Lecture 18

Editing File

Common Peripheral Nerve Problems and Injuries

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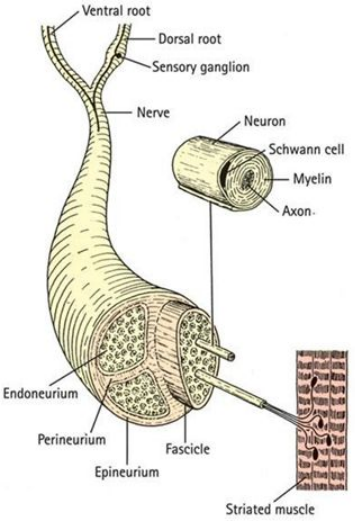
Objectives:

➔ No Objectives were provided for this lecture.

Color Index:

Original text | Doctor's notes | Text book
Important | Golden notes | Extra

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[1]).
- 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, known as the **perineurium**.
- In a transected nerve, these fascicles are seen, their perineurial sheaths are 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**.
- The epineurium varies in thickness according to the area of the nerve 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 ischemia:

- Caused by: Acute nerve compression.
- Starts with **numbness** and tingling within 15 minutes.
- Then **loss of pain** sensibility after 30 minutes.
- Followed by muscle **weakness** after 45 minutes.
- Relief of compression is followed by intense **paraesthesia** 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**.

1- Schwann cells are responsible for the myelination of the axons in the PNS, while the Oligodendrocytes are responsible for that task in the CNS.

Classification of peripheral nerve injury:

❖ Seddon's classification

Neurapraxia

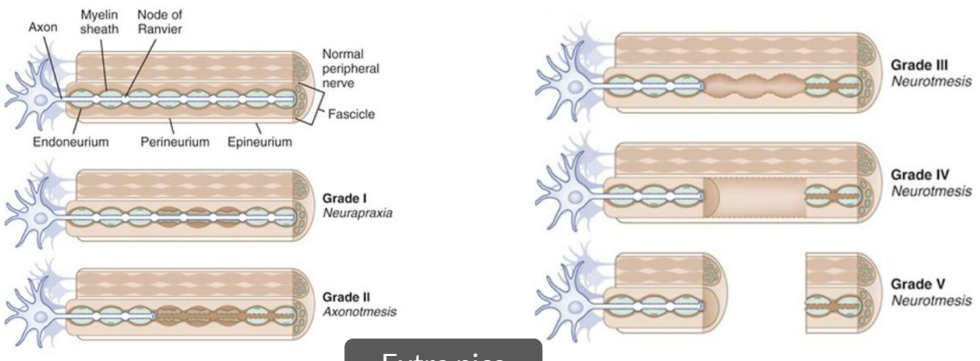
- Reversible physiological nerve conduction block (loss of sensation and muscle power) followed by spontaneous recovery after a few days or weeks.
- Due to mechanical **pressure** causing **segmental demyelination**[1] **(The axon itself is still intact)**
- Examples: Crutch palsy, Saturday night palsy, Tourniquet palsy[2]

Axonotmesis (tmesis = cut)

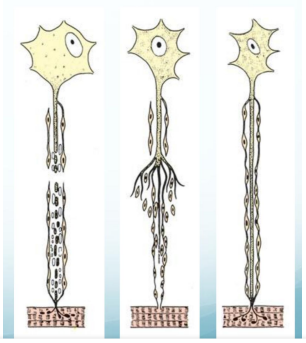
- More severe form of nerve injury.
- Closed fractures and dislocations.
- Literally means **axonal interruption**.
- Loss of conduction but the nerve is in continuity (so there is chance for healing), and the neural tubes (nerve sheath) are intact (the axon within is cut)
- **Wallerian degeneration** distal to the lesion.
- Axonal regeneration starts (at the same time) 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), and function is regained again.

Neurotmesis

- Division of the nerve trunk as in **open fracture.**
- There is healing at the injury site but usually the regenerating axons cannot reach the end organ, and the patient will have anomaly.
- 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 (fibrous tissue around the nerve ending) at the site of injury (regenerating axons, schwann cells and fibroblasts).
- Function is never normal.



