



## Peripheral Nerves Injury

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**Obj:**

**Not given** “in this lecture our references are: The doctor’s notes+1st year Anatomy+Davidson’s+ Surgical Recall+Raslan”.

**Color Index:**

-Slides -**Important** -**Doctor’s Notes** -**Davidson’s Notes** -**Surgery Recall**  
-Extra

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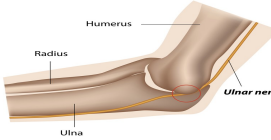
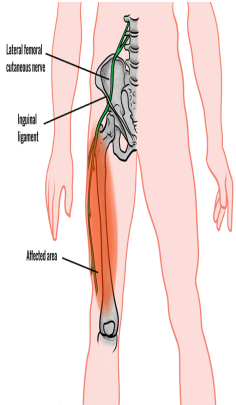

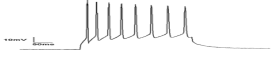
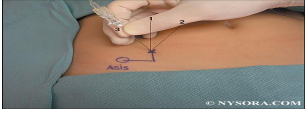
# Davidson's:

## PERIPHERAL NERVE LESIONS:

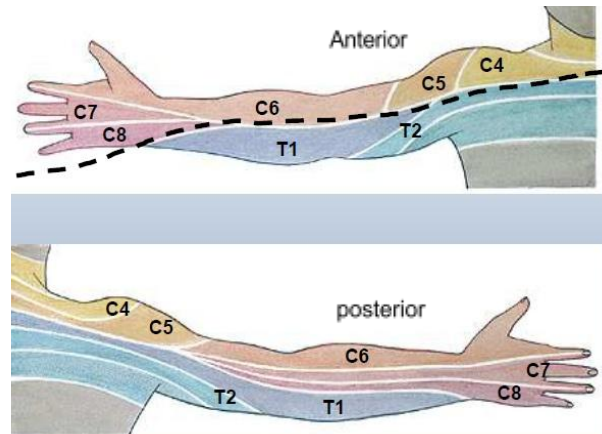
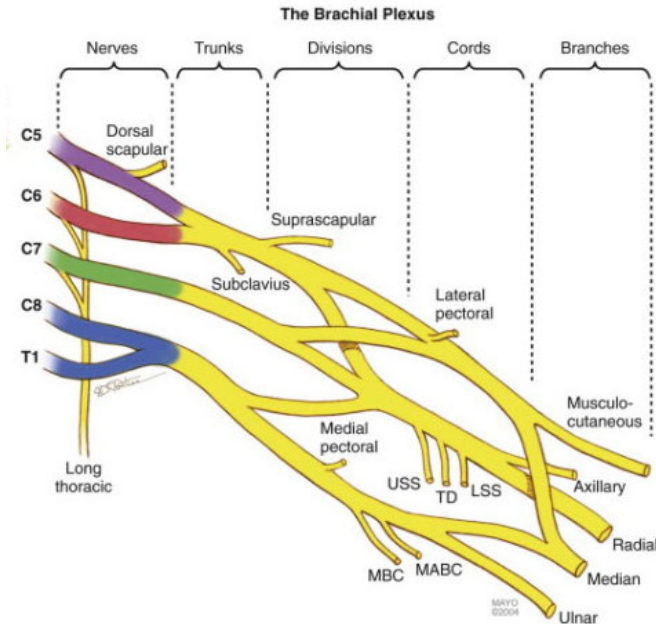
Classified as: "TOM GAIN":

Traumatic.	cOmpressive.	Metabolic.	Genetic.	Autoimmune.	Inflammatory.	Neoplastic.
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The neurosurgeon will see many compressive lesions, a small amount of trauma and the occasional nerve tumour. The **common** compressive neuropathies are (1) **carpal tunnel syndrome**, (2) **ulnar nerve compression at the elbow** (This is usually due to acute and chronic trauma, osteoarthritis or rheumatoid arthritis. Sometimes, the nerve may be compressed by the aponeurosis between the two heads of flexor carpi ulnaris) and (3) **meralgia paresthetica** (The nerve L2/3 sensory lateral cutaneous nerve emerges from the lateral border of the psoas muscle just above the iliac crest and crosses the iliacus to pass beneath or through the inguinal ligament, 1 cm medial to the anterior superior iliac spine, to pass into the thigh. Seat belts, pregnancy, trauma and postsurgical scar tissue, to name but a few, can cause mechanical compression. sent in up to 10% of cases).

