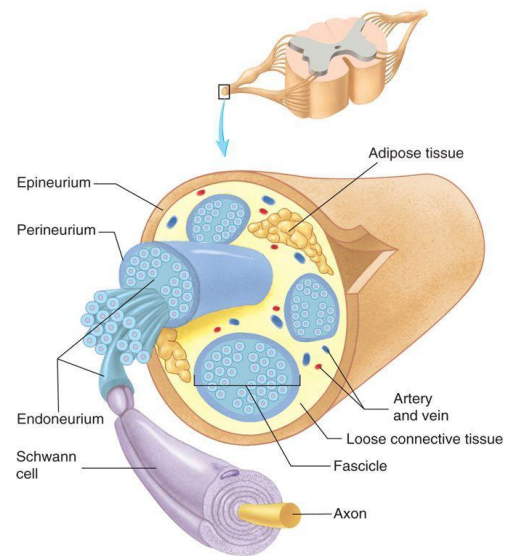




Connective tissue layers of nerves related to Peripheral Nervous System (PNS):

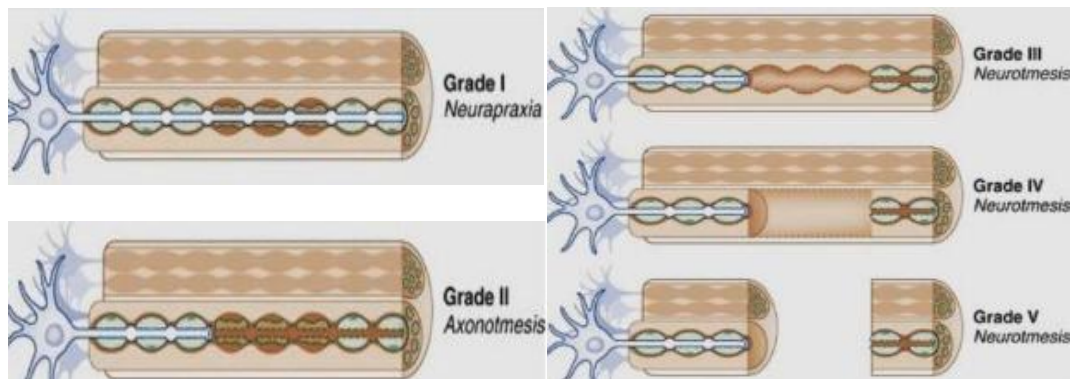
- **Endoneurium:** thin layer of collagenous connective tissue surrounding individual nerve fibers.
- **Perineurium:** layers surrounding each fascicle and compose of interlocking cells which form tight cell junctions (blood-nerve barrier).
- **Epineurium:** layers surrounding the a spinal nerve and is considered as an extension of the dura matter.



Classification of nerve injury:

- **Seddon’s classification:** refer to Physiology (1) note for more details.
- **Sunderland’s classification:**

Grade-I (neuropraxia)	<ul style="list-style-type: none"> • Mild nerve injury caused by transient conduction block. • Myelin sheath is injured but axons are spared. • Prognosis: excellent with complete spontaneous recovery within 6 weeks. • Clinical example: wrist drop secondary to prolonged external pressure that compresses the radial nerve.
Grade-II (axonotmesis)	<ul style="list-style-type: none"> • Injury affecting myelin sheath and the axon itself. • The nerve as a mass of tissue is still in continuity. • Clinical example: crush injuries.
Neurotmesis (cutting of the nerve)	<ul style="list-style-type: none"> • Grade-III: injury affecting myelin sheath, axon and endoneurium but sparing perineurium and epineurium. • Grade-IV: Injury to all nerve trunk elements except epineurium. • Grade-V: Complete cut of all neural and connective tissue elements of the nerve trunk.



