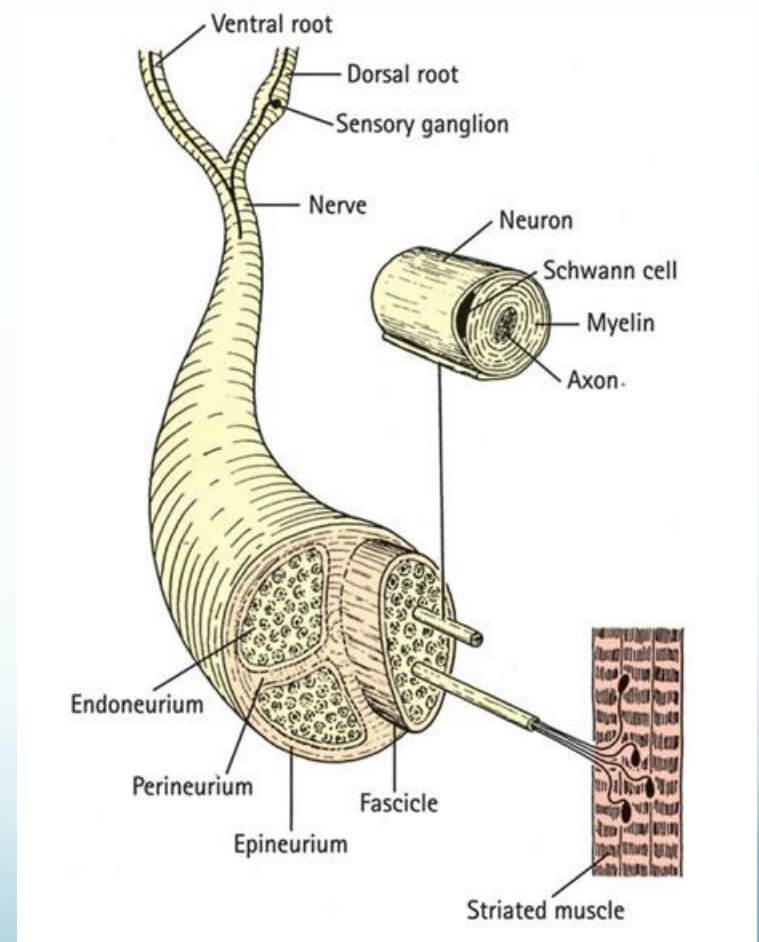


# Peripheral Nerve Injuries

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Consultant Orthopedic and Arthroplasty Surgeon

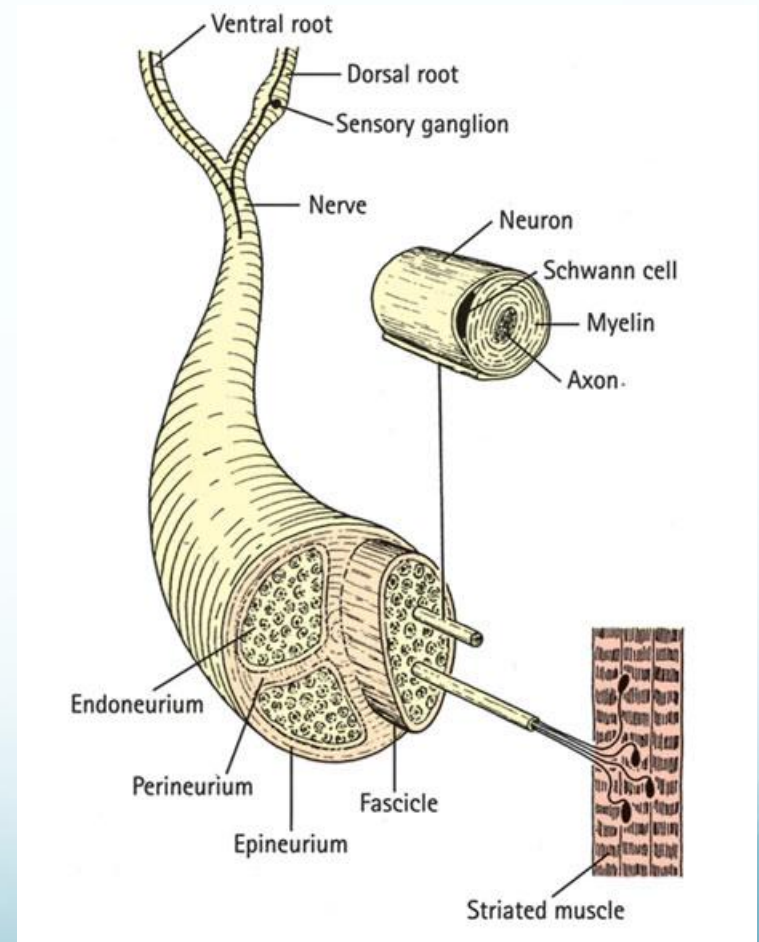
# NERVE STRUCTURE AND FUNCTION

- All motor axons and the large sensory axons serving touch, pain and proprioception are coated with **myelin**
- Lipoprotein derived from the accompanying Schwann cells.



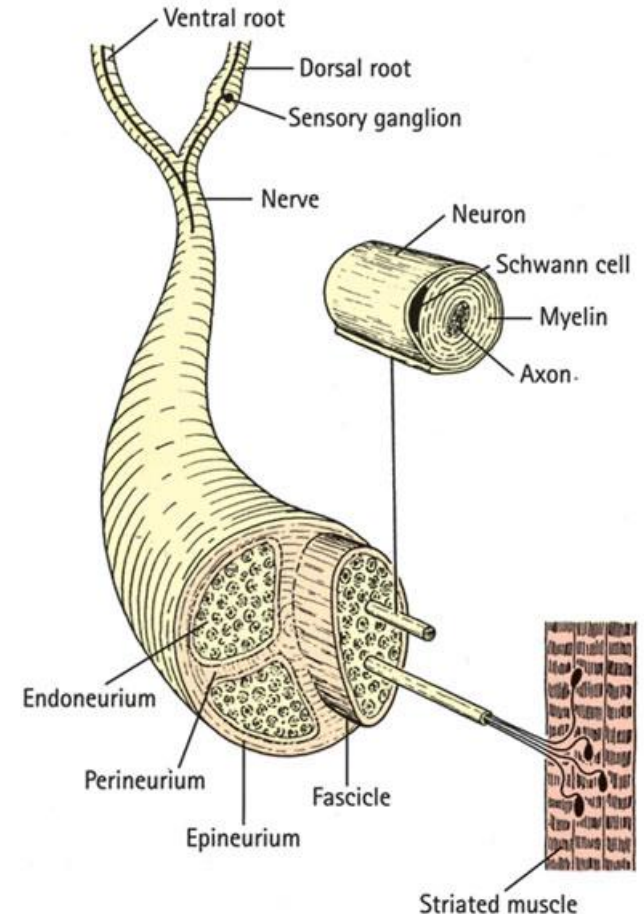
# NERVE STRUCTURE AND FUNCTION

- Outside the Schwann cell membrane the axon is covered by a connective tissue stocking, the **endoneurium**.
- The axons that make up a nerve are separated into bundles (fascicles) by fairly dense membranous tissue, the **perineurium**.