Peripheral nerve lesion:	(1) Carpal tunnel syndrome	(2) Ulnar nerve compression at the elbow	(3) Meralgia paresthetica
<b>Sign and symptoms:</b>	<ul style="list-style-type: none"> <li>pain and numbness in the distribution of the <b>median nerve</b> in the hand.</li> <li>more common in patients with <b>diabetes, hypothyroidism, acromegaly and pregnancy</b>. Symptoms may be intermittent, are usually worst at <b>night</b>, and may be relieved by shaking the hand while holding it in a dependent position.</li> <li>The symptoms are often provoked by wrist flexion.</li> <li>On examination, there are <b>usually no signs</b>. Occasionally, there may be wasting of the thenar eminence, weakness of the abductor pollicis brevis, and diminished or altered sensation in the median nerve distribution.</li> <li>(Tinel's sign): Tapping over the nerve in the carpal tunnel may elicit paraesthesia in the median nerve distribution.</li> <li>Phalen's test: involves acutely flexing the wrist and holding it in this position. This may precipitate paraesthesia or numbness, and this is abnormal if it occurs within 1 minute.</li> </ul> 	<ul style="list-style-type: none"> <li>The nerve may suffer repeated dislocation over the medial epicondyle on flexion of the elbow.</li> <li>There is pain in the forearm and wasting of the small muscles of the hand, leading in the worst cases to an ulnar '<b>claw</b>' hand.</li> <li>There may be <b>reduced sensation</b> in the <b>ulnar</b> distribution of the hand.</li> </ul> <p>Ulnar Nerve Impingement</p> 	<ul style="list-style-type: none"> <li>This is numbness and painful paraesthesia in the lateral thigh caused by compression or <b>injury of the L2/3 sensory lateral cutaneous nerve</b>.</li> </ul>  <p>Meralgia Paresthetica</p> <p>© William E. Morgan</p>
<b>Diagnosis:</b>	<p><b>Confirmed using electrophysiology</b> to measure nerve conduction velocity and distal motor latency.</p> 	<p>The diagnosis may be made clinically, but <b>electrophysiology is recommended to confirm the diagnosis</b>.</p> 	<p><b>confirmed by injecting local anaesthetic</b> into the inguinal region 1 cm medial to the anterior superior iliac spine.</p>  <p>© NYSRR.COM</p>
<b>treatment:</b>	<p>depends on severity of symptoms. Splinting the wrist or <b>injections of steroid</b> into the carpal tunnel provide relief in a third of cases. If this <b>fails</b>, the transverse carpal ligament can be divided <b>surgically</b>, can be performed as a day case under local anaesthetic.</p>	<p>Treatment consists of <b>surgically</b> releasing and decompressing the nerve.</p>	<p>Treatment includes weight loss, the removal of constricting clothes and belts, nonsteroidal anti-inflammatory drugs, ice packs and injections of corticosteroid. Most cases will settle within 2 years. Surgical decompression is reserved for those that do not.</p>

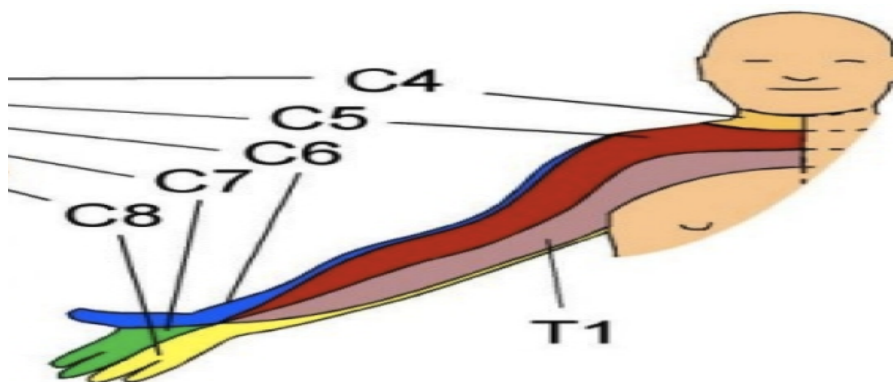
## A. Brachial Plexus Injury:



