receptor



1.Bipolar Neuron
2.Unipolar Neuron
3.Multipolar Neuron

PERIPHERAL NERVE INJURIES

The ability of the nervous system to withstand and adapt to the mechanical stresses placed on it, is essential to prevent injury (Shacklock 1995).

PERIPHERAL NERVE INJURIES

Injury to tissues is caused by excessive physical stress via any of the following mechanisms:

High magnitude stress applied to the tissue for a brief duration; spinal cord injury is a typical outcome from this mechanism of injury.	Low magnitude stress applied for long duration or repetitively; an example of nerve injury from this particular mechanism of injury is Carpal Tunnel Syndrome at the wrist.	Moderate stress applied to a tissue many times. Cubital Tunnel Syndrome at the elbow, for example in a javelin thrower, whereby repetitive high load forces are exerted through the elbow and consequently the ulnar nerve, is an example (Mueller and Maluf 2002).

PERIPHERAL NERVE INJURIES

Stress levels lower than the maintenance range decreases a tissue's tolerance to physical stress; for example during immobilization of a limb, muscle atrophy is a typical byproduct of being in a cast for a prolonged period of time

PERIPHERAL NERVE INJURIES

The extent of an injury to a nerve is dependent on the mechanism of injury, as traumatic injuries, such as a gun-shot wound (i.e. high magnitude stress), will significantly damage a nerve's integrity, whilst a low magnitude stress, such as prolonged intermittent compression over a long duration of time, will have less of an impact on the nerve.

NERVE INJURY CLASSIFICATION

Seddon's classification

In 1943, Seddon described three basic types of peripheral nerve injury that include;

Seddon's classification

NEUROPRAXIA

- A transient physiological block caused by ischemia from pressure or stretch of a nerve with no wallerian degeneration

AXONOTMESIS

- Internal architecture of the nerve is preserved, but axons are so badly damaged that wallerian degeneration occurs

NEUROTMESIS

- Structure of the nerve is destroyed by cutting, severe scarring or prolonged severe compression

Classification of Nerve Injuries

Degree of Injury	myelin	axon	endoneurium	perineurium	epineurium
I; Neuropraxia	+/-				
II; Axonotmesis	yes	yes	no	no	no
III; Neurotmesis	yes	yes	yes	yes	yes

NERVE INJURY CLASSIFICATION			
Sunderland	**Seddon**	**Injury**	**Recovery Potential**
I	**Neuropraxia**	Ionic block; possible segmental demyelination	Full
II	**Axonotmesis**	Axon severed; Endoneurial tube intact	Full
III		Endoneurial tube torn	Slow; incomplete
IV		Only epineurium intact	Neuroma-in-continuity
V	**Neurotmesis**	Loss of Continuity	None
VI		Combination of above	Unpredictable

PERIPHERAL NERVE INJURIES

The majority of nerve injuries in sport will typically involve Neurapraxia or Axontmesis and therefore prognosis for recovery is generally good.

ASSESSMENT OF NERVE INJURY

Knowledge of the myotomes and dermatomes of the upper and lower extremities is important to conduct a thorough assessment of the peripheral nervous system.

ASSESSMENT OF NERVE INJURY

Myotomes of the Upper limb

- C1
- C2
- C3
- C4
- C5
- C6
- C7
- C8
- T1

- Cervical flexion
- Cervical extension
- Cervical lateral flexion
- Shoulder elevation
- Shoulder abduction
- Elbow flexion
- Elbow extension
- Thumb extension
- Finger abduction