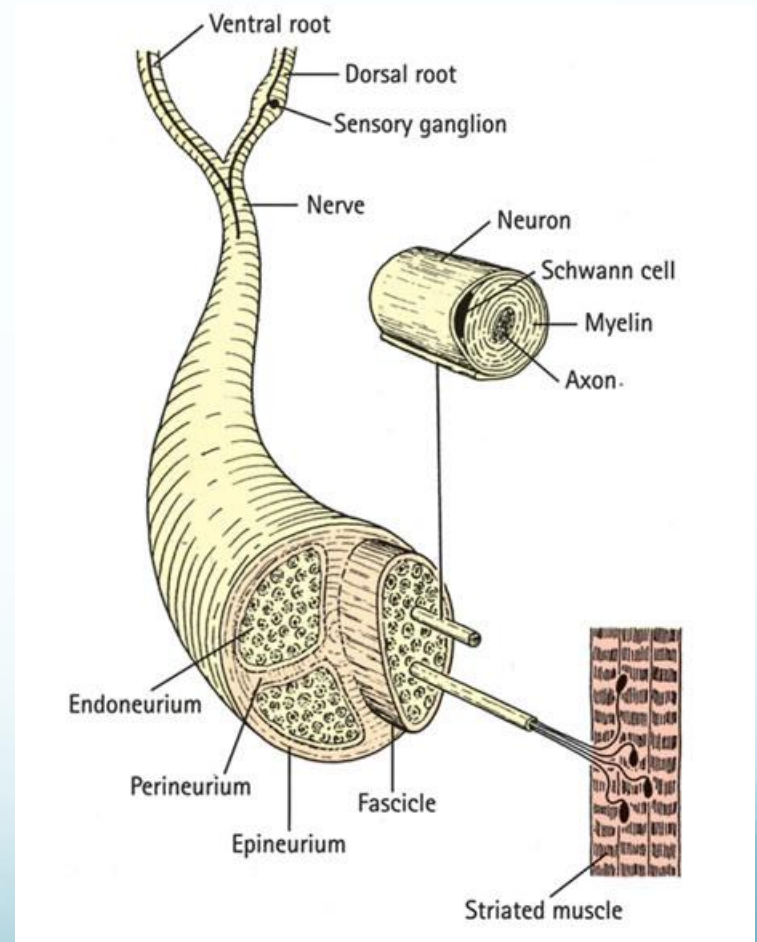
# NERVE STRUCTURE AND FUNCTION

- In a transected nerve, these fascicles are seen, their perineurial sheaths well defined and strong enough to be grasped by fine instruments during nerve repair.
- The groups of fascicles that make up a nerve trunk are enclosed in an even thicker connective tissue coat, the **epineurium**.



# NERVE STRUCTURE AND FUNCTION

- The epineurium varies in thickness and is particularly strong where the nerve is subjected to movement and traction, for example near a joint.
- Richly supplied by blood vessels that run longitudinally in the epineurium.



# PATHOLOGY

- Nerves can be injured by ischaemia, compression, traction, laceration or burning.
- Damage varies in severity from transient and recoverable loss of function to complete interruption.

# Transient ischaemia

- **Acute nerve compression**
- numbness and tingling within 15 minutes
- loss of pain sensibility after 30 minutes
- muscle weakness after 45 minutes.
- Relief of compression is followed by intense paraesthesiae for 5 minutes ( 'pins and needles' after a limb 'goes to sleep'); feeling is restored within 30 seconds and full muscle power after about 10 minutes.
- Due to transient endoneurial anoxia and no nerve damage.

# Neurapraxia

- Seddon (1942).
- Reversible physiological nerve conduction block (loss of sensation and muscle power) followed by spontaneous recovery after a few days or weeks.
- Due to mechanical pressure causing segmental demyelination
- Crutch palsy, Saturday night palsy, Tourniquet palsy.

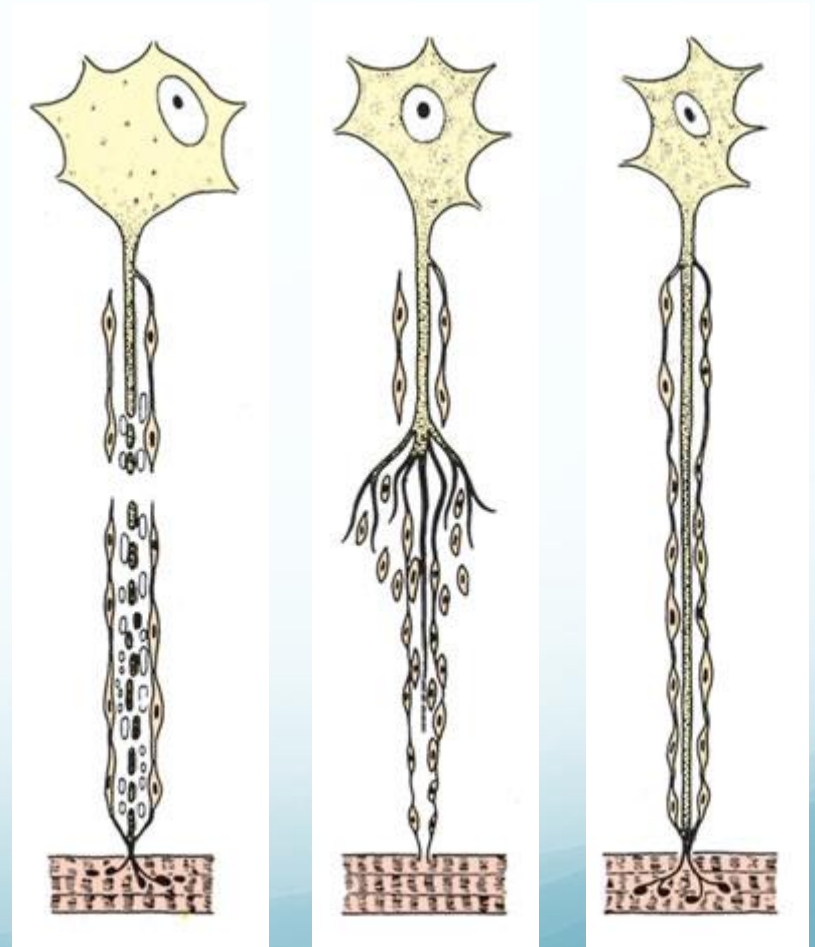


# Axonotmesis

- More severe form of nerve injury
- Closed fractures and dislocations.
- Literally means axonal interruption.
- Loss of conduction but the nerve is in continuity and the neural tubes are intact.