### Anatomy:

- Brachial Plexus is formed by the union of anterior rami of 5th, 6th, 7th, 8th cervical and 1st thoracic nerves
- It is divided into **R**oots, **T**runks, **D**ivisions, **C**ords, and terminal **B**ranches
- Roots are examined by examining dermatomes (sensation) and myotomes (movements)

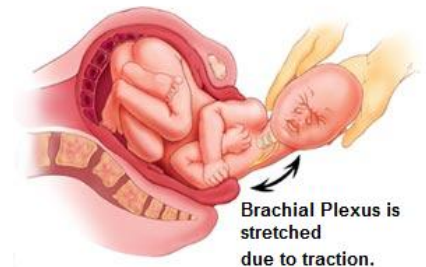
Root	Myotomes (Motor Function)	Dermatomes (Sensory Function)
C5	Shoulder abduction and external Rotation	Shoulder tip + lateral arm
C6	Elbow Flexion	Lateral forearm + thumb and index finger
C7	Wrist extension	Middle fingers
C8	Making a fist	Ring and little finger + lower aspect of medial forearm
T1	Finger crossing	Upper aspect of medial forearm



## Classification of brachial plexus injuries:

### 1. Open Injury:

- stab or gunshot wounds.
- Can be at any level ( roots, trunks, divisions.. etc)
- Classified into:
  1. **Supraclavicular** (roots, trunks, divisions)
  2. **Infraclavicular** (divisions, cords, terminal branches)



### 2. Closed Injuries -Most common-:

- Commonly **at the roots level**
- Causes: RTA, outstretching of the shoulder (e.g. sports, pulling baby in difficult delivery)

## Types of closed brachial of plexus injury:

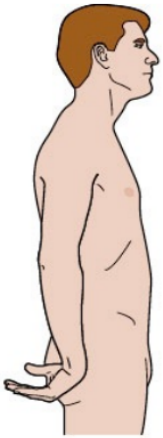
	1. Upper brachial plexus lesion (Erb's Palsy)	2. Lower brachial plexus (Klumpke's palsy)	3.Total palsy
Injured nerve	<b>C5,C6,C7</b>	<b>C8, T1</b>	<b>C6,C6,C7,C8,T1</b>
Motor exam	<p><b>C5:</b> loses the ability to abduct the shoulder and external rotation → Shoulder adduction And Internal rotation</p> <p><b>C6:</b> loses the ability to flex elbow →Extension of the elbow</p> <p><b>C7:</b> loses the ability to extend the wrist →Wrist flexion</p>	<p><b>C8:</b> loses the ability to <u>make a fist</u></p> <p><b>T1:</b> loses the ability to <u>cross fingers</u> The patient will have simian hand and clawing of all fingers</p>	Patient is unable to move entire limb flail <sup>1</sup> limb and both phrenic and sympathetic symptom
Sensory exam	<p><b>Loss of sensation over:</b></p> <p><b>C5:</b> Shoulder tip + lateral arm</p> <p><b>C6:</b> lateral forearm, thumb, index C7: middle finger</p>	<p><b>Loss of sensation over</b></p> <p><b>C8:</b> Ring and little finger + lower aspect of medial forearm</p> <p><b>T1:</b> Upper aspect of medial forearm + medial arm</p>	
Specific sign	<b>Waiter's tip position</b>	<b>Ape's hand.</b> (No hands intrinsic Ms. → Clawing of all fingers)	
Associated injury	<p><b>Phrenic nerve injury</b></p> <p>Which rises from C3,C4,C5 = Paralyzed diaphragm</p> <p>In adults X-ray shows elevated hemi diaphragm</p> <p>In children the intercostals are not strong enough to compensate so the baby will have breathing problems (obstetric palsy)</p>	<p><b>Horner syndrome:</b></p> <p>(Ptosis<sup>2</sup>, Miosis<sup>3</sup>, Anhidrosis<sup>4</sup>)</p> <p>Sympathetic nerves to the face come from a branch of the first thoracic nerve T1 so If T1 is injured then sympathetic to the face are lost on ipsilateral side</p>	