Extra pics



Wallerian degeneration

1- Axons are still intact however
2- Don't apply a tourniquet for more than 2 hours

Classification of peripheral nerve injury:

❖ Sunderland's classification (more practical classification):

Not important, just try to understand the idea. (Seddon classification is the important one)

First degree injury:

- Includes transient ischaemia and neuropraxia.
- 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.

Third degree injury:

- Worse than axonotmesis (but still not neurotmesis)
- 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 (when axon heals in wrong direction).

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.
- Epineurium is injured.

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 (Wrist/foot drop, claw hand), weakness and changes in sensibility.

Assessment of nerve recovery:

- Motor recovery is slower (will come last) than sensory recovery
- **Pain is the first sensation to return**
- Clinical tests of muscle power and sensitivity to light touch and pin-prick to follow up nerve recovery.
- Low energy injury (high chance of recovery) vs a high energy injury (like MVA or fall from height not good sign for patient).

Tinel's sign:

- **Most accurate and reliable test**
- Peripheral tingling (paresthesia) or dysaesthesia upon percussing over the nerve.
- In a neurapraxia, Tinel's sign is negative (good indication)
- In axonotmesis, it is positive and advance with the regenerating axons.

Two-point discrimination:

- Measure of innervation density.

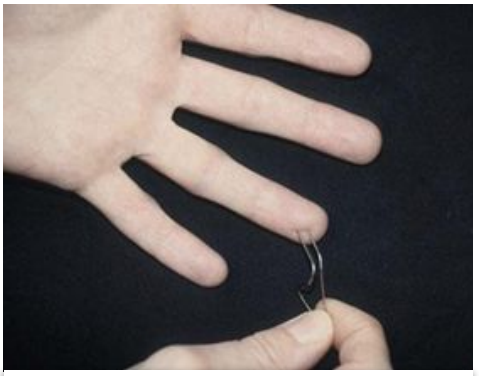
Monofilament assessment:

- Small filament used to check if patient has good degree of nerve sensitivity.

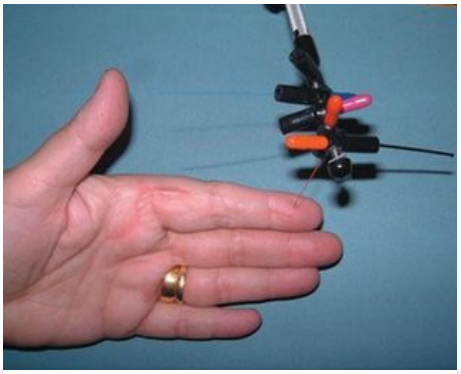
Electromyography (EMG) & Nerve Conduction Studies (NCS):

- Denervation potentials by the third week. (In the initial stages not helpful so we don't do them before 3 weeks. Usually between between 6 weeks - 12 months).
- Distal humeral fracture & nerve injury> surgery>no improvement>Electronic conductive study **after 6 weeks.**
- Excludes neurapraxia.
- Does not distinguish between axonotmesis and neurotmesis.
- #MRI confirms the diagnosis of nerve injury.

