

Peripheral Nerve Injuries



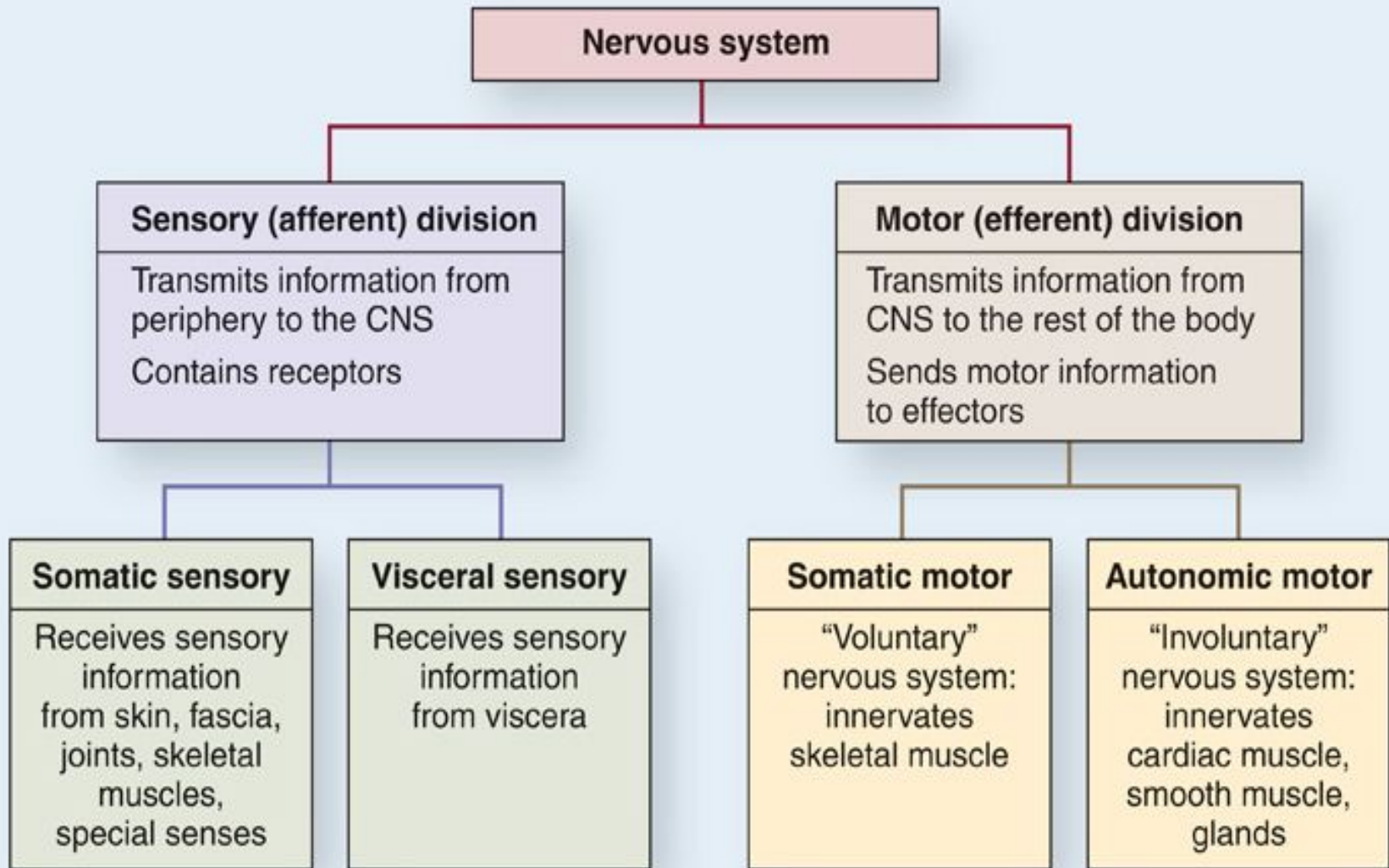
Mohamad Samih Yasin, FRCS
5th-year medical students

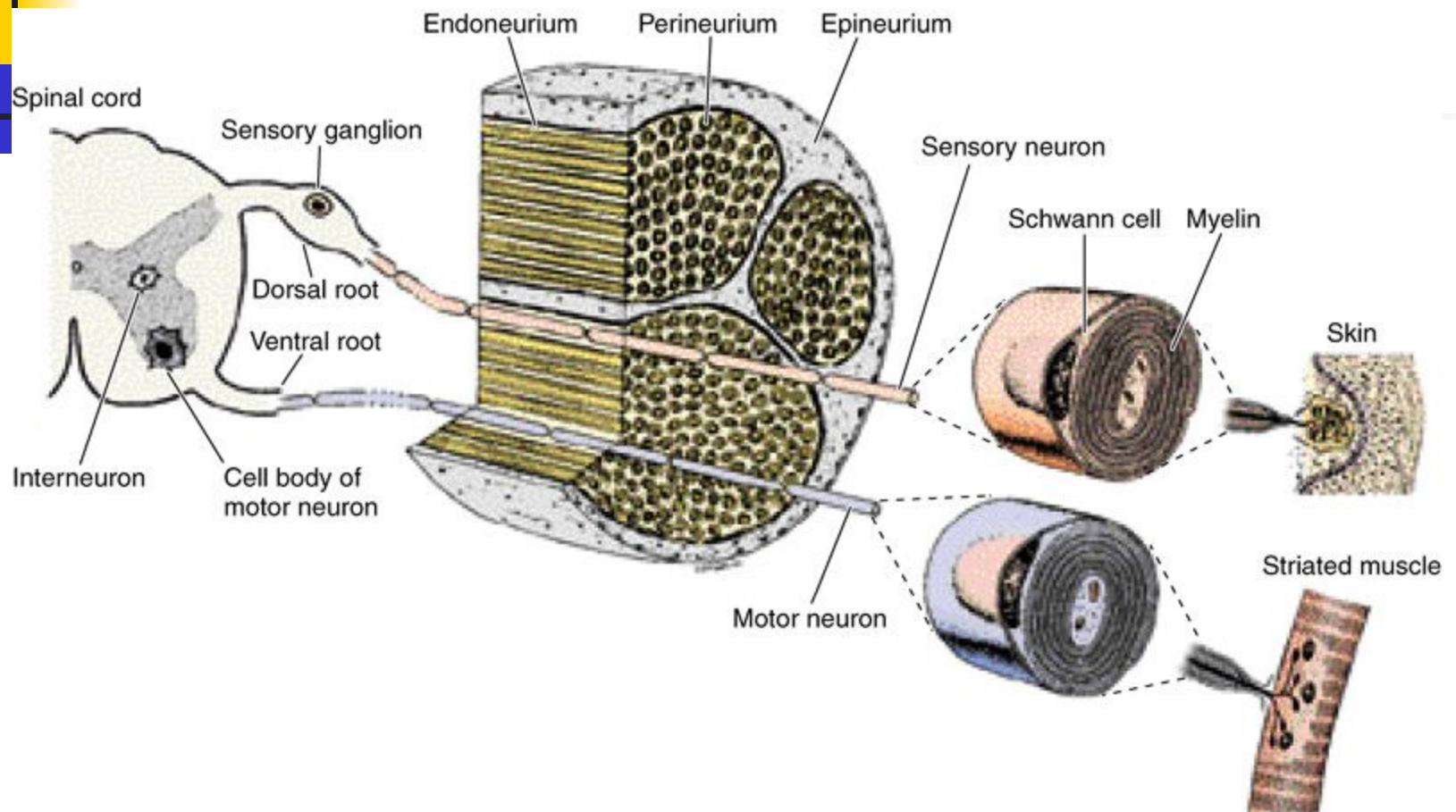


Seminar Outline

- **Pathology of Nerve Injuries**
- **Clinical Features**
- **Principles of Treatment**
- **Nerve Injuries Affecting the Upper Limb**
- **Nerve Injuries Affecting the Lower Limb**
- **Nerve Entrapment Syndromes**