<sup>1</sup> Medical term refers to an extremity in which the primary nerve has been severed, resulting in complete lack of mobility and sensation.

<sup>2</sup> Drooping of the upper eyelid

<sup>3</sup> Constricted Pupil

<sup>4</sup> Inability to sweat



(a) Erb-Duchenne palsy (waiter's tip)



b) Horner's syndrome



c) Ape's hand

## B. Peripheral Nerve Injury:

1. Axillary nerve injury	
<b>Course</b>	It passes inferiorly and laterally along the posterior wall of the axilla. Then, it passes posteriorly (through a quadrangular space) and passes around the surgical neck of the humerus. → It Supplies: the Deltoid (shoulder abduction) and Teres minor muscle (external rotation)
<b>Cause</b>	Shoulder Surgery, <b>shoulder dislocation</b> , trauma
<b>Motor exam</b>	Loss of deltoid → Limitation of shoulder abduction (patient can still initiate abduction by supraspinatus)
<b>Sensory exam</b>	Loss of sensation over the skin of the lateral arm on lower half of the deltoid
2. Musculocutaneous nerve injury	
<b>Course</b>	→ It provides sensory innervation to the lateral aspect of the forearm → Supplies Coracobrachialis, biceps, brachialis muscles.
<b>Cause</b>	Stab wounds near axilla
<b>Motor exam</b>	→ Coracobrachialis and brachialis are not clinically important → Biceps: <ul style="list-style-type: none"> <li>◆ Weak supination (because the supinator muscle can compensate)</li> <li>◆ Loss of elbow flexion</li> </ul>
<b>Sensory exam</b>	Loss of sensation over the lateral forearm and the thumb



### 3.Radial Nerve Injury

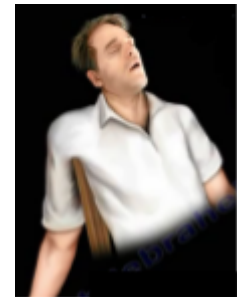
<b>Course</b>	Runs in spiral groove, injuries happen in humerus bone fractures: It supplies.. <ul style="list-style-type: none"> <li>→ <b>Arm: triceps</b> (strong extensor of the elbow), Brachioradialis, Extensor carpi radialis longus (wrist extension)</li> <li>→ <b>Forearm: <u>Sensory branches</u></b> over 3 ½ fingers laterally on dorsal side  <u>Motor branch:</u> (thumb and finger extension) Posterior interosseous nerve</li> </ul>		
<b>Cause</b>	<u>Compression of the nerve in axilla</u> → <b>Saturday night palsy</b>	<u>Fracture Humerus at the spiral groove</u>	<u>Stab wound in the forearm, Radial head fracture or excision</u> → <b>posterior interosseous nerve injury</b>
<b>Motor Exam</b>	☹ Loss of extension at (wrist, elbow, fingers , thumb)	✓ Spared triceps = normal elbow ☹ No wrist extension = wrist drop ☹ No thumb or finger extension	✓ Normal elbow extension ✓ Normal wrist extension (NO WRIST DROP) <sup>5</sup> ☹ Can't extend the thumb or fingers
<b>Sensory exam</b>	Loss of sensation over the 3 ½ fingers laterally on the dorsal side		NO SENSORY LOSS



Wrist drop



Saturday night palsy is called like that because drunk people sleep with an arm behind the chair = compression