Nerve regeneration and degeneration:

- **Location of nerve injury:**

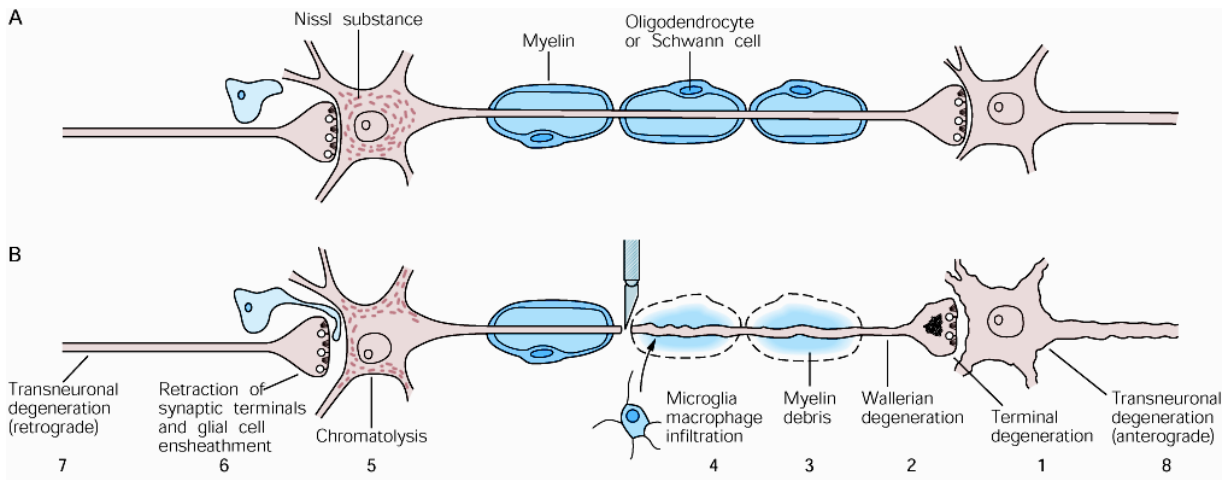
Cell body	Neuron is lost.
Close to neuronal cell body	Poor prognosis for regeneration and neuronal survival.
Close to target sites of nerve fibers	Good prognosis for regeneration and neuronal survival.



- **Peripheral nerve degeneration:**

- ✓ Axons of peripheral nerves may respond to injury in 3 ways:

Segmental demyelination	<ul style="list-style-type: none"> • Occurs with grade-I nerve injury (when there is mild compressive force on a nerve). • If compression is not severe → slow conduction velocity; if compression is severe → conduction block. • Regeneration: recovery of function occurs as Schwann cells divide and initiate re-myelination.
Wallerian and axonal degeneration	<ul style="list-style-type: none"> • Occurs with grade-IV and grade-V nerve injury when there is complete axonal cut of CNS/PNS. • The process takes about 1 week with changes involving proximal and distal segments to the zone of injury. • Distal segment changes: <ul style="list-style-type: none"> ✓ Decreased synthesis of myelin lipids; myelin sheaths separate from axons rapidly deteriorate to form bead-like structures. ✓ Phagocytosis of extracellular myelin by attraction of macrophages to myelin and other debris. • Proximal segment changes: <ul style="list-style-type: none"> ✓ Chromatolysis of cell body: represents a switch in function of cell body from axon maintenance to axon regeneration. This is represented by: <ul style="list-style-type: none"> ❖ Breakup of RER (Nissel bodies). ❖ Eccentric displacement of cell nucleus. ❖ Switch in pattern of gene expression from axon maintenance to protein synthesis.