# Axonotmesis

- Wallerian degeneration distal to the lesion.
- Axonal regeneration starts within hours of nerve at a speed of 1–2 mm per day.
- Eventually, they join to end-organs (motor end-plates and sensory receptors).
- Function is regained again.



# Neurotmesis

- Seddon; division of the nerve trunk as in open fracture.
- If the injury is more severe, whether the nerve is in continuity or not, recovery will not occur.
- Rapid wallerian degeneration.
- The endoneurial tubes are destroyed
- Regenerating axons does not reach the distal segment
- Neuroma formation at the site of injury(regenerating axons, schwann cells and fibroblasts)
- Function is never normal.

# CLASSIFICATION OF NERVE INJURIES

- Sunderland (1978); a more practical classification
- **First degree injury**: transient ischaemia and neurapraxia, reversible.
- **Second degree injury**: axonotmesis; axonal degeneration but, because the **endoneurium** is preserved, regeneration can lead to complete, or near complete, recovery without the need for intervention.

# CLASSIFICATION OF NERVE INJURIES

- **Third degree injury:** worse than axonotmesis.
- The endoneurium is disrupted but the **perineurium** is intact.
- Chances of the regenerating axons to reach their targets are good
- Fibrosis and crossed connections will limit recovery.

# CLASSIFICATION OF NERVE INJURIES

- **Fourth degree injury:** Only the **epineurium** is intact.
- The nerve trunk is still in continuity but internal damage is severe.
- Recovery is unlikely.
- The injured segment should be excised and the nerve repaired or grafted.
- **Fifth degree injury:** The nerve is divided and will have to be repaired.

# CLINICAL FEATURES

- Acute nerve injuries are easily missed, especially if associated with fractures or dislocations.
- Ask for numbness, paraesthesia or muscle weakness in the related area.
- Examine for signs of abnormal posture, weakness and changes in sensibility.

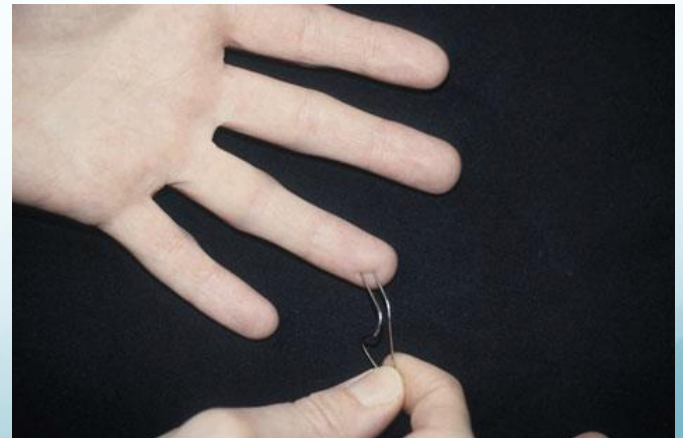
# Assessment of nerve recovery

- Motor recovery is slower than sensory recovery.
- Clinical tests of muscle power and sensitivity to light touch and pin-prick.
- low energy Vs high energy



# Assessment of nerve recovery

- Tinel's sign – peripheral tingling or dysaesthesia upon percussing the nerve.
- In a neurapraxia, Tinel's sign is negative.
- In axonotmesis, it is positive and advance with the regenerating axons
- Two-point discrimination: measure of innervation density.

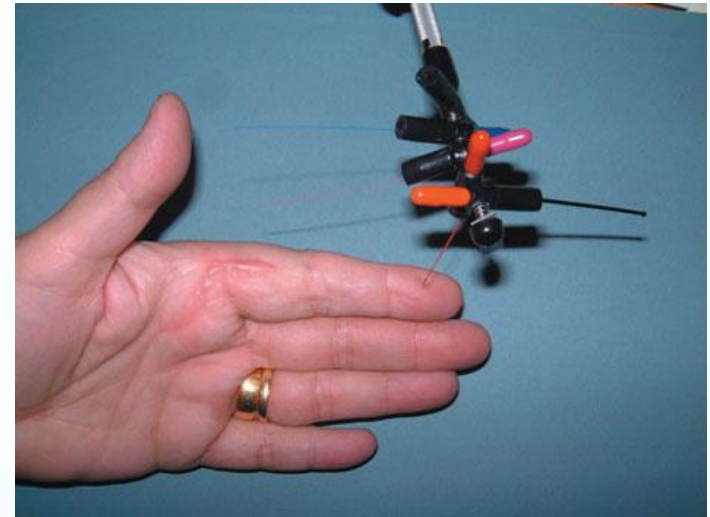


# Assessment of nerve recovery

- **Monofilament assessment**

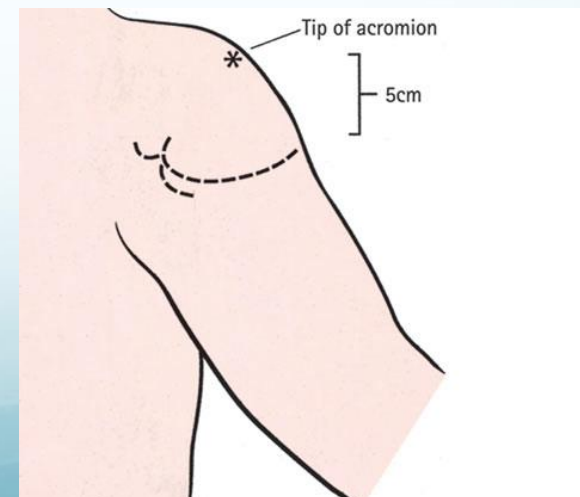
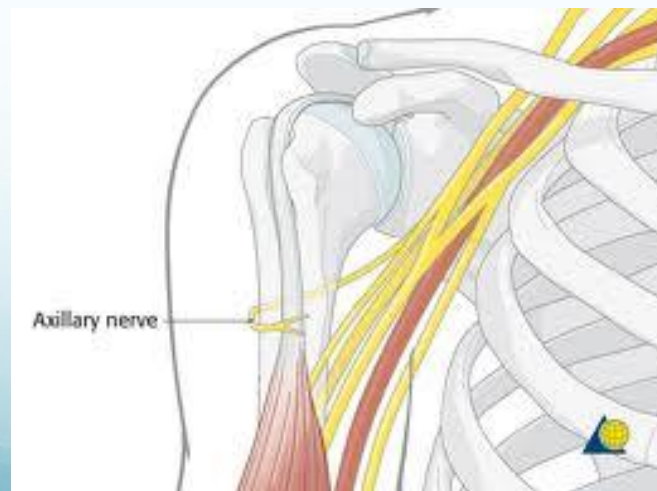
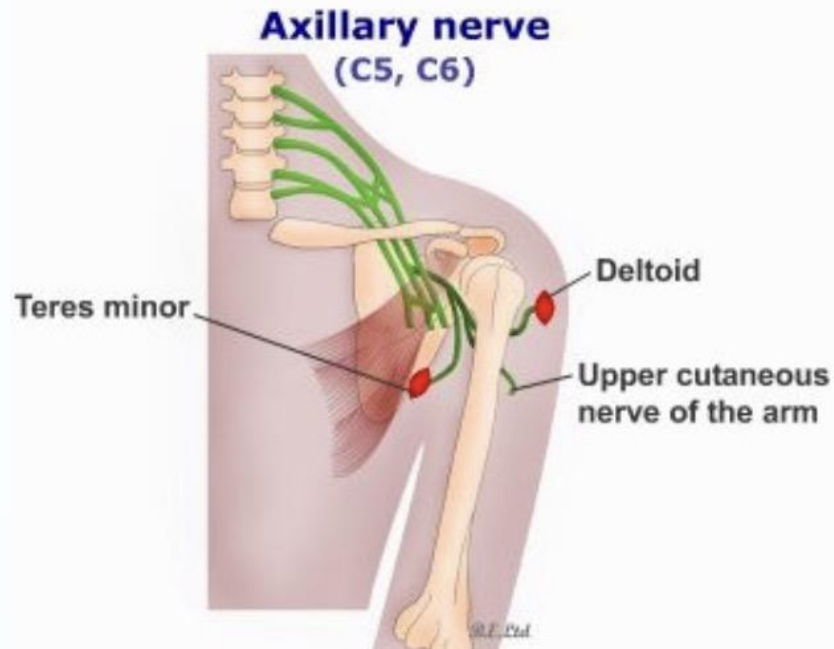
## **Electromyography (EMG) and Nerve Conduction Studies (NCS):**