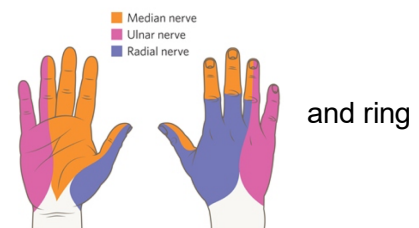
<sup>5</sup> The nerve that supply the supinator and the extensor carpi radialis longus will be undamaged, and because the latter muscle is powerful, it will keep the wrist joint extended

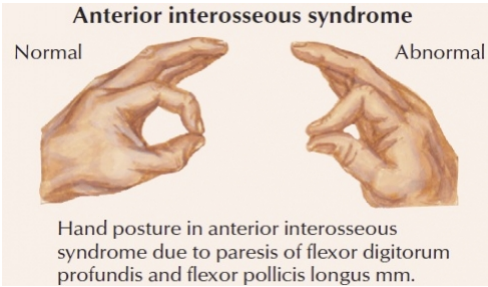
# BACK TO ANATOMY! \*IMPORTANT\*

	Muscles	Nerves
Finger	<p><b>Metacarpophalangeal (MP) joints:</b></p> <ul style="list-style-type: none"> <li>→ <b>Extension</b> is by the radial nerve</li> <li>→ <b>Flexion</b> is by the ulnar nerve by the interossei and Lumbrical</li> </ul> <p><b>Interphalangeal joints (IP):</b></p> <ul style="list-style-type: none"> <li>→ <b>Extension</b> is by the ulnar nerve by the interossei and lumbrical</li> <li>→ <b>Flexion</b> by the long flexors of the forearm</li> </ul> <p><b>Lumbrical&gt;</b></p>	<p>muscles</p>
Hand	<p><b>Hypothenar:</b> little finger abduction, opposition</p> <p><b>Thenar:</b> opposition of thumb + adduction of the thumb (adductor pollicis)</p> <p><b>Interossei:</b> abduction and adduction of the fingers(except for little finger abduction) + MP flexion + IP extension</p> <p><b>Lumbricals:</b> MP flexion+IP extension(anti-claw)</p>	<p><b>The hand has 20 muscles</b></p> <ul style="list-style-type: none"> <li>→ <b>15 supplied by the ulnar nerve:</b> (3 hypothenar + 8 interossei (dorsal and palmar) + 2 lumbricals + adductor pollicis + Palmaris brevis)</li> <li>→ <b>5 by the median nerve</b> (3 thenar + 2 lumbricals (1st and 2nd))</li> </ul> <p><b>*Basically* All the actions are from the ulnar nerve Except one and half are from the median nerve:</b></p> <ul style="list-style-type: none"> <li>• Opposition of the thumb</li> <li>• Index and middle radial lumbricals</li> </ul>
Forearm	<p><b>A) 5 superficial muscles:</b></p> <ul style="list-style-type: none"> <li>• Pronator teres → pronation of the forearm</li> <li>• Flexor carpi radialis → wrist flexion</li> <li>• Palmaris longus → wrist flexion</li> <li>• Flexor carpi ulnaris → wrist flexion</li> <li>• Flexor digitorum superficialis → flexion of the proximal Interphalangeal joints (PIP) so flexes the middle phalynx</li> </ul>	<p><b>The median nerve has 2 branches</b></p> <p><b>1) Superficial</b> which supplies all the superficial group muscles <b>EXCEPT</b> Flexor carpi ulnaris (supplied by ulnar nerve)</p>
	<p><b>B) 3 deep muscles:</b></p> <ul style="list-style-type: none"> <li>• Flexor digitorum profundus</li> <li>• Flexor pollicis longus</li> <li>• Pronator quadratus</li> </ul>	<p><b>2) Deep</b> (anterior interosseous nerve) which supplies the deep 2 and a half muscles (PURE MOTOR) <b>EXCEPT</b> Half of flexor digitorum profundus to the little and ring finger (supplied by ulnar n.)</p>


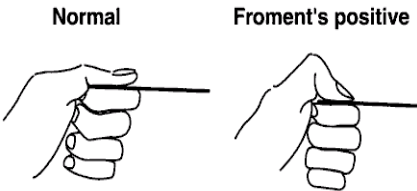
## B. Peripheral Nerve Injury Cont:

4. Median Nerve	
Course	<p><b>Motor Supply For:</b></p> <p>Forearm:</p> <ul style="list-style-type: none"> <li>→ Superficial flexors except flexor carpi ulnaris</li> <li>→ Deep flexors except half of flexor digitorum profundus to little finger</li> </ul> <p>Hand:</p> <ul style="list-style-type: none"> <li>→ Thenar muscles</li> <li>→ Index and middle lumbricals</li> </ul> <p><b>Sensory supply for:</b> lateral 3 and a half fingers on the palmar side</p>



Injury	Injury of median nerve	Anterior interosseous nerve injury
Cause	<b>At the wrist level:</b> laceration, carpal tunnel syndrome, <b>suicide</b>	<b>At the elbow region:</b> Supracondylar fracture of the humerus.
Motor exam	only loss of thumb opposition and abduction.  The loss of radial 2 lumbricals does not cause clawing because the interosseous muscles are intact	<b>Affects the deep 2 and half muscles:</b> <ul style="list-style-type: none"> <li>• Half of Flexor digitorum profundus of the index</li> <li>• Flexor pollicis longus of the Thumb</li> <li>• Pronator quadratus (pronation is not lost because of pronator teres)</li> </ul>
Sensory exam	Loss collateral 3 ½ fingers on the palmar side	NO SENSORY LOSS
Specific sign	No specific sign	<b>can not make a perfect "O"</b> = the "O" sign the thumb, index and middle fingers because he can't flex the tips of the index and middle finger (DIP joint: this is the action of the flexor digitorum profundus ms. Of Index)   <p>Anterior interosseous syndrome</p> <p>Normal                      Abnormal</p> <p>Hand posture in anterior interosseous syndrome due to palsy of flexor digitorum profundus and flexor pollicis longus mm.</p>

### 5. Ulnar Nerve Injury

Course	<b>Motor Supply For:</b> Forearm: <ul style="list-style-type: none"> <li>→ Flexor carpi ulnaris</li> <li>→ Medial half of flexor digitorum profundus</li> </ul> Hand: <ul style="list-style-type: none"> <li>→ Lumbricals + interossei + hypothenar + adductor pollicis</li> </ul> <b>Sensory supply for:</b> medial 1 and a half fingers front and back of the hand	
Level	<b>At the elbow level</b>	<b>At the wrist</b>
Motor exam	loss of flexor carpi ulnaris and half of flexor digitorum profundus all of the hand muscles <ul style="list-style-type: none"> <li>• cannot oppose the little finger</li> <li>• atrophy of hypothenar muscles</li> <li>• Cannot adduct or abduct the fingers = ulnar claw hand<sup>6</sup></li> </ul>  <p>Ulnar Claw Hand</p>	All hand muscles: <ul style="list-style-type: none"> <li>• Hypothenar atrophy</li> <li>• No opposition of the little finger</li> <li>• Cannot adduct or abduct the fingers</li> <li>• Loss of thumb adduction resulting in froment's sign<sup>7</sup></li> </ul>  <p>Normal                      Froment's positive</p>
Sensory exam	Loss medial 1 and a half fingers front and back of the hand	

<sup>6</sup> no claw in the index or middle fingers because the radial 2 lumbricals are intact

<sup>7</sup> you ask the patient to hold a pen with his thumb but he cannot so he contracts the flexor pollicis longus because the adductor pollicis is lost