Functional Organization of the Nervous System

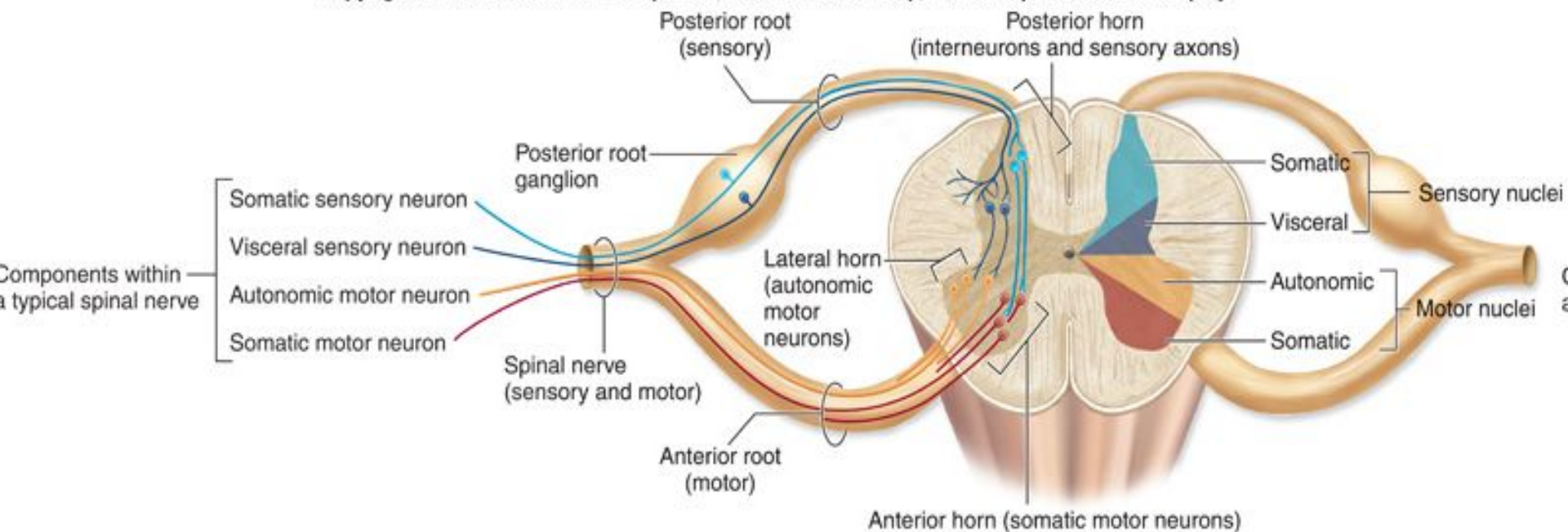


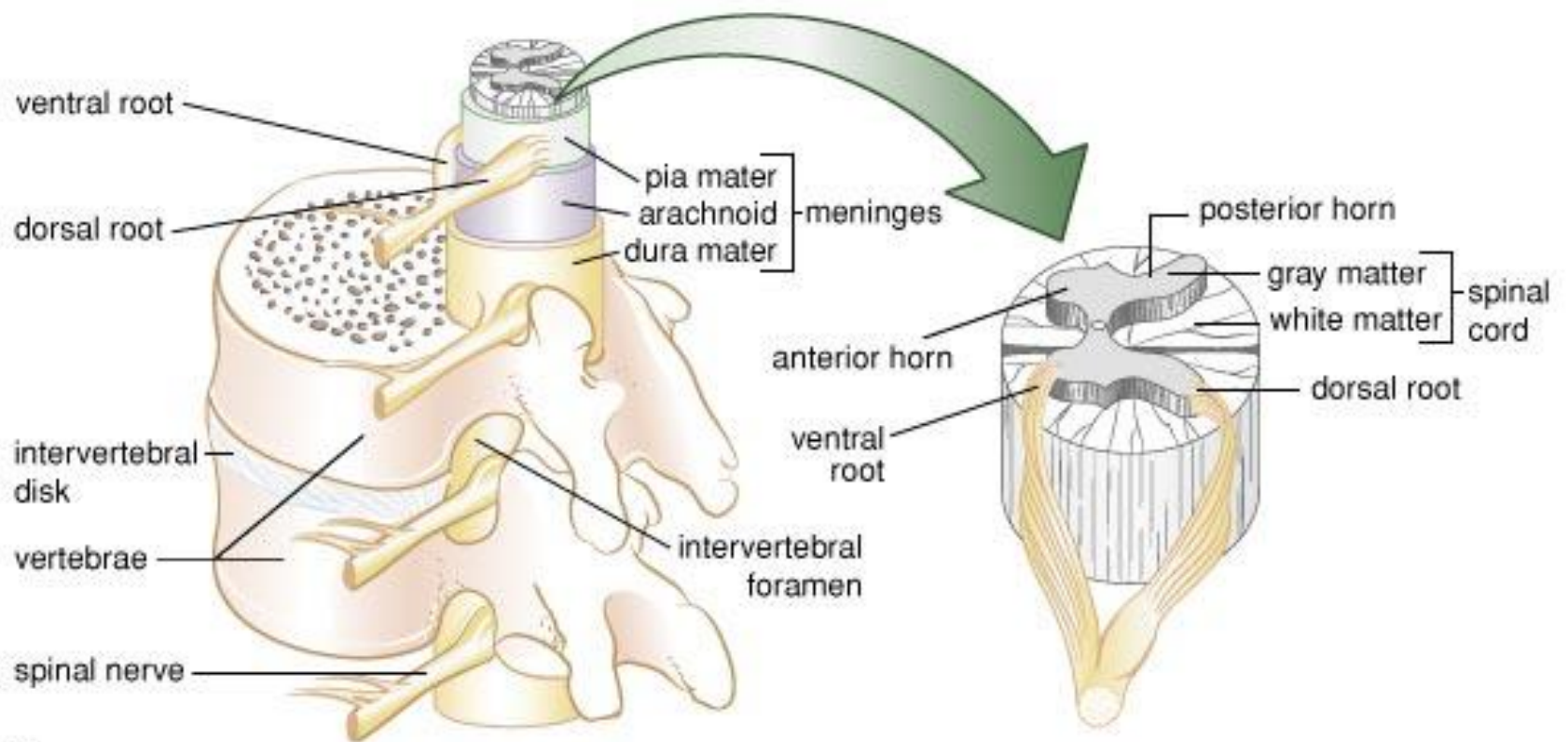


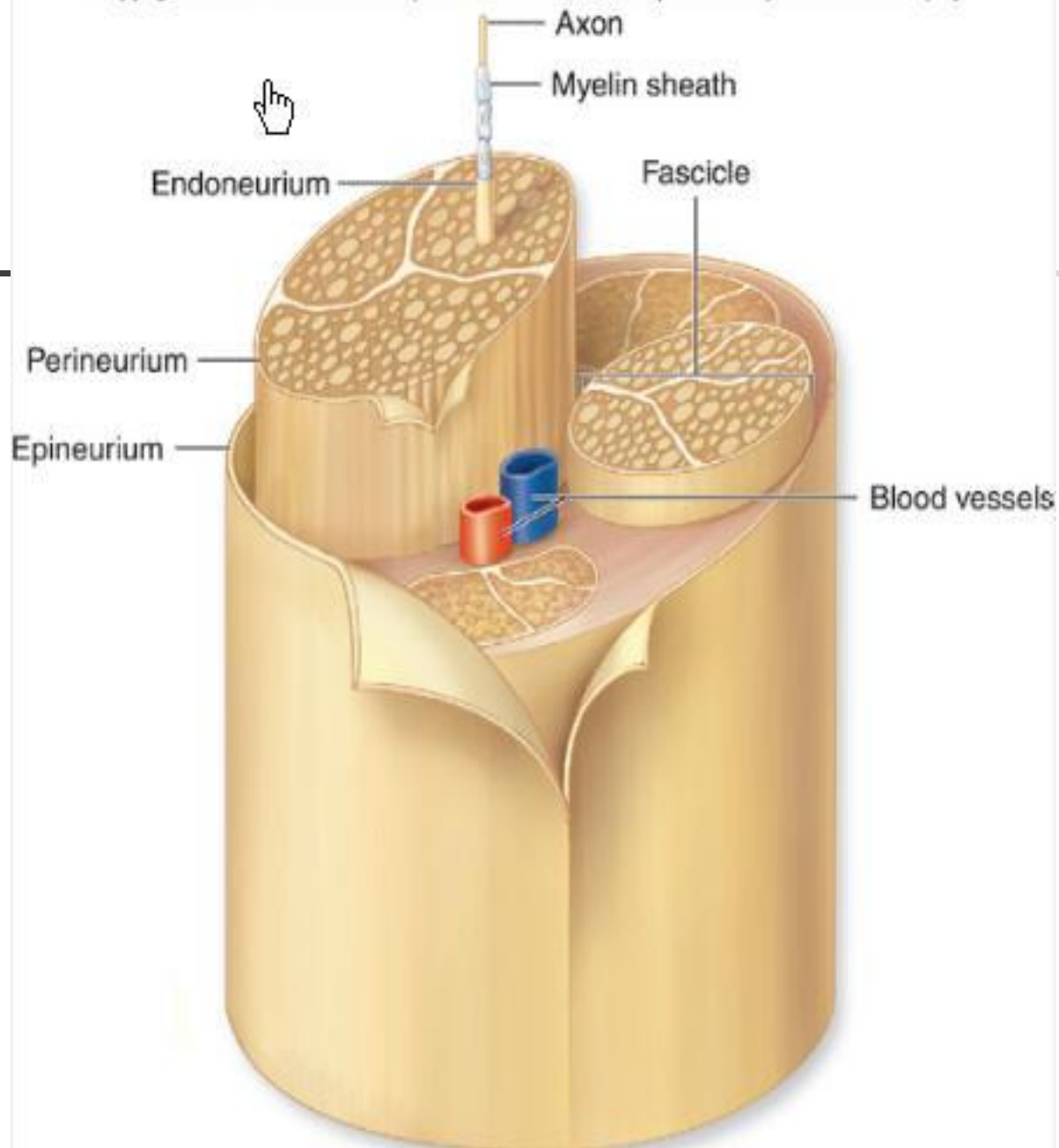


Fiber Type	Diameter (uM)	Myelination	Speed	Example
A	10-20	heavy	fast	touch
B	3 >	moderate	medium	
C	1.3 >	none	slow	pain

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Pathology of Nerve Injuries

- Various mechanisms of injury & Variable damage
- **Transient Ischemia**
 - Acute nerve compression : 15, 30, 45 min
 - Relief of compression
 - Endoneurial anoxia
- **Seddon's Classification**
- **Neurapraxia**
 - Definition
 - Consequences
- **Axonotmesis**
 - Seen typically after close fractures and dislocations
 - Wallerian degeneration
 - Axonal degeneration
- **Neurotmesis**
 - Variable degree of damage
 - Wallerian Degeneration
 - Regeneration



Sunderland Classification of Nerve Injuries

- **Grade I**
 - Same as Seddon's neuropraxia.