Tinel's sign



Two-point discrimination



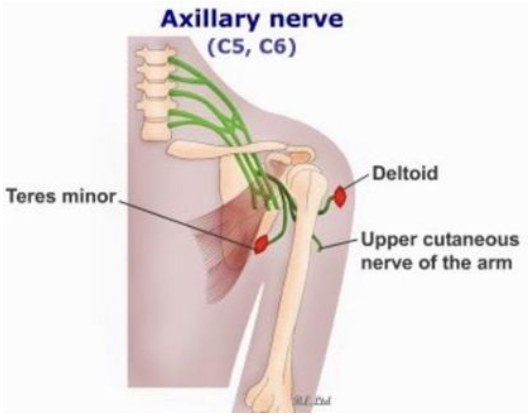
Monofilament assessment

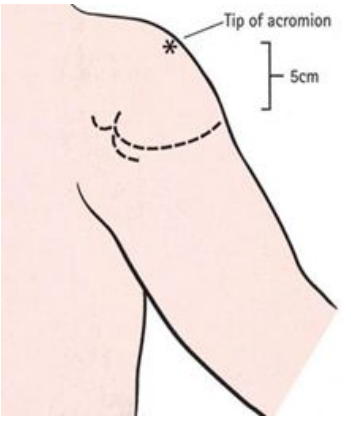
Upper limb nerve injury

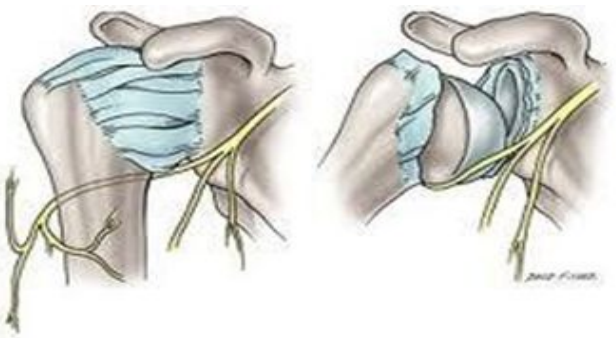
❖ Axillary nerve:

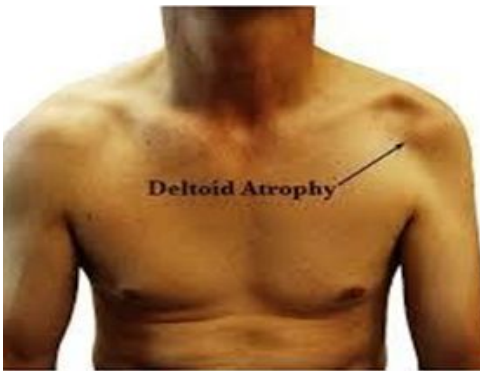
- The axillary nerve (C5, 6); arises from the posterior cord of the brachial plexus.
- Supplies:
  - Teres minor
  - Deltoid Muscles
  - And a patch of skin over the muscle at proximal arm.
- Has an anterior branch that curls round the surgical neck of the humerus at 5 cm below the tip of the acromion.

Injuries	Clinical features
• Shoulder dislocation or fractures of the humeral neck. • Lateral deltoid-splitting incisions	• Shoulder weakness, and the deltoid is rapidly wasted [1] • Numbness over the deltoid. • High recovery: 80% of cases recover spontaneously.





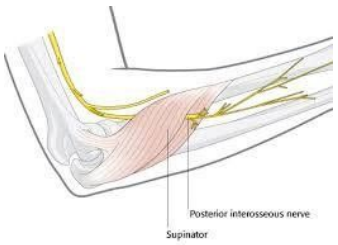
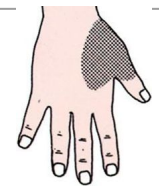




Deltoid wasting occurs only in chronic injuries

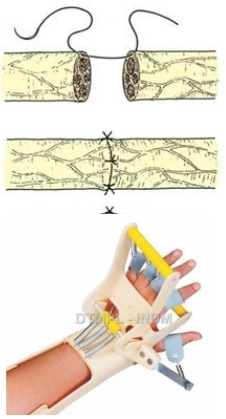
Upper limb nerve injury

❖ Radial nerve:

	Low lesions	High lesions	Very high lesion
Level	Elbow or upper forearm.	Humerus (around spiral groove)	Axilla or shoulder
Injuries	• **Fractures** or **dislocations** at the elbow. • Iatrogenic lesions of the posterior interosseous nerve where it winds through the supinator muscle	• Fractures of the humerus or after prolonged tourniquet pressure.	• Trauma or operations around the shoulder. • More often, chronic compression in the axilla (Saturday night palsy) or (crutch palsy).
Clinical features	• Cannot extend the metacarpophalangeal joint (**MCP** joints) of the hand with weakness of thumb extension. • **Wrist extension is preserved** (very imp) because the branch to the extensor carpi radialis longus arises proximal to the elbow.	• Wrist drop • Inability to extend the Metacarpophalangeal (MCP) joints or elevate the thumb. • Sensory loss at the dorsal first web space • Reduce the fracture and if the patient is still unable to extend the wrist, book them for urgent **nerve exploration** and possible repair. (x-ray pic).	• In addition to weakness of the wrist and hand, the **triceps** is paralysed (loss of elbow extension) and the triceps **reflex** is absent. For the triceps, test elbow extension AGAINST gravity
Pic		  	 

Treatment:

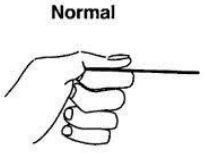
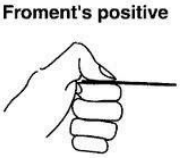
Open Injuries	Closed Injuries	If recovery fails
Nerve exploration and - Primary repair - Grafting[1]	Observe with splinting[2] and physiotherapy (to prevent contractures)	Tendon transfer[3]



1- Usually the Sural nerve
2- Otherwise he'll have muscle stiffness and deformity so we splint and keep the fingers extended.
3- Current literature states that for injury in this nerve specifically it's better to wait; don't do anything, nerve repair or graft, regardless of the injury wait for 6 months and most of the patients will recover.

Upper limb nerve injury

❖ Ulnar nerve:

	Low lesions	High lesions
Level	Near the wrist, e.g. cuts on shattered glass or injury at level of forearm due to compression	Near the elbow, e.g. elbow fractures or dislocations.
Clinical features	• Numbness of the ulnar one and a half fingers. • **Claw hand deformity**; with hyperextension of the MCP joints and flexion of distal IP joints of the ring and little fingers due to weakness of the intrinsic muscles. • Weak finger abduction (because of loss of intrinsic ms) and **thumb adduction**, makes pinch difficult. • Hypothenar and interosseous wasting. • Ask patient to hold paper by the side and he won't be able to do it using the thumb and will compensate by using Flexor pollicis longus (which is supplied by median nerve) for loss of Thumb adductor pollicis (positive Froment's sign)	• Hand: not markedly deformed because the ulnar half of Flexor Digitorum Profundus is paralysed and the fingers are therefore **less clawed' (high ulnar paradox).** • Explanation: in low lesions there is claw hand because the flexor digitorum profundus is working and causes flexion supplied by median nerve BUT if it is high both muscles are affected so there isn't much clawing. • 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.
Pic	     	

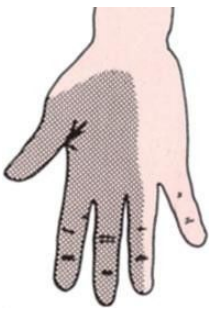
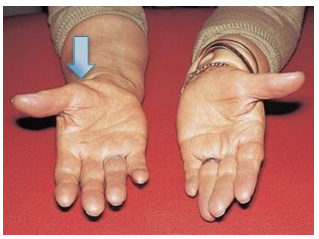
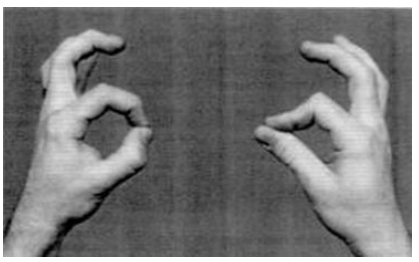
1. Why is the morphology of claw hand like that? Because from your anatomy it is the opposite of the muscles that were paralyzed which are the two medial lumbricals, these muscles flex the fingers at the metacarpophalangeal joints, and extend them at the interphalangeal joints

Upper limb nerve injury

❖ Median nerve:

	Low lesions (more common than higher)	High lesions
Level	Near the wrist.	High up in the forearm.
Injury	Cuts in front of the wrist or by carpal dislocations.	Forearm fractures or elbow dislocation.

