# Nerve structure and function

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St6 Orthopaedics
Registrar teaching programme 27/9/10

# Nerve physiology and function

- Quiz
- Structure
- Action potential
- Function
- Nerve injury/repair
- Nerve conduction studies
- Answers & Winner (s)!!!!

1. Smallest unit of the nerve that can be surgically repaired is

- (a) endoneurium
- (b) perineurium
- (c) epineurium
- (d) axon

2. Types of nerve tissues surrounding the axons include all of the following ***except*** :

(a)Mesoneurium

(b)Perineurium

(c)Endoneurium

(d)Hyponeurium

(e)Epineurium

3. F response in Nerve Conduction studies. Choose the wrong option

(a) Are delayed waves

(b) Indicate reflex orthodromic conduction down motor nerves to muscle

(c) Useful in detecting distal nerve lesions

(d) Can be present in Gullian Barre syndrome

4. The following are true regarding nerve injuries ***except***

(a) Usually recover at 1mm/day

(b) Sharp lacerations to nerve should be explored and repaired immediately

(c) Blunt injury should be explored if no recovery at 9 months

(d) Unlikely to recover if no signs of reinnervation by 18 months post injury

5. Which among the following is favourable for a good outcome after a nerve repair ?

(a) Old age

(b) Associated bone/vessel injury

(c) Secondary repair

(d) Repair under tension

(e) Sharp injury

6. All the following can be used as a nerve graft ***except***

(a) Sural nerve

(b) Peroneal nerve

(c) Antebrachial cutaneous nerve

(d) Terminal branch of PIN

7. All the following are CNS glial cells ***except***

(a) Schwann cell

(b) Oligodendroglial cell

(c) Astrocyte

(d) Microcyte

8. Wallerian degeneration ***does not*** occur in

(a) Neurotmesis

(b) Neuropraxia

(c) Axonotmesis

(d) All the above

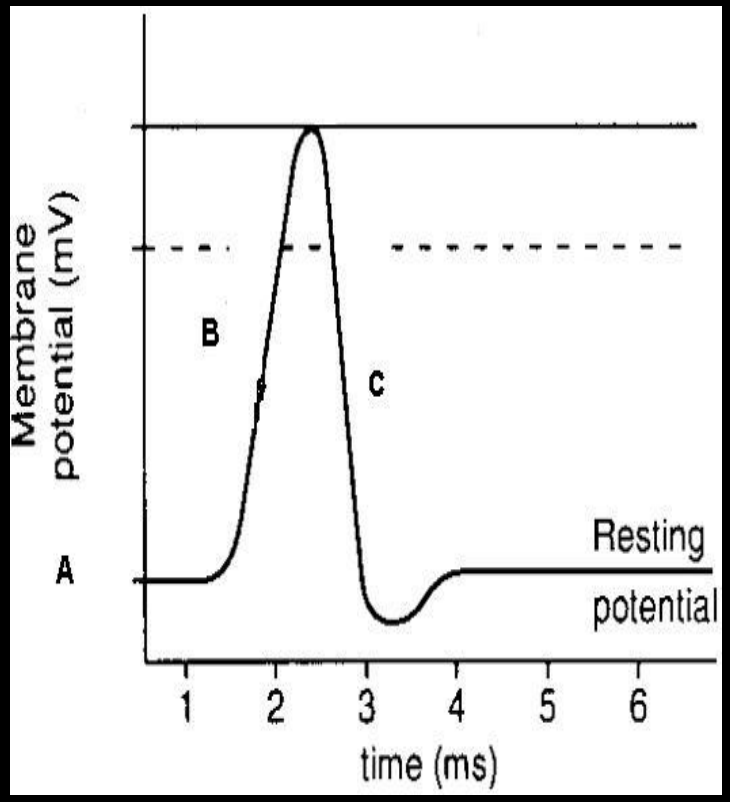
(e) None of the above

9.

(a) What is the value of A

(b) Name the phases of the nerve action potential B,C

(c) What is the main ionic change happening in B,C



10. The type of peripheral nerve injury that requires acute repair is:

(a) No peripheral nerve injury should be acutely repaired.