- **Grade II**
 - Same as Seddon's axonotmesis.
- **Grade III**
 - Neurotmesis with preservation of the perineurium. The endoneurium is disrupted, with loss of growth guides for axonal regeneration.
 - Patients should expect a 60-80% recovery.
 - Fibrosis occurs within the perineurium due to influx of inflammatory cells and fibroblasts, which hinders axonal regeneration.
- **Grade IV**
 - Neurotmesis with preservation of the epineurium. Everything else is disrupted.
 - The nerve will grossly appear edematous.
 - Nerve grafting is required.
- **Grade V**
 - Complete transection of the nerve trunk.
 - Bypass/jump grafting is required.

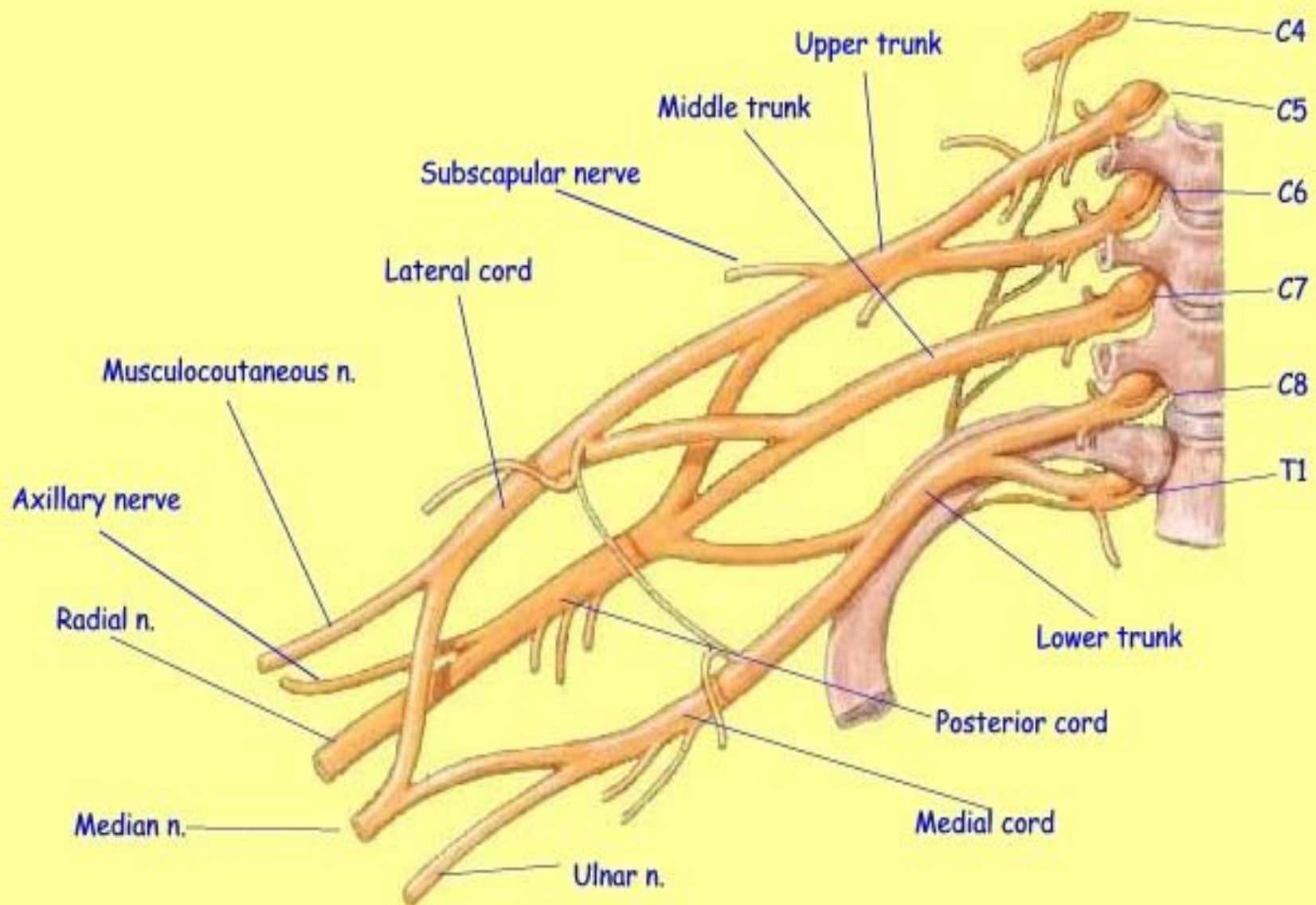


Seddon Type	Degree	Myelin Intact	Axon Intact	Endoneurim Intact	Wallerian .Degen	Reversible
Neurapraxia	1st	No	Yes	Yes	No	reversible
Axonotmesis	2nd	No	No	Yes	Yes	reversible
Neurotmesis	3rd	No	No	No	Yes	irreversible