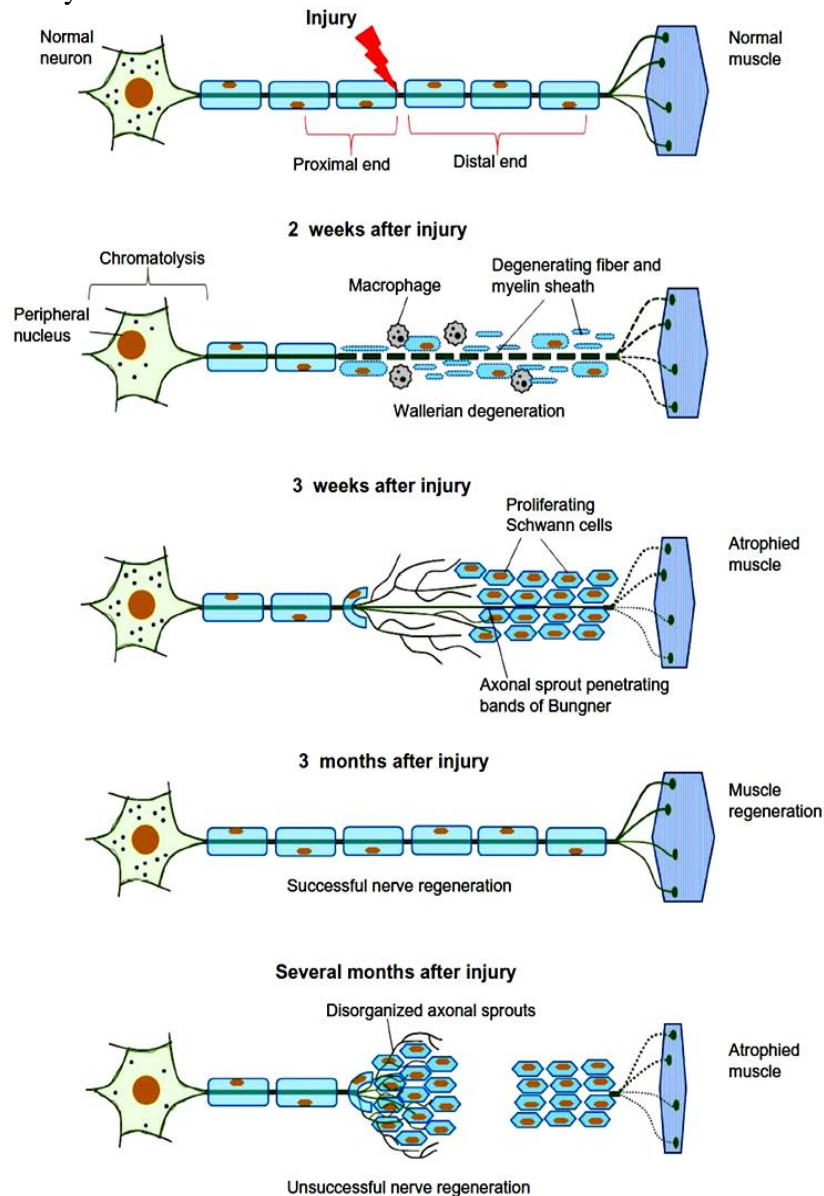
- **Axonal regeneration in PNS.**

- ✓ Role of Schwann cells:

- ❖ Differentiate and proliferate.
- ❖ Upregulate expression of neurotrophins.
- ❖ Nuerolemma form a regeneration tube which guides regeneration of the injured axon.
- ❖ Debridement which sets stage for regeneration.

- ✓ Process of axonal regeneration:

- ❖ Axon sprout grows out from proximal stump and growth cone guided through the bands of Bungner to their target by multiple signals in the microenvironment.
- ❖ Macrophages migrate through basal lamina into injury site to phagocytose myelin and axonal debris, clearing the way for axon sprout to progress distally.



- **Nerve regeneration by surgery:**

- ✓ If there is no recovery of nerve injury within 3-6 months, surgery is recommended.

- ✓ Types of surgery:

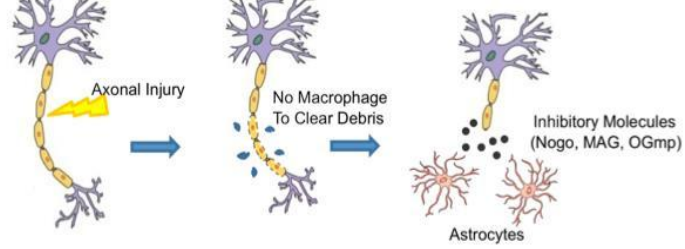
- ❖ *Nerve repair*: sewing the two ends of a nerve together.
- ❖ *Nerve graft*: for more extensive damage; a small piece of donor nerve is used to bridge the gap between the two nerve ends.



- ❖ *Nerve transfer*: if recovery is not expected for a long time; transfer of functioning nerves which are close to the target to the injured nerve.
- ❖ *Neurolysis*: removal of scars from nerve to prevent scar tissue from blocking the nerve from regeneration.

- **There is no nerve regeneration in CNS:**

CNS: No axonal regeneration



PNS: Axonal regeneration present