(b) A sharp transection

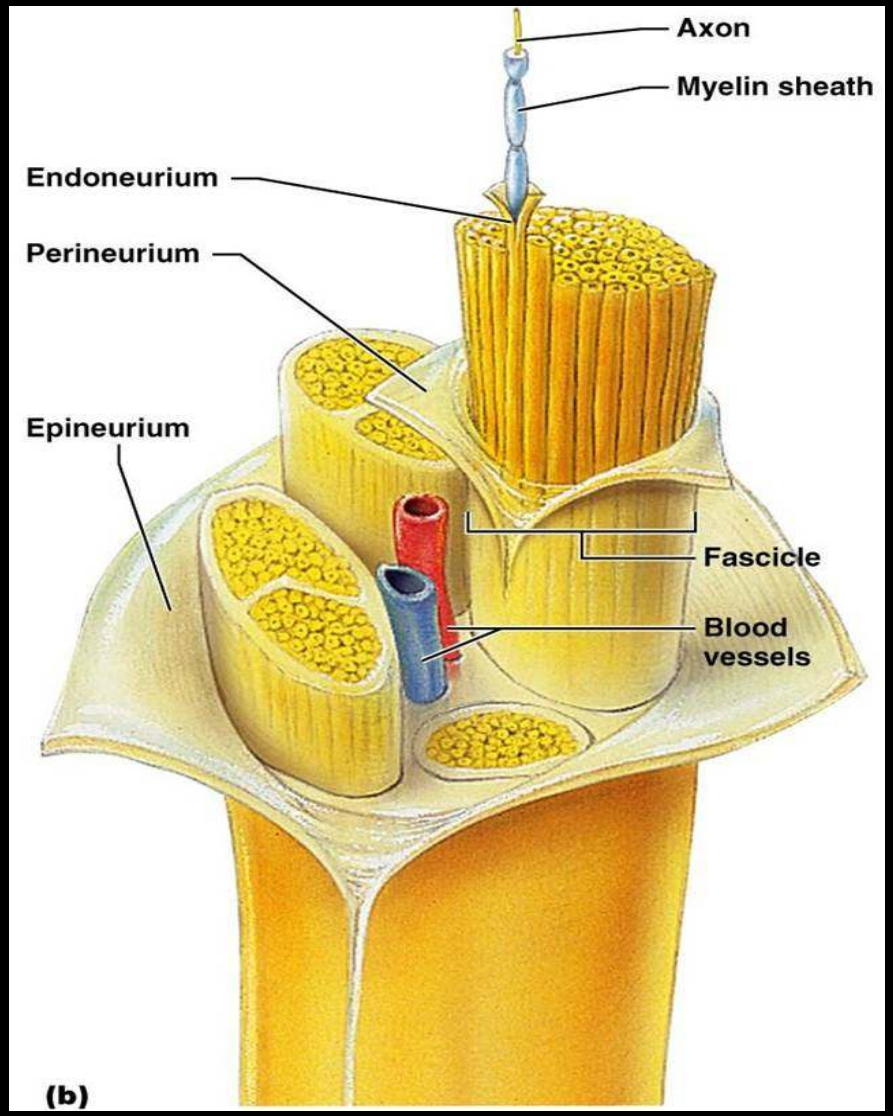
(c) A stretch injury

(d) A blunt transection

(e) A contusion injury

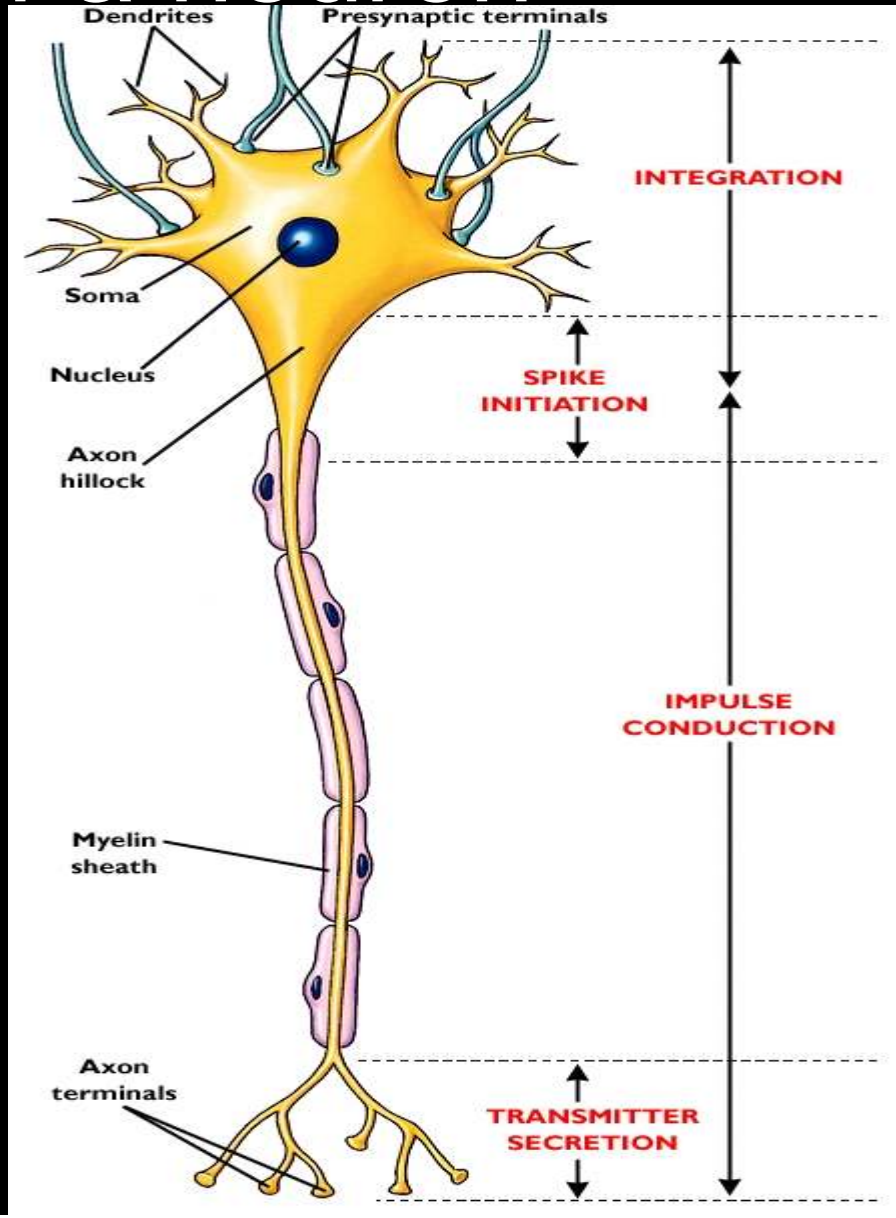
# Structure

- Endoneurium-covers nerve fibre
- Perineurium ( forms fascicles)-group of nerve fibres