Sunderland Grade	Myelin Sheath	Axon	Endoneurim	Perineurium	Epineurium
I	Disrupted	Intact	Intact	Intact	Intact
II	Disrupted	Disrupted	Intact	Intact	Intact
III	Disrupted	Disrupted	Disrupted	Intact	Intact
IV	Disrupted	Disrupted	Disrupted	Disrupted	Intact
V	Disrupted	Disrupted	Disrupted	Disrupted	Disrupted

Nerve injuries affecting upper limbs



Nerve Injuries Affecting The Upper Limb



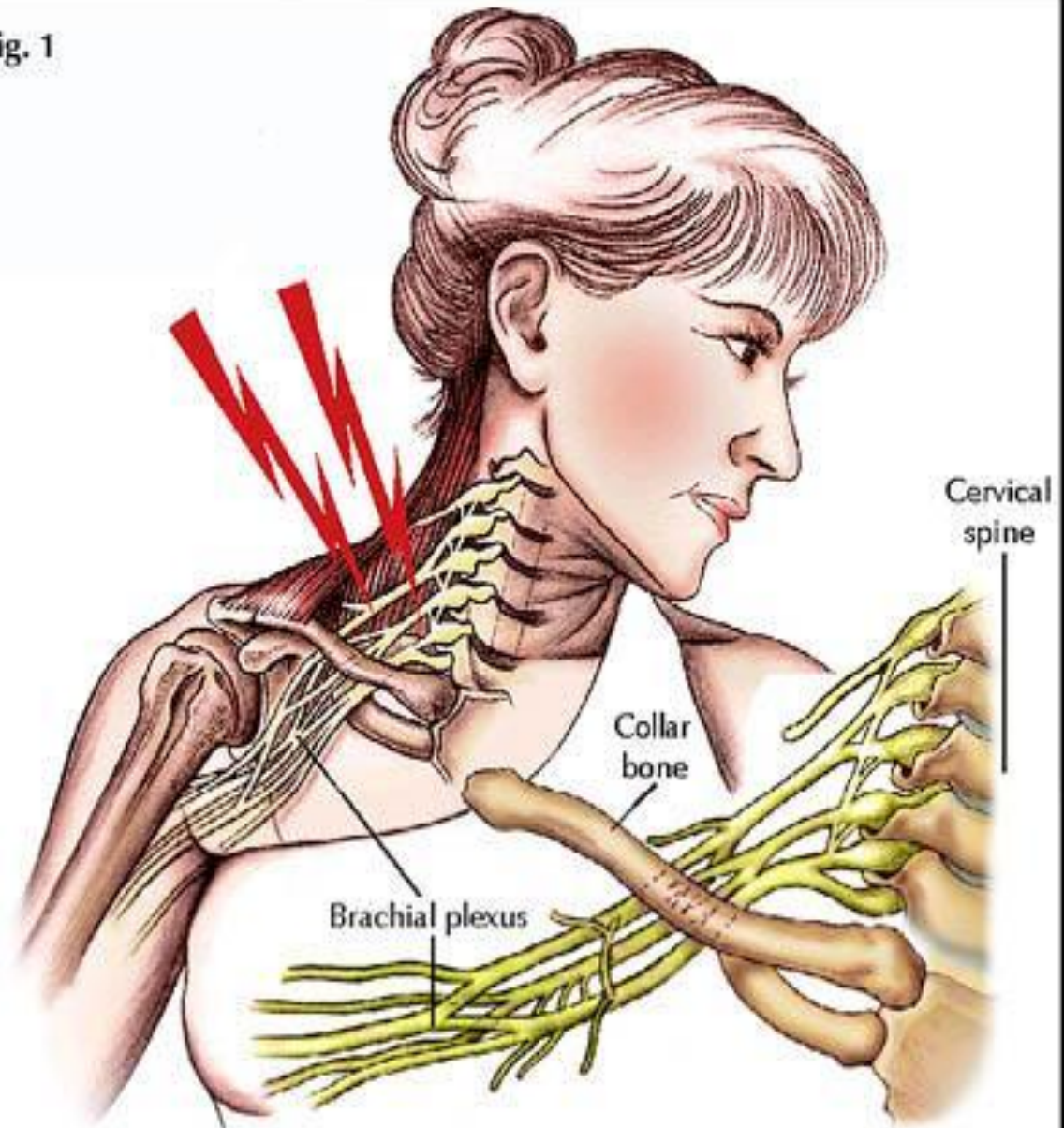
- Brachial Plexus
- Long Thoracic Nerve
- Axillary Nerve
- Radial Nerve
- Median Nerve

Brachial Plexus Injury

- Suprascapular
vs
- Infraclavicular

- Preganglionic
vs
- Postganglionic

Fig. 1



Cervical Burners



Brachial Plexus Injury





Brachial Plexus Injury

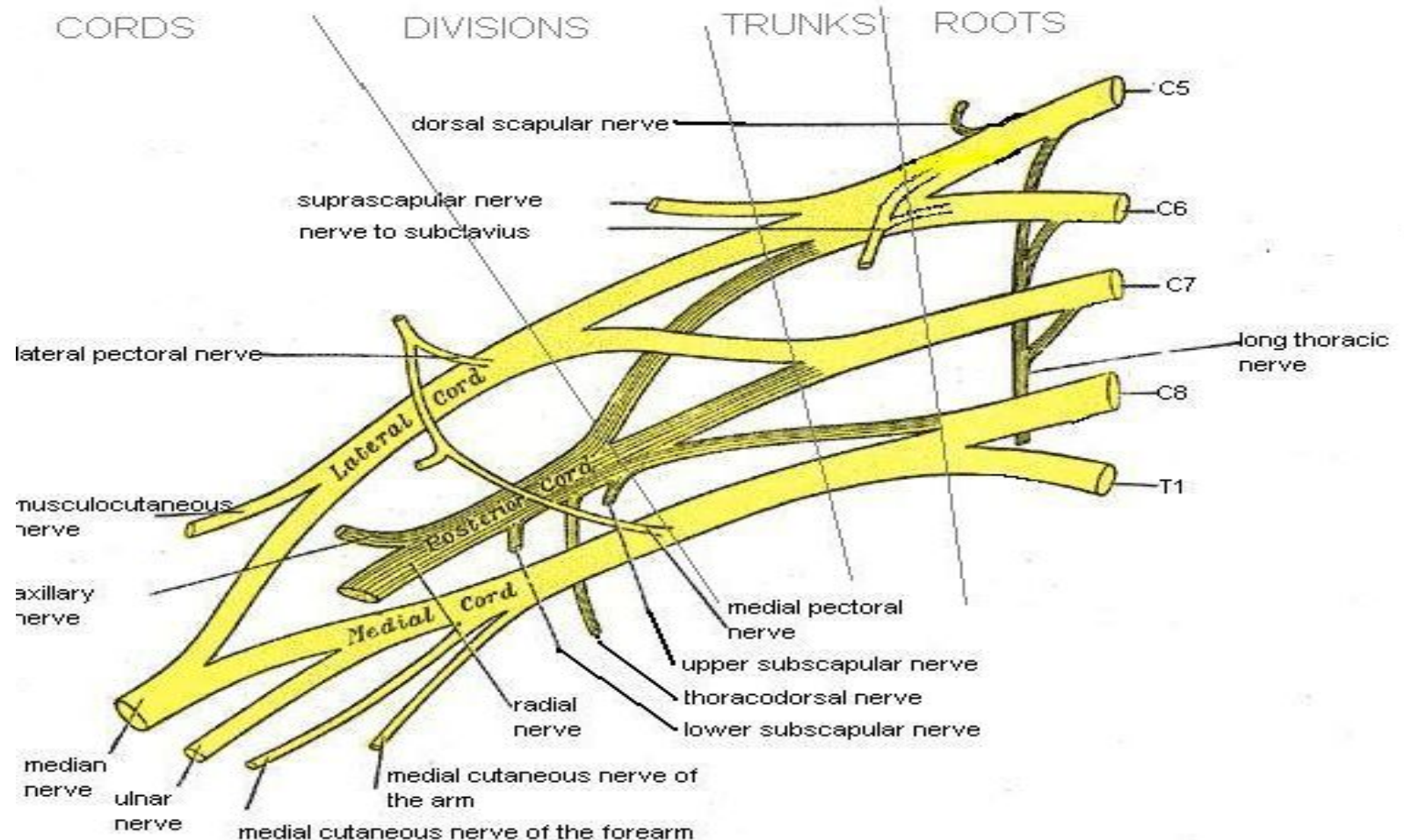
Clinical Features

■ Clinical examination should establish:

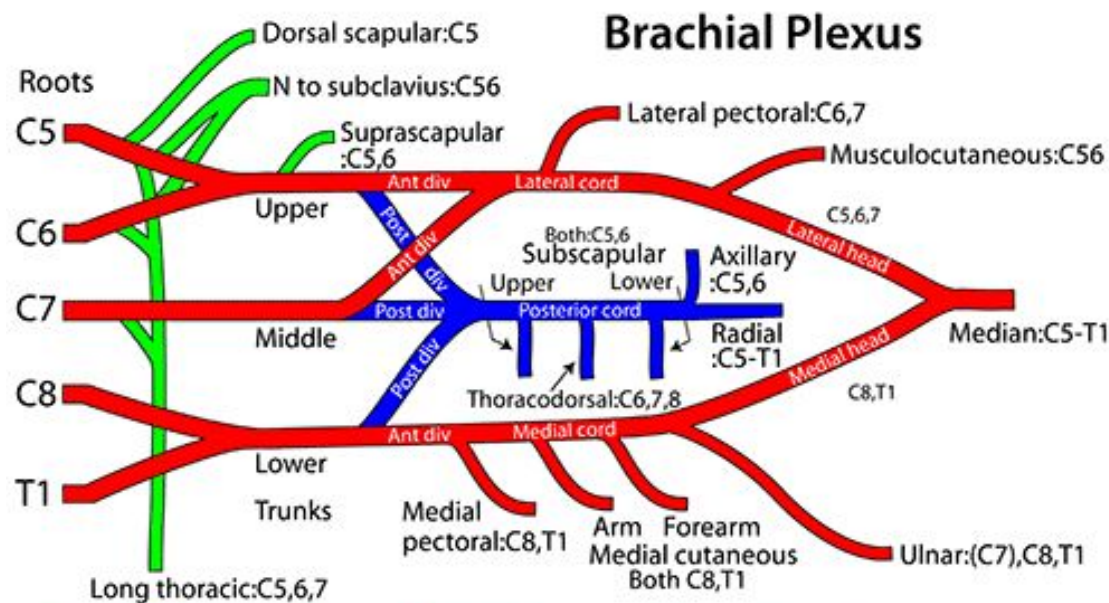
- **The level of the lesion**
 - Upper plexus injuries
 - Lower plexus injuries
 - Total plexus injuries
- **Preganglionic or postganglionic**
 - **Features suggesting preganglionic root avulsions**
 - Burning pain in an anesthetic hand
 - Paralysis of scapular muscles or diaphragm
 - Horner's Syndrome
 - Severe vascular injury
 - Associated fractures of the cervical spine
 - Spinal cord dysfunction
 - **Histamine Test**
 - **CT Myelography or MRI**
- **The type of damage**
 - Neurapraxia, Axonotmesis, or Neurotmesis

Brachial Plexus Injury

Normal Anatomy

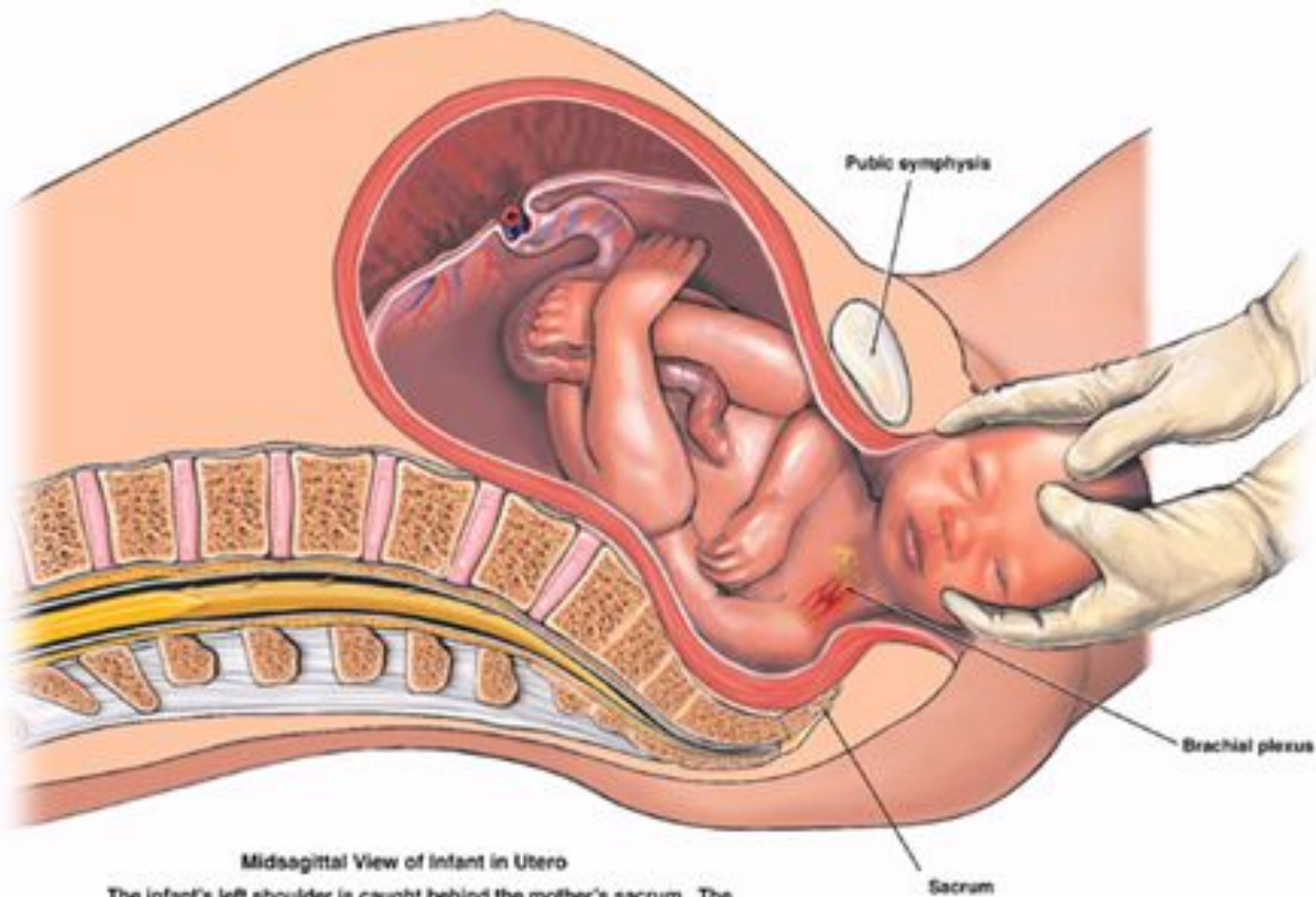


Brachial Plexus Injury



Note that there is usually some C7 in the ulnar nerve that gets there via a connection from the lateral cord or median nerve beyond the brachial plexus