- Denervation potentials by the third week.
- Excludes neurapraxia
- Does not distinguish between axonotmesis and neurotmesis



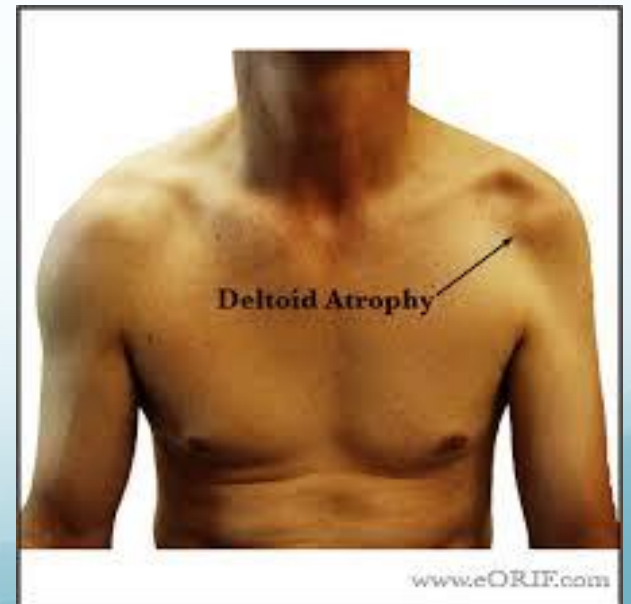
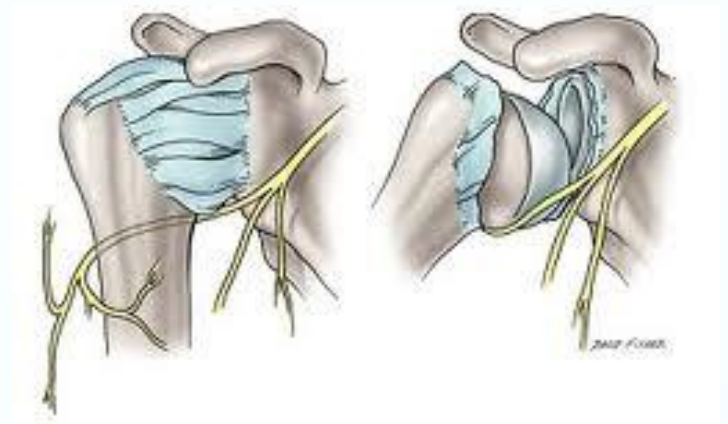
# AXILLARY NERVE

- The axillary nerve (C5, 6); posterior cord of the brachial plexus.
- Teres minor, deltoid and a patch of skin over the muscle.
- Anterior branch that curls round the surgical neck of the humerus at 5 cm below the tip of the acromion.



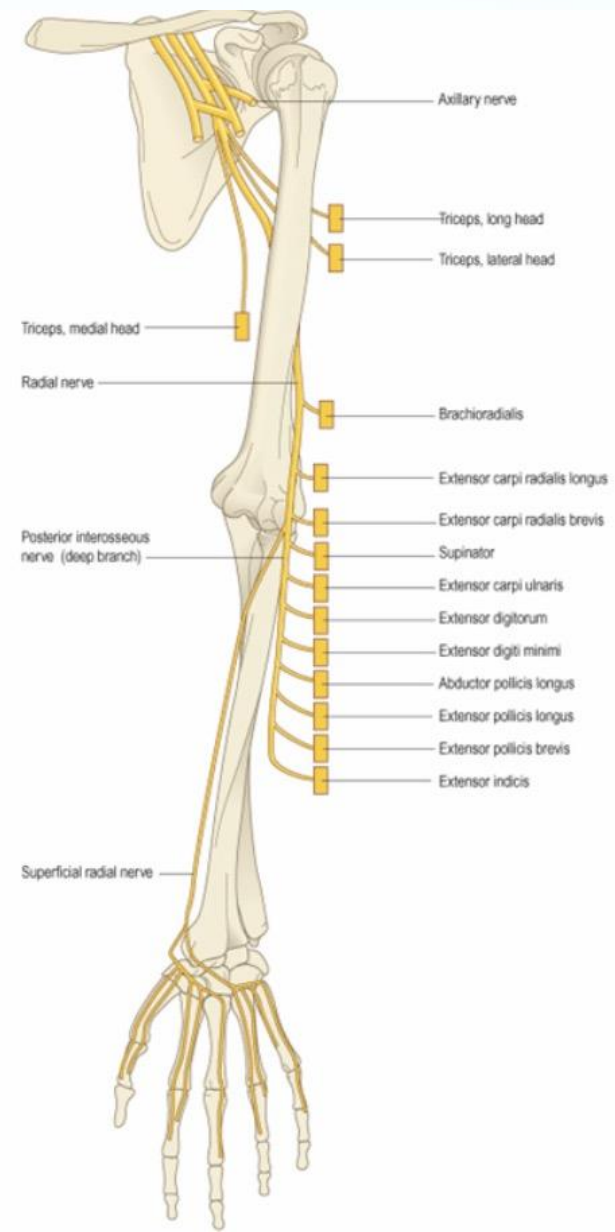
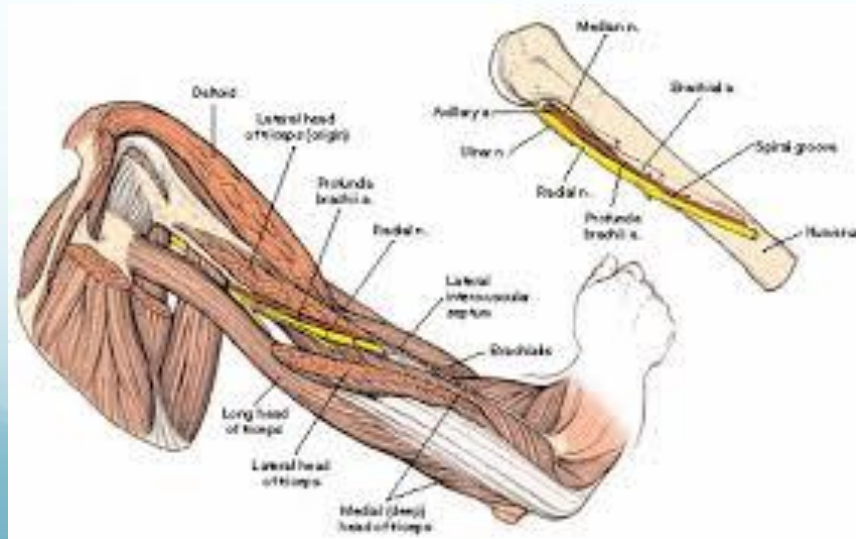
# AXILLARY NERVE