- Epineurium-group of fascicles
- Paraneurium-outside epineurium



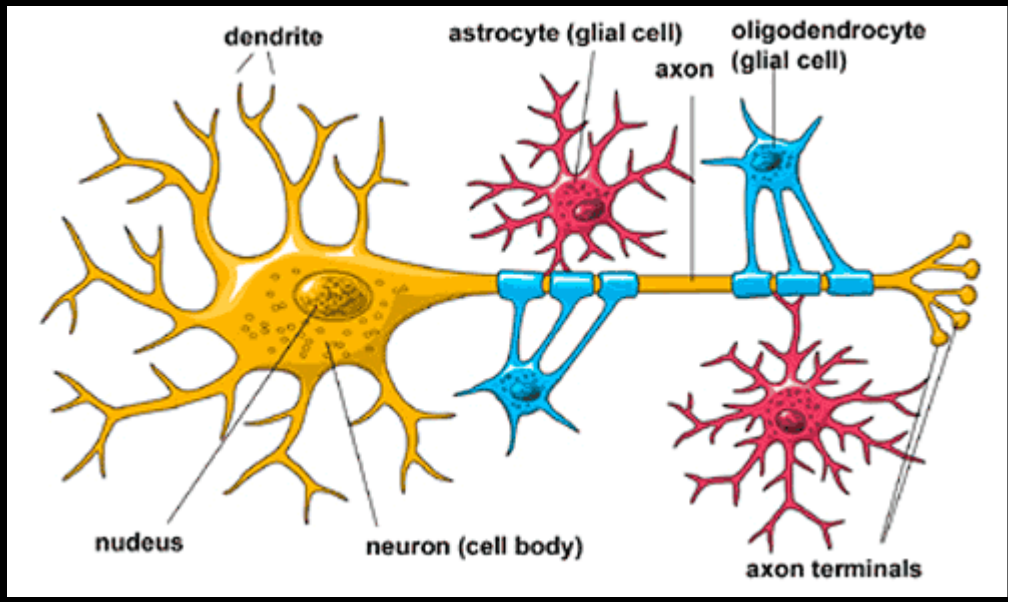
# Structure of a neuron

- Cell body-nucleus, cytoplasmic contents
- Axon- responsible for transportation of materials
- Dendrites- form synapse with axons from other cells- commonly chemical