Obstetrical Brachial Plexus Injury



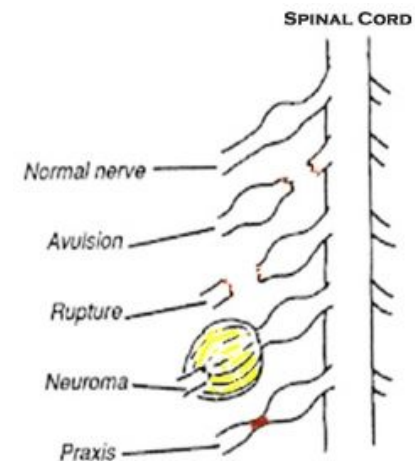
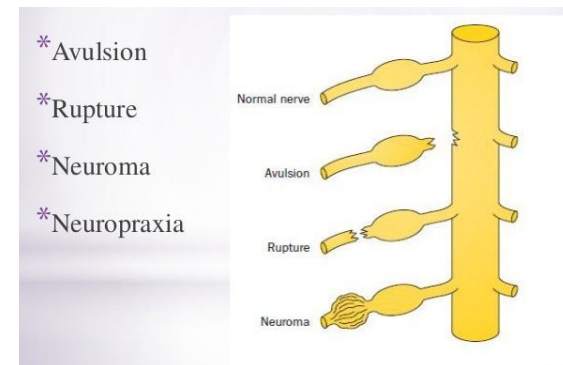
The infant's left shoulder is caught behind the mother's sacrum. The brachial plexus is stretched and damaged as the head is pulled out.

Stretch (neurapraxia) : Injury occurs outside the spinal cord . MC •

Rupture: nerve is torn outside the spinal cord . common form. may require surgical repair •

Avulsion: nerve roots are torn from the spinal cord injury.10-20%. Cannot be surgically repaired directly - nerve transfers . +/- Phrenic nerve (diaphragm) +/- Horner's syndrome •

Neuroma •

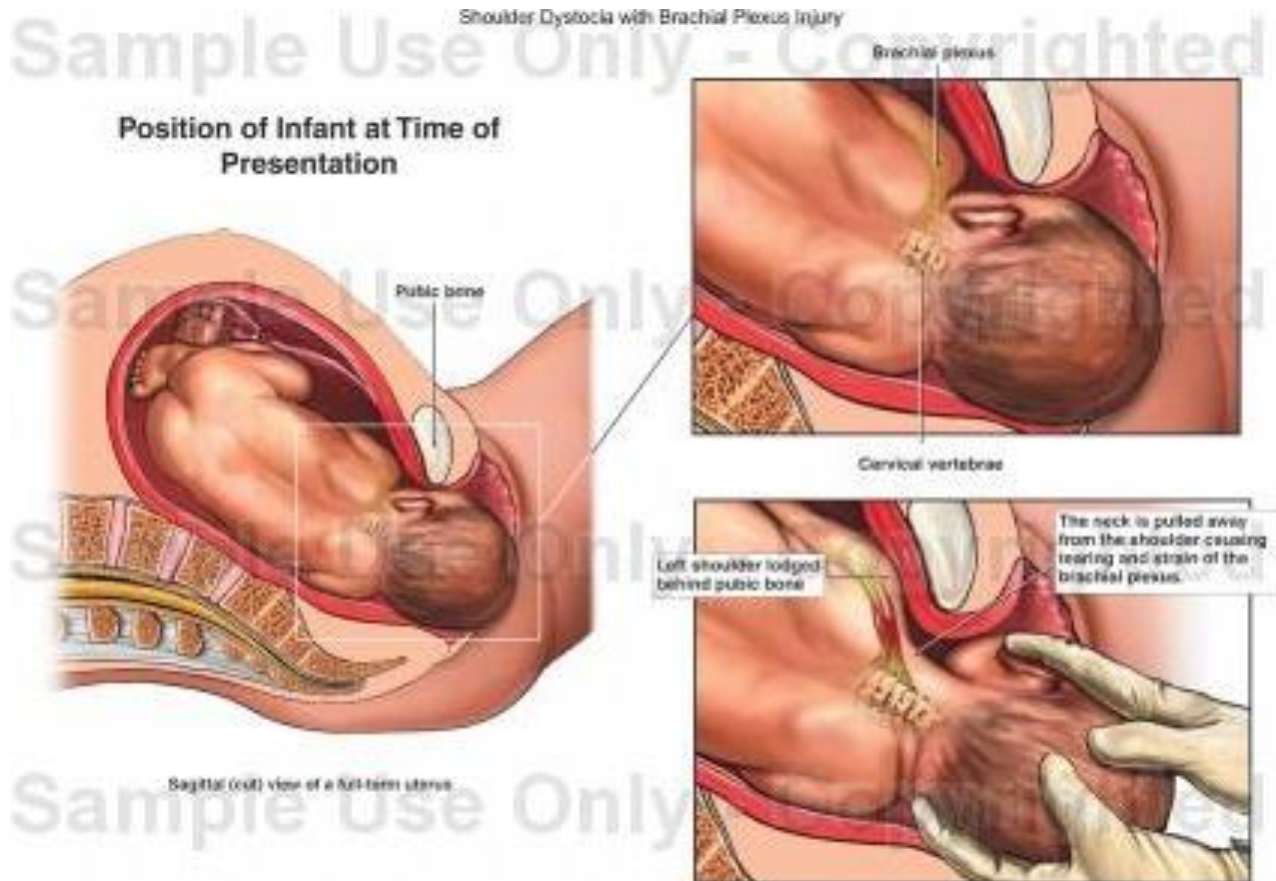




Obstetrical Brachial Plexus Injury

- **Erb's Palsy**
- **Klumpke's Palsy**

Obstetrical Brachial Plexus Injury



Obstetrical Brachial Plexus Injury

- Clinical Features

- The diagnosis is usually obvious at birth
- Further examination a day or two later will define the type of brachial plexus injury.
- Erb's Palsy
- Klumpke's Palsy
- X- rays should be taken

Obstetrical Brachial Plexus Injury

– Erb's Palsy



waiter's tip hands



Brachial Plexus Injury

Upper Erb's C5, C6

Shoulder abduction/external rotation, elbow flexion affected. Good spontaneous recovery expected in over 80% of cases

Extended Erb's C5, C6, C7

As above with wrist drop. Good spontaneous recovery in about 60% of cases

Total palsy with no Horner syndrome C5, C6, C7, C8, T1

Complete flaccid paralysis good spontaneous recovery of the shoulder and elbow in 30–50% of cases. A functional hand may be seen in many patients

Total palsy with Horner syndrome C5, C6, C7, C8, T1

Complete flaccid paralysis with Horner syndrome. The worst outcome. Without surgery, severe defects throughout the limb function

Narakas AO. Obstetric brachial plexus injuries. In: LambDW(Ed.) The paralysed hand. Edinburgh, Churchill Livingstone, 1987: 116–35.