- Shoulder dislocation or fractures the humeral neck.
- Lateral deltoid-splitting incisions
- Shoulder 'weakness', and the deltoid is wasted. numbness over the deltoid
- Recovers spontaneously; 80%



# RADIAL NERVE

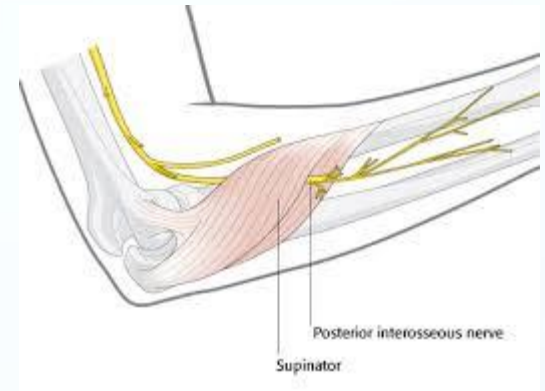
- **Low lesions;** elbow or upper arm
- **High lesions;** humerus
- **Very High lesions:** axilla or shoulder



# Clinical Features

## Low lesions

- Fractures or dislocations at the elbow
- Iatrogenic lesions of the posterior interosseous nerve where it winds through the supinator muscle
- Cannot extend the MCP joints of the hand with weakness of thumb extension
- Wrist extension is preserved because the branch to the extensor carpi radialis longus arises proximal to the elbow.



# Clinical Features

## High lesions

- Fractures of the humerus or after prolonged tourniquet pressure
- Wrist drop, inability to extend the MCP joints or elevate the thumb and sensory loss at the first web space.



# Clinical Features

## Very high lesions

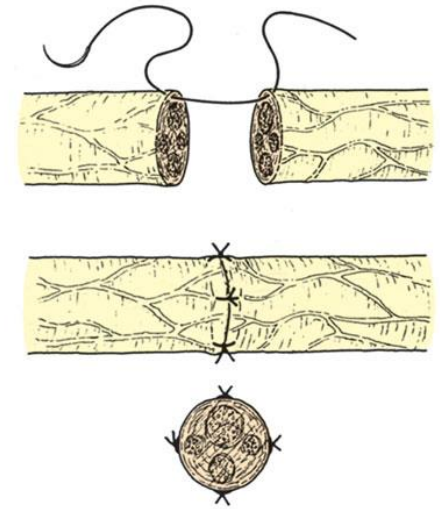
- Trauma or operations around the shoulder
- More often, chronic compression in the axilla; ('Saturday night palsy') or ('crutch palsy').
- In addition to weakness of the wrist and hand, the triceps is paralysed and the triceps reflex is absent.