ASSESSMENT OF NERVE INJURY

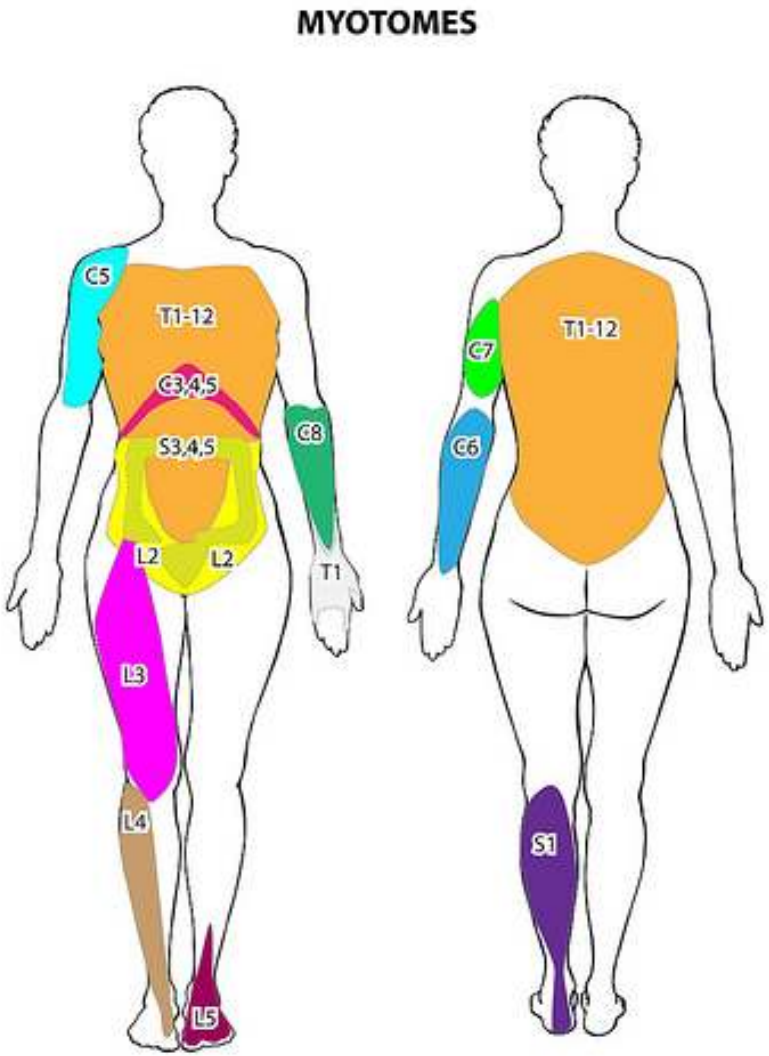
Myotomes of the Lower limb

- L1
- L2
- L3
- L4
- L5
- S1

- Hip flexion
- Hip adduction
- Knee extension
- Ankle dorsi-flexion
- Great toe extension
- Ankle plantar flexion