Obstetrical Brachial Plexus Injury

– Total Plexus

- Infant with total brachial plexus palsy of the right limb



Brachial Plexus Injury

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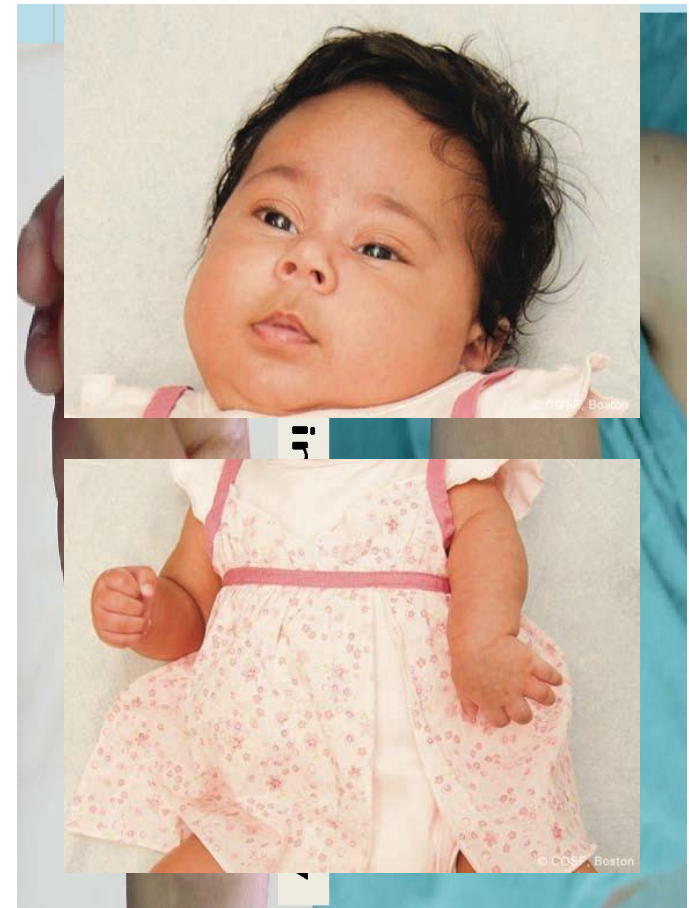
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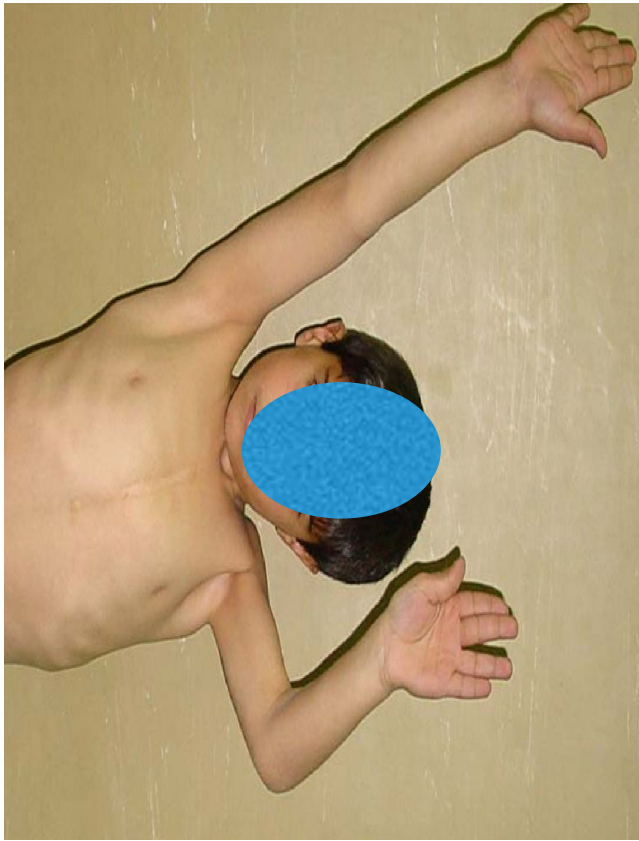
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Isolated Klumpke's?!



Brachial Plexus Injury



Good Prognosis

- Complete recovery possible if biceps and deltoid are anti-gravity by 2 months
- Erb's Palsy
- Early twitch biceps activity suggests a favorable

Bad Prognosis

- Lack of biceps function by 3 months
- Preganglionic injuries (worst prognosis), avulsions from the cord, which will not spontaneously recover motor function, loss of rhomboid function (dorsal scapular nerve), elevated hemidiaphragm (phrenic nerve).
- Horner's syndrome (ptosis, miosis, anhidrosis): less than 10% recover spontaneous motor function
- C7 involvement
- Klumpke's Palsy



Obstetrical Brachial Plexus Injury

– Prognosis

- Paralysis may recover completely
- Paralysis may improve and then remain static
- Paralysis may remain unaltered



Long Thoracic Nerve Injury

- Mechanism of injury
- Winging of scapula
- Prognosis

Long Thoracic Nerve Injury

Winging Of Scapula

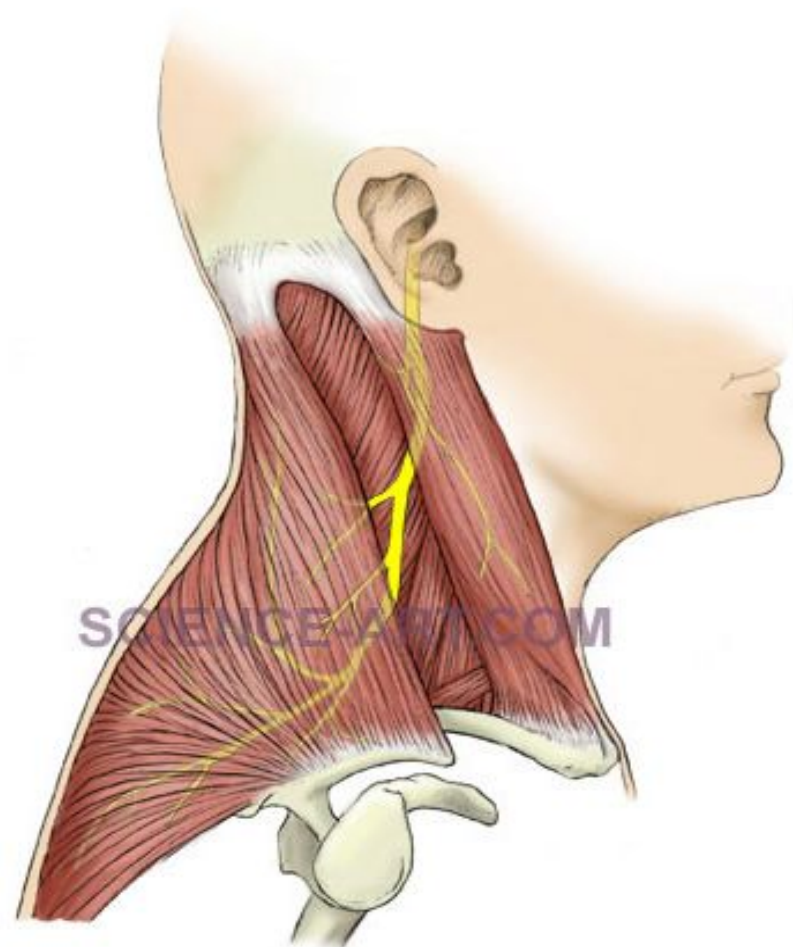


Winging of scapula



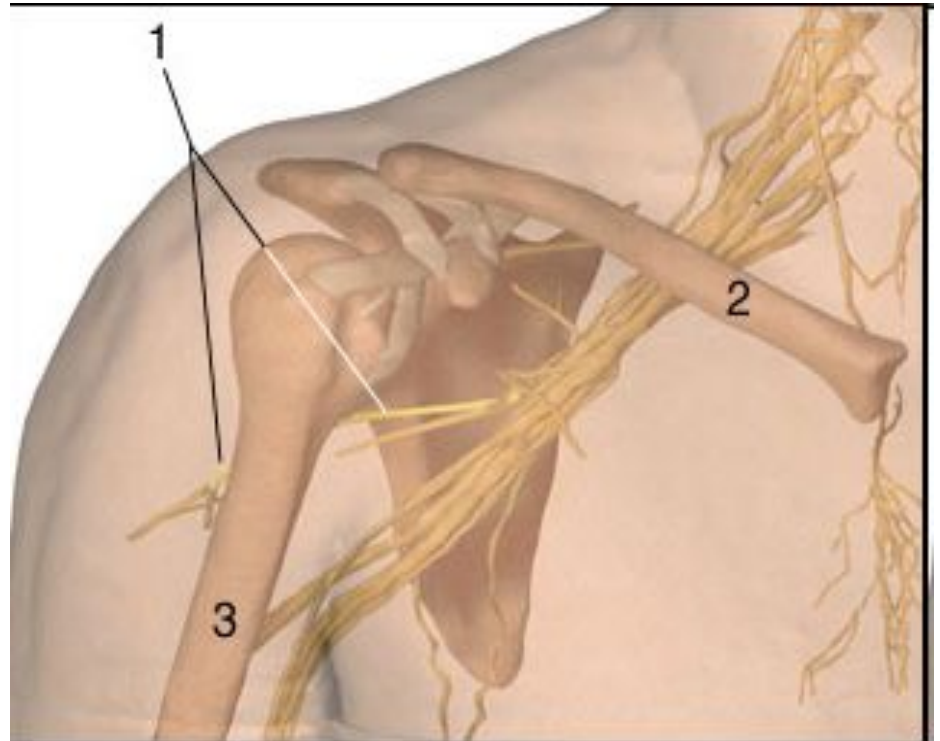
Spinal Accessory Nerve Injury

- Normal Function
- Dangerous Areas
- Mechanism of Injury
- Clinical Features
- Management