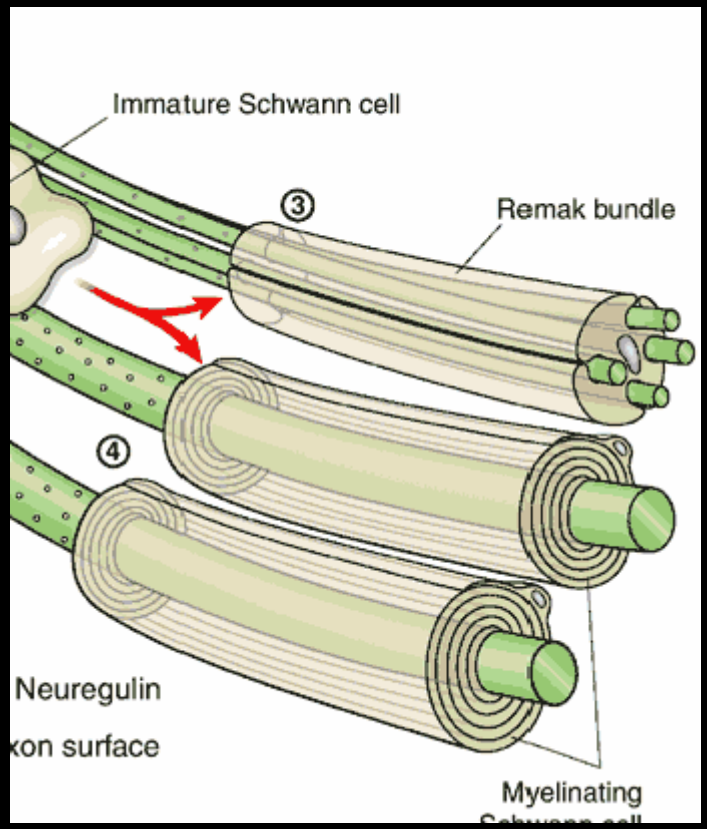
# Structure

- CNS glial cells
  - Oligodendrocytes ( resp for myelination), Astrocytes
  - Microglia
- PNS glial cell
  - Schwann cells



# Structure

- Schwann cell myelinates the PNS
- Nodes of Ranvier are gaps between adjacent Schwann cells on the nerve fibre
- Responsible for Saltatory conduction



# Nerve diameter and function

- A -myelinated. Large diameter.

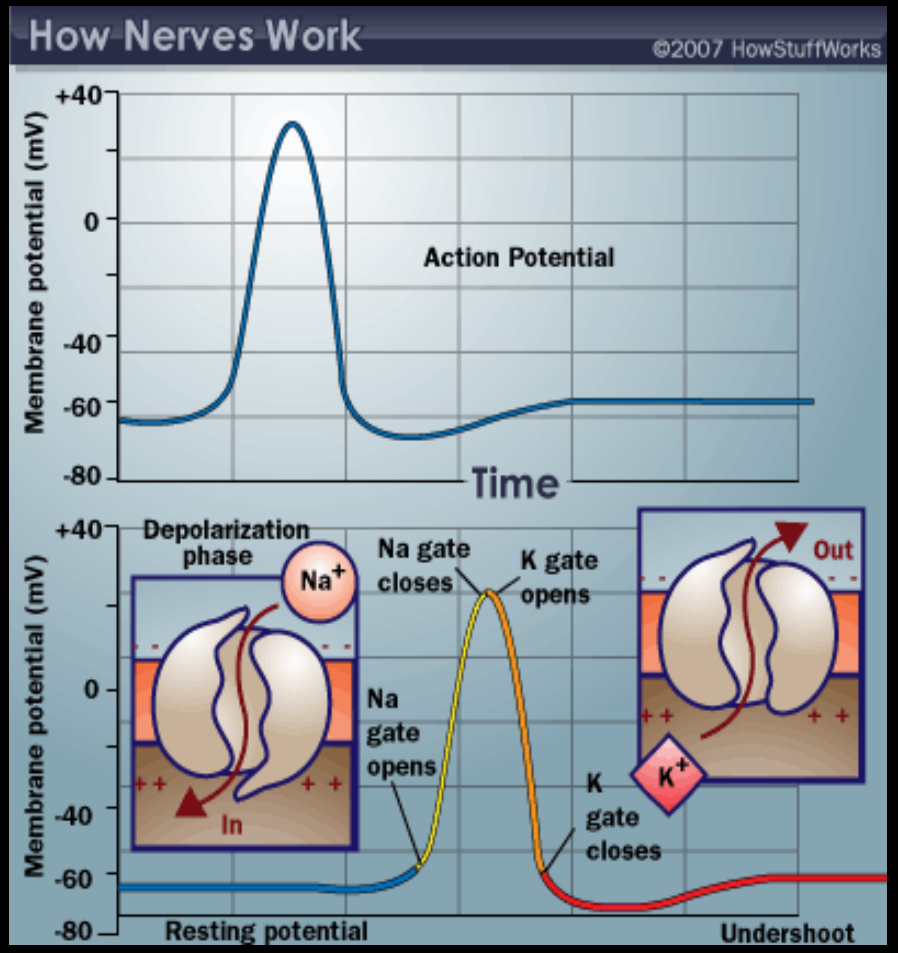
  Responsible for skl muscle, sensory like pain, touch etc.
- B -myelinated. Smaller diameter.

  Preganglionic autonomic
- C -unmyelinated. Smallest diameter.