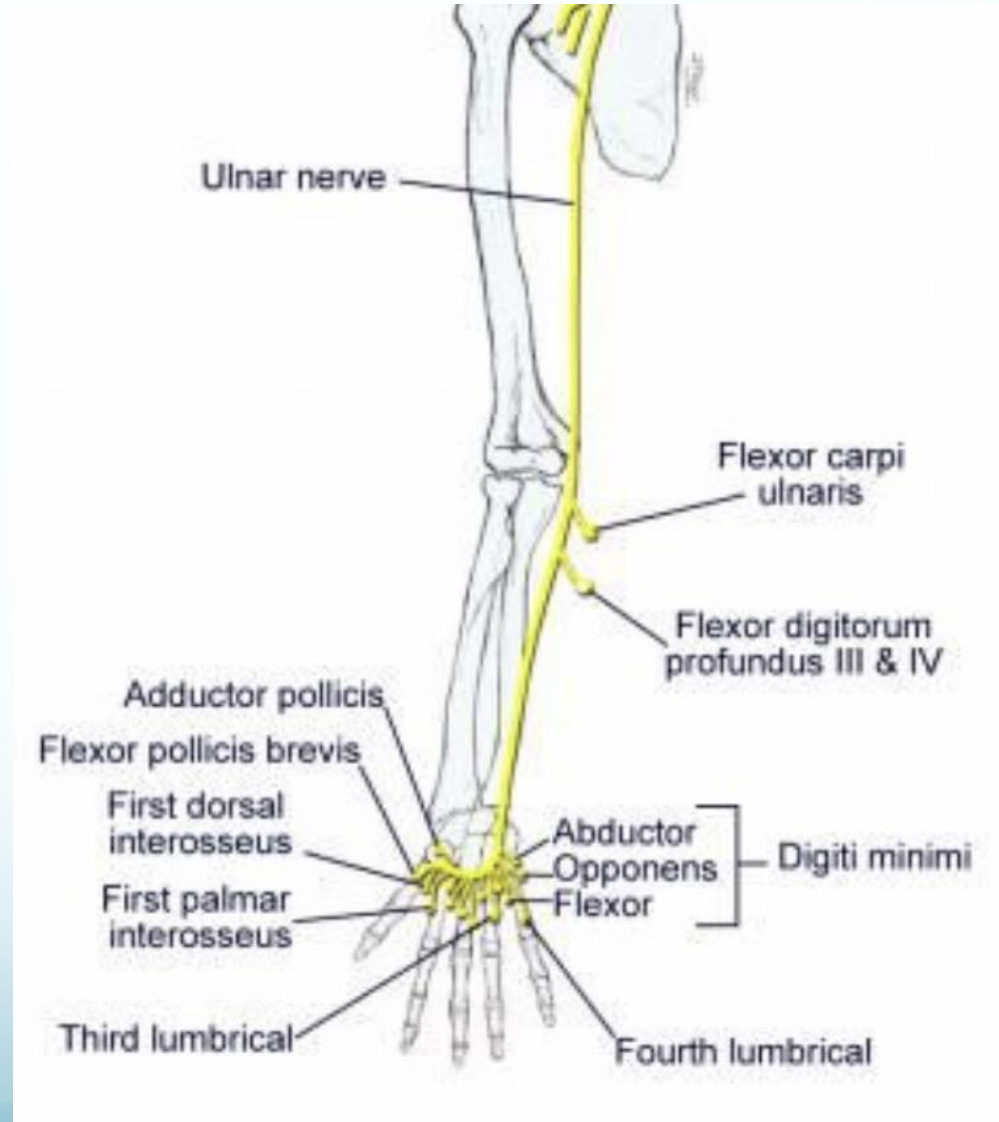
# Treatment

- Open injuries; nerve explored and repaired or grafted as soon as possible.
- Closed injuries; usually recovers.
- Splinting
- If no recovery; Tendon transfers



# ULNAR NERVE

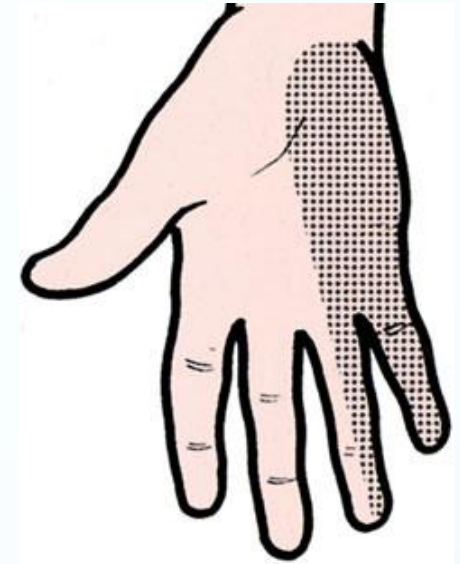
- Injuries are near the wrist (Low lesions)
- or near the elbow (High lesions).



# ULNAR NERVE

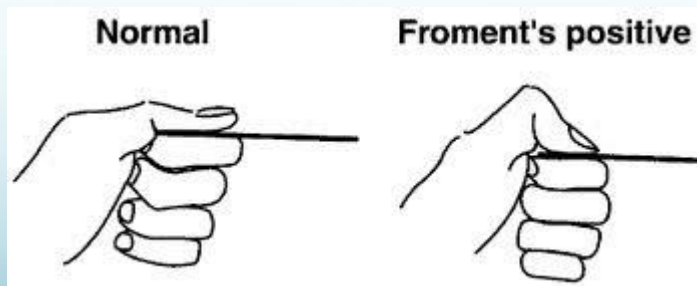
**Low lesions;** cuts on shattered glass.

- Numbness of the ulnar one and a half fingers
- Claw hand deformity; with hyperextension of the MCP joints of the ring and little fingers due to weakness of the intrinsic muscles.



# ULNAR NERVE

- Weak finger abduction is weak and thumb adduction, makes pinch difficult.
- Hypothenar and interosseous wasting
- Flexor pollicis longus compensate for loss of Thumb adductor pollicis (Froment's sign).



# ULNAR NERVE

**High lesions;** elbow fractures or dislocations.

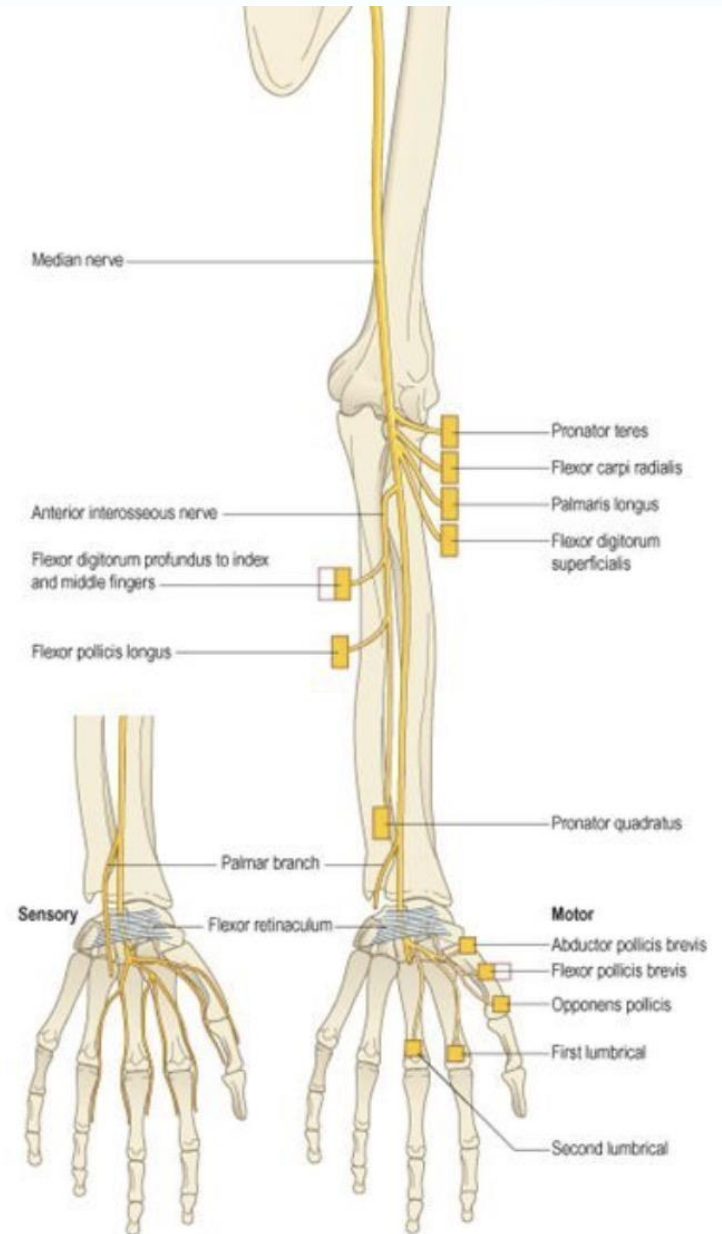
- Hand: not markedly deformed because the ulnar half of FDP is paralysed and the fingers are therefore less 'clawed' ('high ulnar paradox')
- Ulnar neuritis; compression or entrapment of the nerve in the medial epicondylar (cubital) tunnel.

severe valgus deformity of the elbow or prolonged pressure on the elbows in anaesthetized or bed-ridden patients.