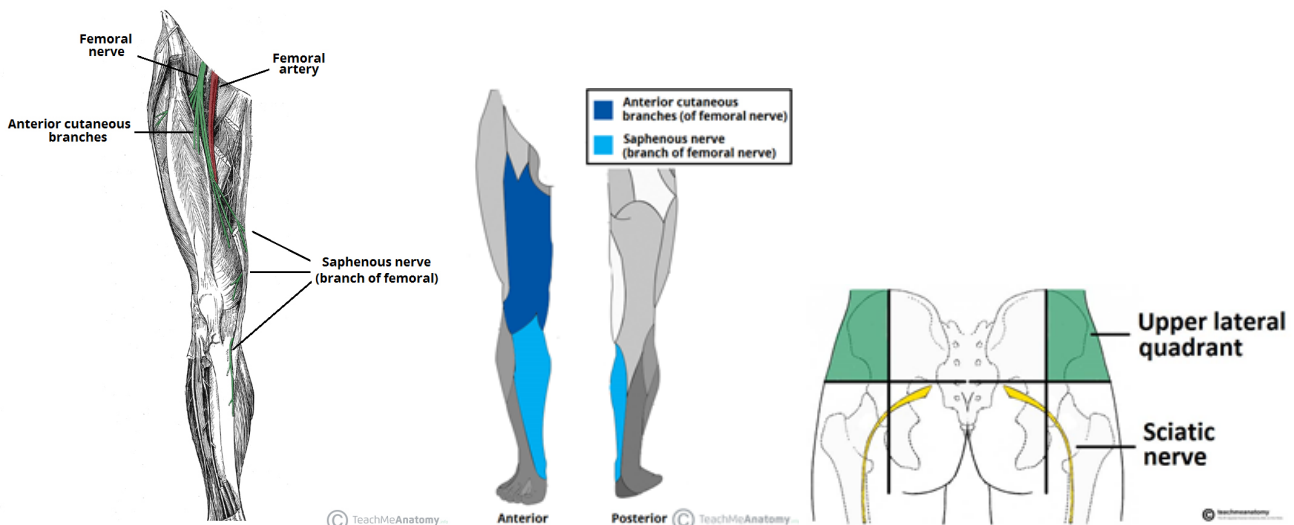


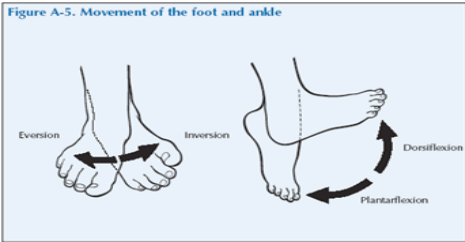

## 6. Median and Ulnar Nerve Injury At The Wrist

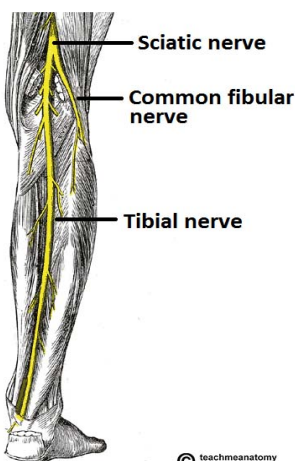
- Loss of intrinsic muscles
- Loss of sensation
- **Clawing of ALL FINGERS** = Ape hand (simian hand)

### Lower limb nerve injuries:

Femoral Nerve (front)	Sciatic Nerve (back)
<b><u>Nerve Roots:</u></b> L2-L4	<b><u>Nerve Roots:</u></b> L4-S3.
<p><b><u>Course:</u></b> Descends lateral to <b>psaos major</b> &amp; enters the thigh behind the <b>inguinal ligament</b> Passes lateral to femoral artery and divides into terminal branches.</p> <p><b><u>The first cutaneous branches</u></b> of the femoral nerve are the anterior cutaneous branches that arise in the femoral triangle. They supply the skin on the anteromedial thigh.</p> <p><b><u>The last cutaneous branch</u></b> of the femoral nerve is the saphenous nerve which supplies the skin on the medial side of the leg and the foot.</p>	<p style="text-align: center;"><b>It is <span style="color: red;">very commonly</span> injured in two cases:</b></p> <p style="text-align: center;">1-Hip arthroplasty.</p> <p style="text-align: center;">2-Injections. (When we're injecting, we should direct the needle away from sciatic nerve, in <b>upper outer</b> part of the muscle)</p>
<p><b><u>Sensory:</u></b> sensation of <b>anterior thigh</b> and <b>inner thigh</b>.</p> <p><b><u>Motor:</u></b> it supplies the <b>quadriceps</b> muscles '<b>knee extension</b>'</p>	
<p><b><u>If injured:</u></b> he <b>can't extend his knee</b> and when he can't extend it, he can't walk. (more important than knee flexion, we need to extend our knee to be able to stand and walk)</p>	<p><b><u>If injured:</u></b> the <b>hamstring</b> will be affected, so there <b>will not be knee flexion</b>.</p>
<p>Femoral nerve injury is <b>related to psaos muscle</b>, so in case of psaos abscess, we may cut the nerve while draining the pus.</p>	<p><b>After supplying the hamstring, it will be divided into two parts:</b></p> <p style="text-align: center;">A-Posterior tibial nerve</p> <p style="text-align: center;">B-Common peroneal nerve.</p>