  Post ganglionic autonomic, thermoceptors

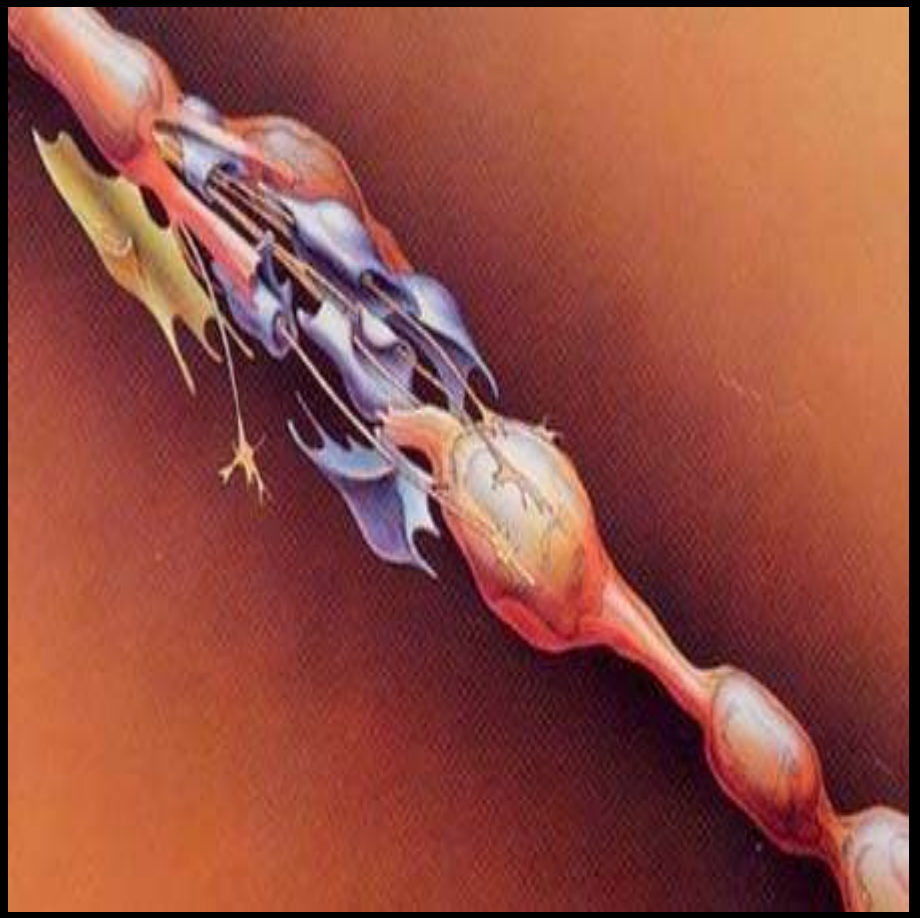
# Action potential

- RMP is negative
- Na- Extracellular
- K- intracellular
- Na/K exchange pump maintains RMP
- Changes happen on threshold stimulus( all/none phenomenon)
- Refractory period



# Wallerian degeneration

- Following axonotmesis or neuronotmesis
- PNS able to regenerate unlike CNS
- Axon atrophies proximally, chromatolysis occurs in cell body with nucleus migrating to periphery
- Distal to injury, myelin sheath degenerates,neural tube collapses and replaced by macrophages/glial cells.
- Cell produces neurotrophic factors and regeneration occurs at 1mm/day
- Presence of Tinels sign