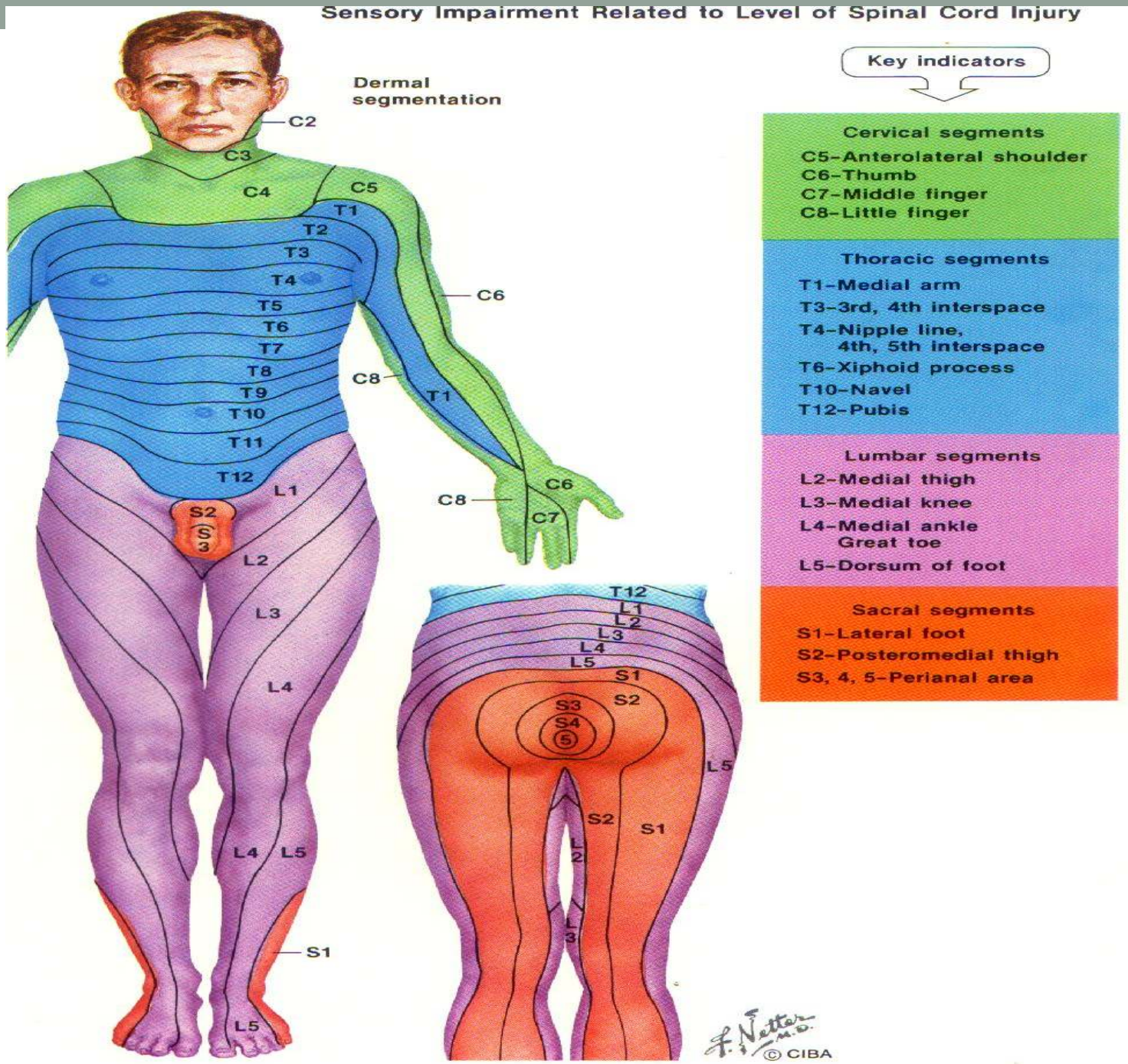
ASSESSMENT OF NERVE INJURY

Myotomes



ASSESSMENT OF NERVE INJURY

Dermatomes



NEURODYNAMIC TESTING

Nerves slide and stretch during limb movements to allow for changes in nerve bed length (Babbage et al. 2007) and whilst healthy nerves can tolerate strain and compression, injured or inflamed nerves become sensitive to mechanical stimuli and can inflict pain on movement (Bove et al. 2005).

NEURODYNAMIC TESTING

Neurodynamic tests were developed to evaluate peripheral nerve sensitivity to movement and to infer underlying pathomechanics (Topp and Boyd 2006).

UPPER LIMB NEURODYNAMIC TEST

UPPER LIMB NEURODYNAMIC TEST WITH MEDIAN NERVE BIAS

UPPER LIMB NEURODYNAMIC TEST WITH RADIAL NERVE BIAS

UPPER LIMB NEURODYNAMIC TEST WITH ULNAR NERVE BIAS

LOWER LIMB NEURODYNAMIC TEST

LOWER LIMB NEURODYNAMIC TEST
THE SLUMP TEST

LOWER LIMB NEURODYNAMIC TEST

THE STRAIGHT LEG RAISE

NEURODYNAMIC TESTS AS TREATMENT TOOLS

The purpose of utilizing neurodynamic tests as treatment tools is to minimize scarring and stretching of the nerve, and maintain or restore normal nerve excursion and function (Wehb´e and Schlegel 2004).

NEURODYNAMIC TESTS AS TREATMENT TOOLS

"SLIDING" TECHNIQUE

NEURODYNAMIC TESTS AS TREATMENT TOOLS
"TENSIONING" TECHNIQUE

Treatment plans for nerve injury

- Immediately post-injury, inflammation occurs, thereby rendering injured tissues less capable of tolerating stress compared to their pre-morbid level (Mueller and Maluf 2002).
- Non-steroidal anti-inflammatory drugs (NSAIDs), ice, rest, elimination of the aggravating activity, physical and manual therapy into the conservative treatment plan (McKean 2009; Shapiro and Preston 2009);

END OF LECTURE
Part A