Posterior tibial nerve	Common fibular (peroneal) nerve
<b>Nerve roots:</b> L4-S3	<b>Nerve roots:</b> L4 – S3
<b>Course:</b> Descends through popliteal fossa to posterior compartment of leg, accompanied with posterior tibial vessels Passes deep to flexor retinaculum to reach the sole of foot where it divides into 2 terminal branches	<b>Course:</b> Leaves popliteal fossa & turns around the lateral aspect of neck of fibula. Then divides into: Superficial peroneal: descends into lateral compartment of leg Deep peroneal: descends into anterior compartment of leg
<b>Motor:</b> Innervate the <b>posterior leg compartment</b> , which it is responsible for <b>ankle flexion (planterflexion), toe flexion</b> <b>sensory:</b> sensation of the <b>sole of the foot</b> .	<b>Motor:</b> It supplies the <b>anterior leg compartment</b> , the <b>lateral leg compartment</b> . <b>Sensory:</b> sensation of the <b>dorsum of the foot</b> .
Laceration in the <b>popliteal fossa</b> will only injure the posterior tibial nerve.	<b>The lateral leg compartment:</b> causes <b>foot to evert</b> . <b>Anterior compartment:</b> is responsible for <b>ankle extension</b> and <b>toe extension (dorsiflexion)</b> .
	It is the <b>most common injury</b> of a nerve in the <b>lower limb</b> . <b>Why?</b> It is very <b>superficial at the fibular head</b> . So any injury there, will affect the nerve, including <b>sitting in abnormal position</b> (زي اللي بيلعبوا طرنيب) when you do this you stretch the nerve.
 <p>Figure A-5. Movement of the foot and ankle</p>	<b>If injured: Drop foot</b> , no ankle extension and no toe extension and also loss of dorsum sensation. 



- **Sciatic nerve injury is a disaster**, because you will not only lose your hamstring which is knee flexion, but you lose the **posterior tibia** which is ankle flexion, toe flexion and sole sensation. And you lose the **common peroneal** nerve which is ankle extension, toe extension and sensation dorsum.

## Remember:

- **What will common peroneal nerve injury cause?**  
Drop foot, no ankle extension and no toe extension and also loss of dorsum sensation.
- **What is the problem of femoral nerve injury?**  
Loss of knee extension and loss of sensation of anterior and inner thigh.
- **Sciatic nerve injury cause?**  
Loss of Knee flexion (hamstring) and both nerves common peroneal and posterior tibia.
- **What is the problem with posterior tibial nerve injury?**  
Loss of ankle flexion (planterflexion), toe flexion and also loss of sensation of sole of the foot.
- drop wrist (**radial nerve**), and drop foot (**common peroneal**).

# Surgical Recall

1. How can the flexor digitorum profundus (FDP) apparatus be tested?

Check isolated flexion of the middle finger DIP joint

2. How can the flexor digitorum superficialis (FDS) apparatus be tested?

Check isolated flexion of the finger at the MP joint

3. What are the “intrinsic” hand muscles? Lumbricals, interosseous muscle

4. What is ADDuction and ABDuction of the fingers?

ADDuction is to midline and ABDuction is separation from midline

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اسع وادء حلك تقبل الئ  
SEEK YOUR DREAM, AND YOU WILL REACH IT.