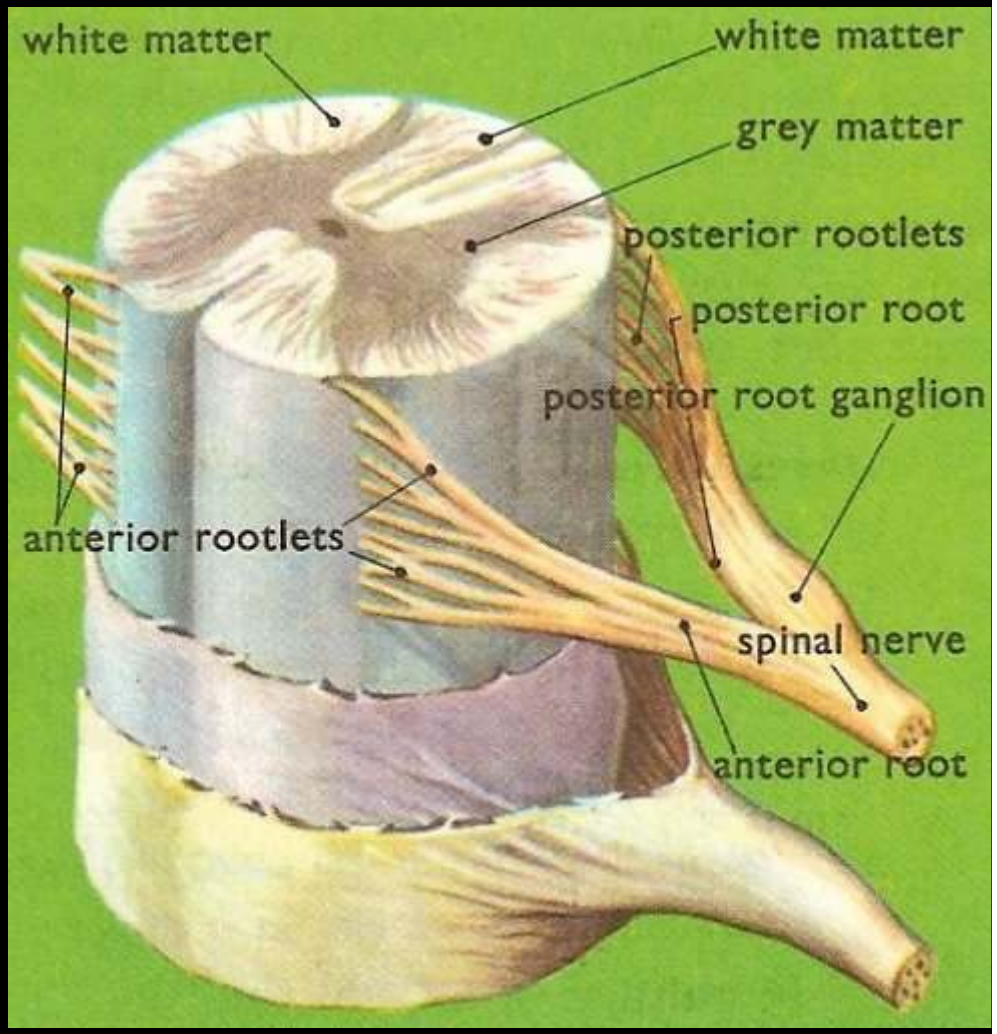


# Function

- CNS- Brain, Spinal cord
- ANS- Sympathetic and Parasympathetic
- PNS- 12 cranial nerves,
  31 pairs of spinal nerves

# PNS

- Dorsal root ganglion- contains the cell body of sensory root
- Motor nerve's cell body in the anterior horn



# ANS

| | Parasympathetic | Sympathetic |
|---|---|---|
| Function | Conserves energy | Fight/flight response |
| Location of preganglionic nerve fibres | Brainstem and sacral regions | Thoracolumbar region |
| Ganglia | Close to target organ | Paraspinal region |
| Axons | Pre-long, post-short | Pre-short, post-long |
| Rami | None | White rami T1-L2, gray rami to all spinal nerves |

# Spinal Cord Crossection: Detailed Anantomy

1. Fasciculus gracilis
1a. Fasciculus cuneatus
} Dorsal columns

2. Dorsolateral fasciculus or tract of Lissauer

3. Posterior or dorsal spinocerebellar tract

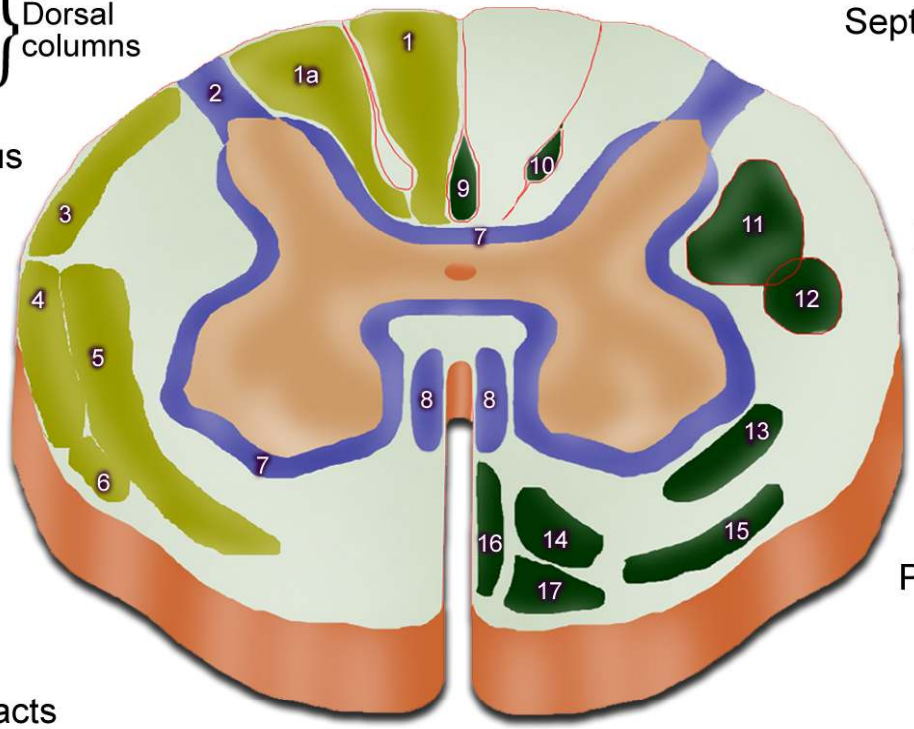
4. Anterior or ventral spinocerebellar tract