# MEDIAN NERVE

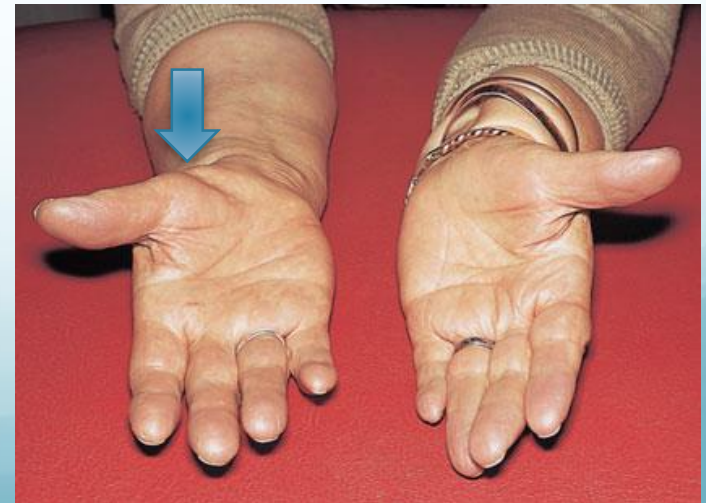
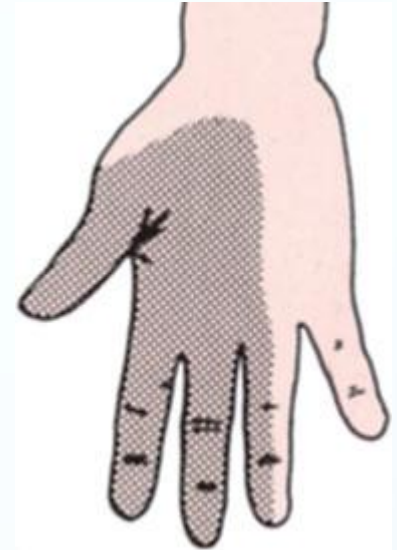
- Most commonly injured near the wrist (Low lesion)
- or high up in the forearm (High lesions)



# MEDIAN NERVE

**Low lesions;** cuts in front of the wrist or by carpal dislocations.

- Unable to abduct the thumb
- sensation is lost over the radial three and a half digits.
- Thenar eminence is wasted and trophic changes



# MEDIAN NERVE

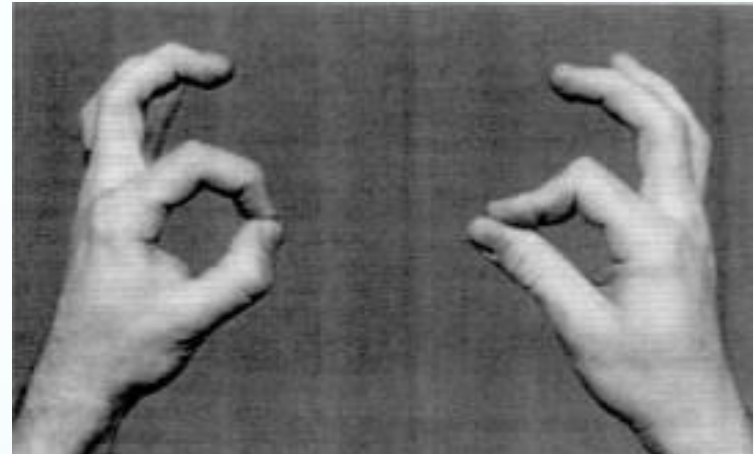
- **High lesions;** forearm fractures or elbow dislocation
- Same as low lesions but, in addition, the long flexors to the thumb, index and middle fingers, the radial wrist flexors and the forearm pronator muscles are all paralysed.
- Typically the hand is held with the ulnar fingers flexed and the index straight (the 'pointing sign').





# MEDIAN NERVE

- Thumb and index flexors are deficient, there is a characteristic pinch defect with the distal joints in full extension.

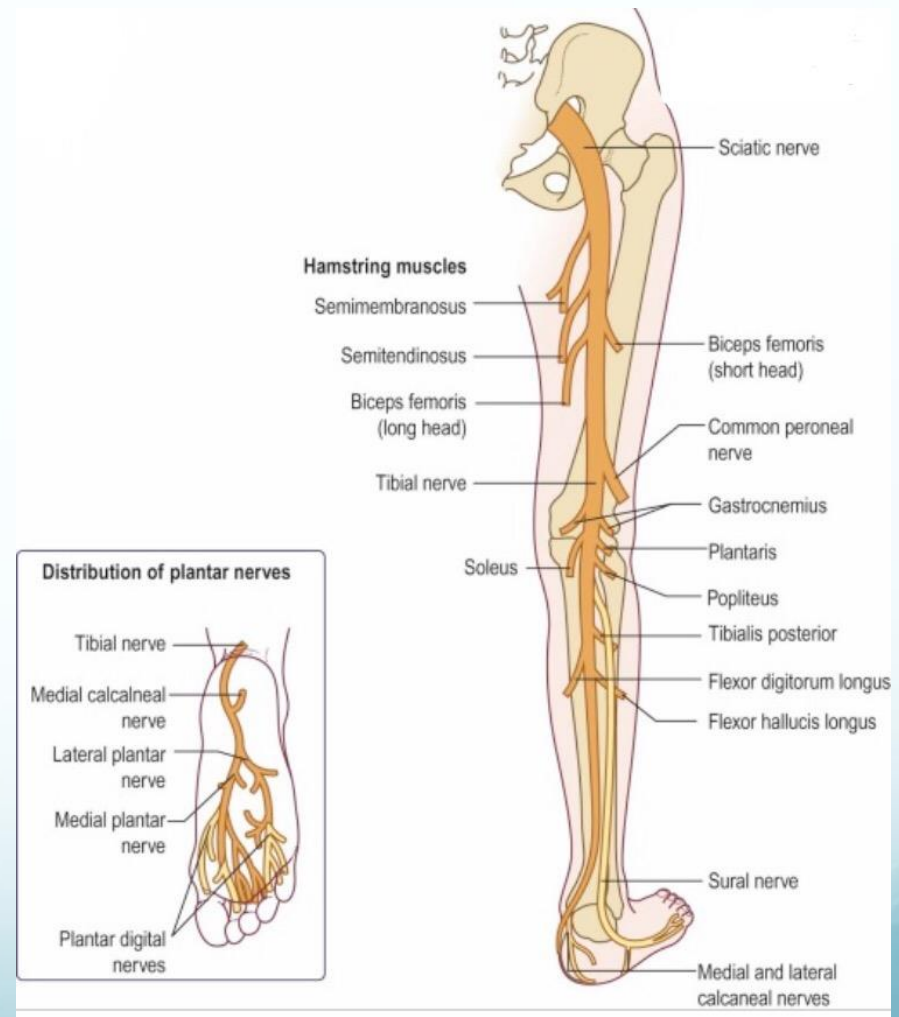


**Isolated anterior interosseous nerve lesions;** extremely rare.

- Similar to those of a high lesion but without any sensory loss.