Clinical features	• Unable to **abduct the thumb.**
	• Sensation is lost over the radial three and a half digits.
	• Thenar eminence is wasted and trophic changes.
		• Same as low lesions but, in addition to these paralysed muscles:
		  ○ The long flexors to the thumb, index and middle fingers.
		  ○ The radial wrist flexors.
		  ○ **The forearm pronator muscles**.
		• Typically, the hand is held with the ulnar fingers flexed and the index straight (the 'pointing sign'). Positive "OK" sign
		• Thumb and index flexors are deficient; there is a characteristic pinch defect with the distal joints in full extension
		• Pucker sign.

Pic	 	 

Isolated anterior interosseous nerve lesions:

- Extremely rare.
- Similar to those of a high lesion but **without any sensory loss** (this is a purely motor nerve).

1. What is the most sensitive median nerve clinical test? Durkan test.

Lower limb nerve injury

❖ Sciatic nerve:

Injury

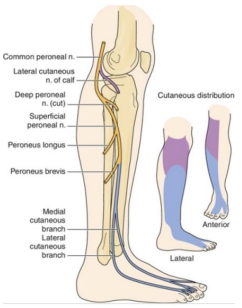
- Division (cut) of the main sciatic nerve is rare.
- Traction lesions (traumatic hip dislocations and with pelvic fractures).
- Iatrogenic lesions (posterior approach in total hip replacement).

Clinical features

- In a **complete lesion** at the hip: the hamstrings and all muscles below the knee are paralysed and the ankle jerk is absent.
- Very debilitating injury affects patient's quality of life.
- Sensation is lost below the knee, except on the medial side of the leg (supplied by saphenous branch of femoral).
- **Foot-drop** and a **high-stepping gait.**
- Sometimes only the deep part of the nerve is affected (common peroneal nerve lesion), which can happen after hip replacement. More common.

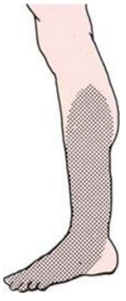
❖ Peroneal nerve:

- Common peroneal nerve or one of its branches.
- Often damaged at the level of the fibular neck.



Injury

- 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.



Clinical features

- **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 nerve:

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

Quiz

MCQ

Q1: Which nerve is the most likely to be injured in anterior shoulder dislocation?
A. Median
B. Axillary
C. Ulnar
D. Radial

Q2: 11 years old boy sustained left supracondylar humeral trauma following a fall which of the following statements is correct if the median n. or its branches are injured as a result of this injury:
A. the ok sign positive
B. Clawing of the hand
C. loss of thumb adduction
D. loss of sensation of little finger

Q3: Loss of pronation is a motor effect of:
A. Median nerve injury in elbow
B. Median nerve injury at the wrist
C. Axillary nerve injury
D. Ulnar nerve injury

Q4: : As a result of injury of the ulnar nerve at the wrist:
A. marked atrophy of the thenar eminence
B. wasting of hypothenar eminence
C. loss of sensation over the thumb
D. Unable to abduct the thumb.

Q5: A 32-year-old man comes to the physician because of episodic tingling and numbness in his right hand for the past 3 months. His symptoms are worse in the evening. There is no history of trauma. He is employed as a carpenter. Physical examination shows decreased pinch strength in the right hand. Sensations are decreased over the little finger and both the dorsal and palmar surfaces of the medial aspect of the right hand. Which of the following is the most likely site of nerve compression?
A. Cubital tunnel
B. Carpal tunnel
C. Radial groove
D. Surgical neck of humerus

SAQs

What's the most common classification of peripheral nerve injury?
1- Neurapraxia
2-Axonotmesis
3- Neurotmesis

Give 3 lines of management of closed non-iatrogenic peripheral nerve injury:
1- Observe with splinting and physiotherapy
2- Nerve exploration with primary repair or grafting
3- tendon transfer

Answers

Q1	Q2	Q3	Q4	Q5
B	A	A	B	A

THANK YOU

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