5. Spinothalamic, spinoreticular, spinomesencephalic (spinotectal), and spinohypothalamic tracts

6. Spinoolivary tract

7. Fasciculi proprii

8. Medial longtudinal or sulcomarginal fasciculi




Ascending tracts
Decending tracts
Bidirectional tracts

9. Septomarginal fasciculus

10. Interfascicular or semilunar fasciculus

11. Lateral corticospinal or pyramidal

12. Rubrospinal tract

13. Medullary or lateral reticulospinal tract

14. Pontoreticulospinal or medial reticulospinal tract

15. Vestibulospinal tract

16. Anterior or ventral corticospinal tract

17. Tectospinal tract

# Applied neurology

-Differences between UMN and LMN
-Brown Sequard syndrome
-Lambert Eaton syndrome
-Myasthenia Gravis
-Tinel’s sign

# Nerve injury and repair

- Aetiology- Physical, inflammation, infection, ischaemia, tumour, Iatrogenic
- Injury- Classified by Seddon, Sunderland
- Neuropraxia- no structural damage
- Axonotmesis- spontaneous regeneration possible. 1mm/day
- Neurotmesis-forms neuroma

# Nerve repair -Patient factors

- Type of injury- Blunt/Sharp.

  -Blunt generally immediate repair ***not*** done due to poor bed. Also gives the oppurtunity to assess the extent of injury with time
- Delay- Sharp- immediate repair, Blunt-if no recovery by 3 months, explore.

  -Delay of more than 6/12 carries poor prognosis.

  -No evidence of reinnervation by 18 months is bad
- Age- younger the better
- Gap between ends
- Level- proximal is bad
- Associated injuries to vessels/bone

# Nerve repair-surgeon factors

- Set up
- Experience
- Technique
- Good exposure
- Proper alignment
- Opposition without tension

# Nerve graft

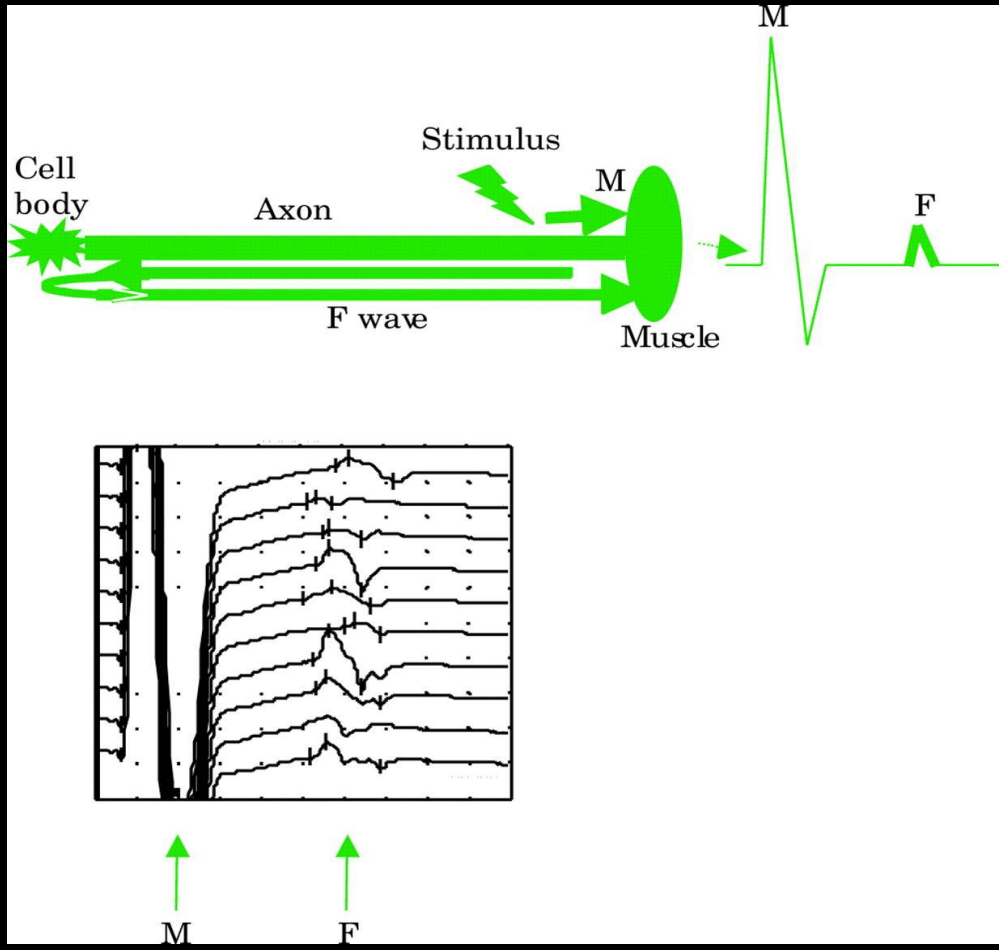
- Used when defect in nerve and unable to repair without tension
- Should try simple measure like release from scar tissue, transposition, bone shortening, flexion of joint, etc
- Common nerves used are Sural, Medial cutaneous nerve of forearm, terminal branch of posterior interosseous nerve
- Common technique used is epineural repair, fascicular repair