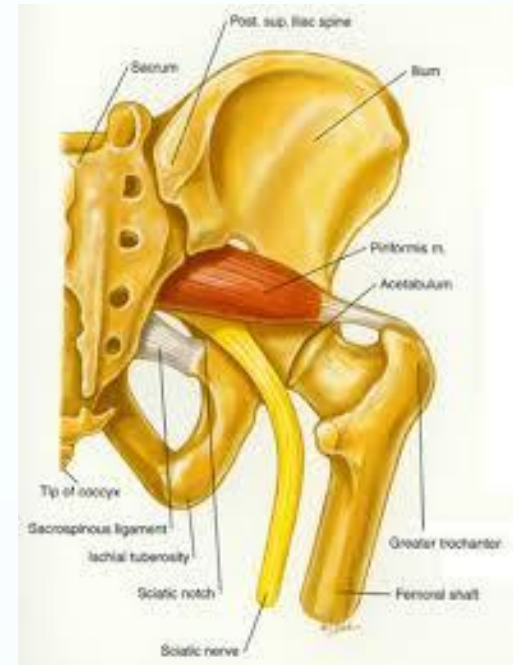
# SCIATIC NERVE

- Division of the main sciatic nerve is rare.
- Traction lesions; traumatic hip dislocations and with pelvic fractures.



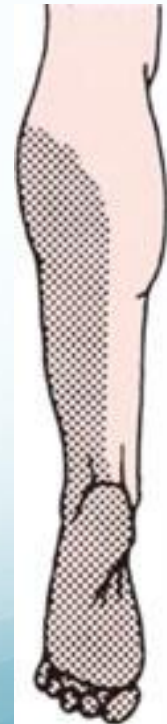
# SCIATIC NERVE

- Iatrogenic lesions; total hip replacement.
- **complete lesion**; hamstrings and all muscles below the knee are paralysed; the ankle jerk is absent.



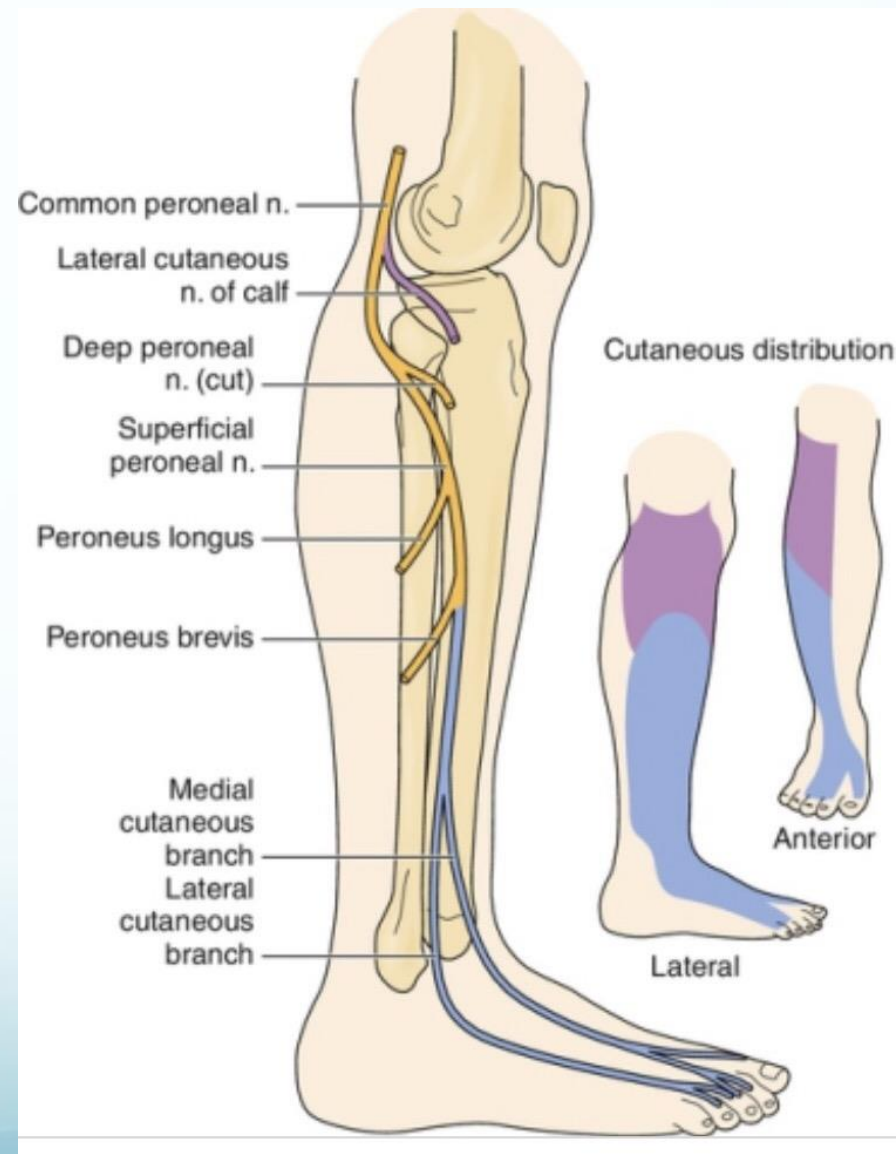
# Clinical features

- Sensation is lost below the knee, except on the medial side of the leg
- Foot-drop and a high-stepping gait
- Sometimes **only the deep part of the nerve** is affected (common peroneal nerve lesion); after hip replacement



# PERONEAL NERVES

- Common peroneal nerve or one of its branches



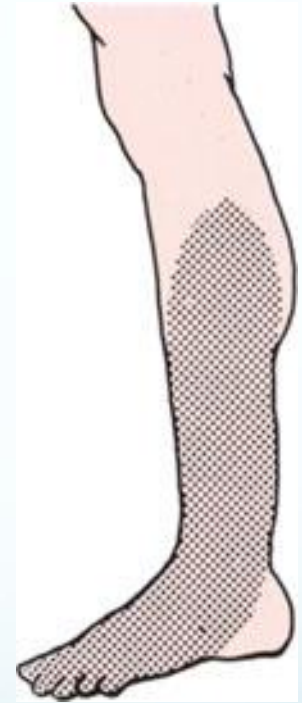
# PERONEAL NERVES

- Often damaged at the level of the fibular neck
- Severe traction when the knee is forced into varus (e.g. in lateral ligament injuries)
- fractures around the knee
- During operative correction of gross valgus deformities),
- Pressure from a splint or a plaster cast, from lying with the leg externally rotated



# PERONEAL NERVES

- Foot-drop; can neither dorsiflex nor evert the foot ;high-stepping gait
- Sensation is lost over the front and outer half of the leg and the dorsum of the foot



# TIBIAL NERVES

- Rarely injured except in open wounds
- Unable to plantar-flex the ankle or the toes
- sensation is absent over the sole and part of the calf.
- Because both the long flexors and the intrinsic muscles are involved, there is not much clawing.





THANK YOU