# Nerve conduction studies

- Act as supplement to accurate clinical examination
- Valuable test in detecting site of lesion in peripheral nerve/lower motor neuron
- Use NCV, EMG
- Amplitude assesses the quantity of axons while velocity and latency assess the quality of conduction
- MUAP (orthodromic), SNAP ( antidromic), CNAP ( both sensory and motor)

# F waves

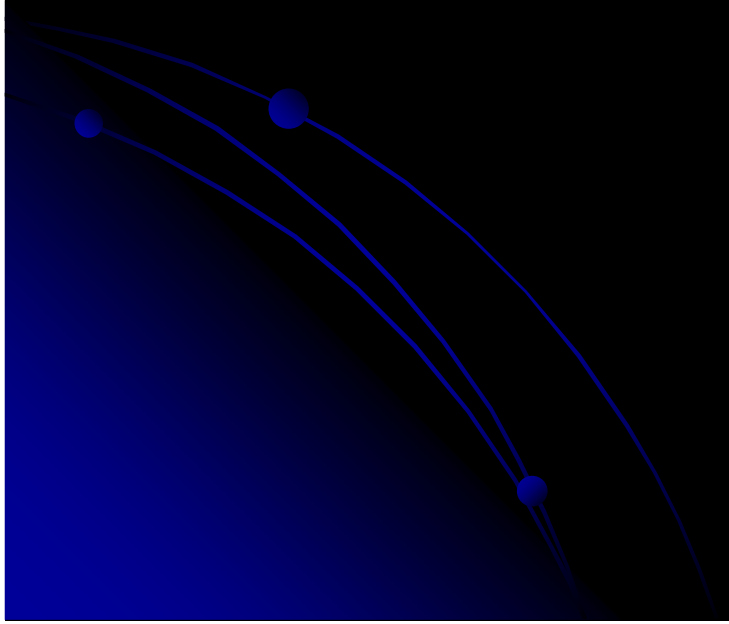
- Measure antidromic conduction of impulse
- From peripheral nerve to anterior horn cells
- Used to detect early proximal lesions affecting multiple roots Ex Gullian Barrie syndrome



# SSEP

- Mainly for spinal cord monitoring esp during scoliosis surgery
- Stimulation of mixed nerve
- Resultant evoked potential recorded centrally

# Questions???



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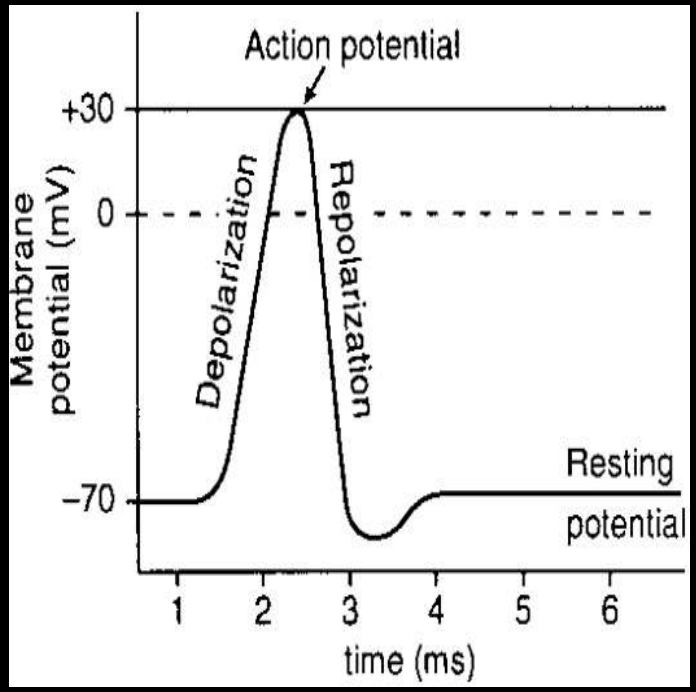

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