Axillary Nerve Injury

- Mechanism of injury
- Clinical features
- Management
- Prognosis



Radial Nerve

- Course of radial nerve
- Lesions causing radial nerve injury
 - Low lesions
 - High lesions
 - Very high lesions

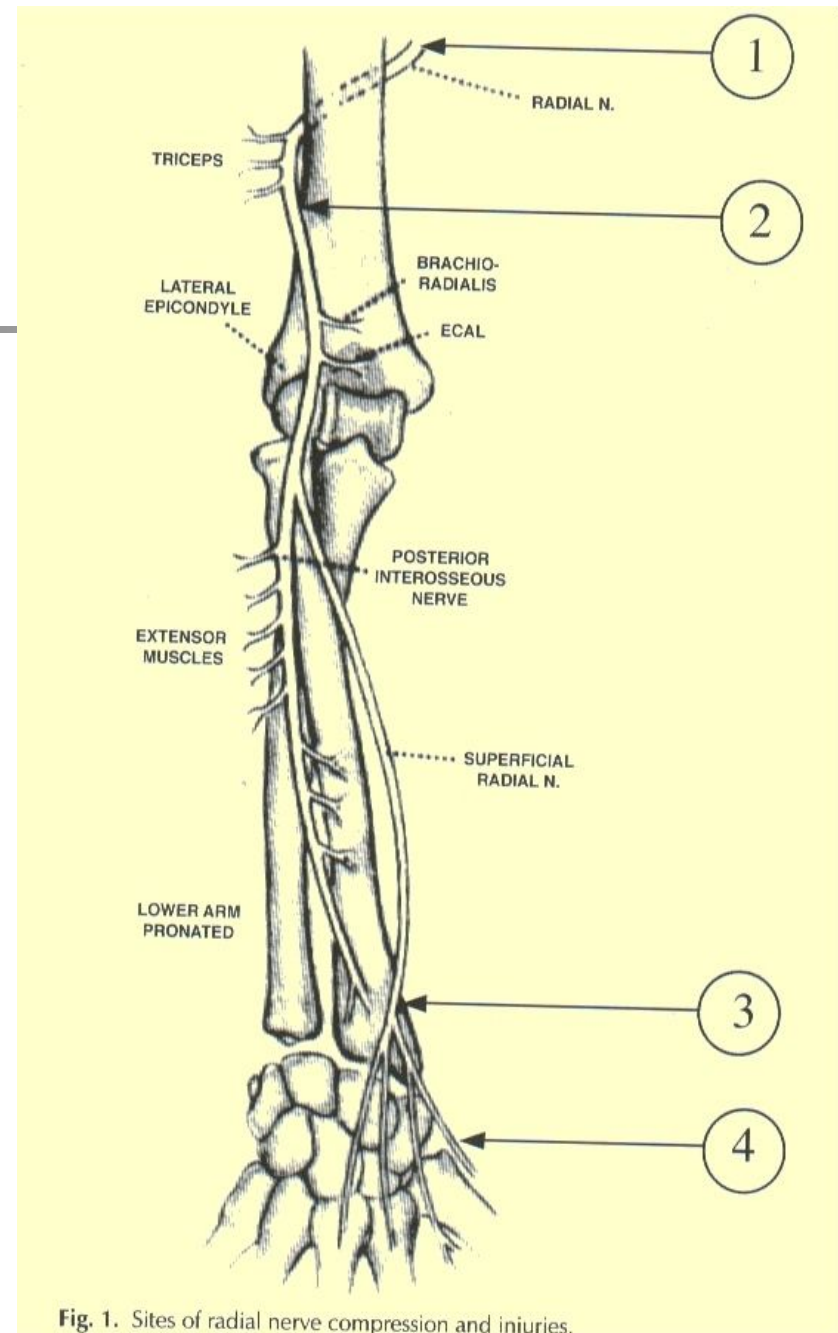
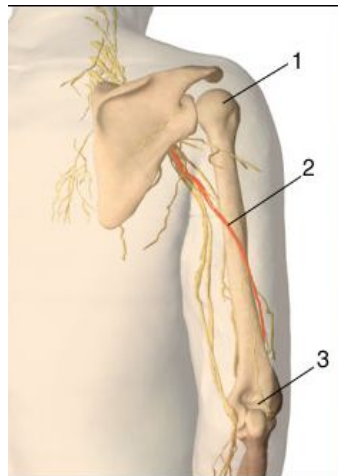
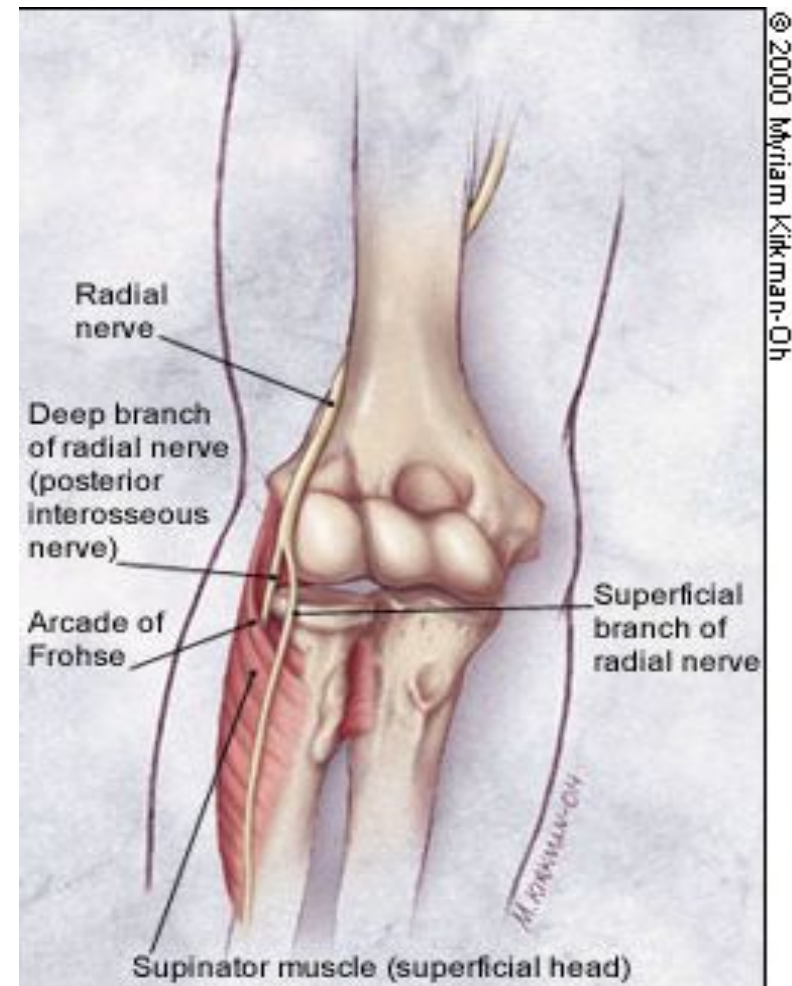


Fig. 1. Sites of radial nerve compression and injuries.

Radial Nerve Injury

Low lesions

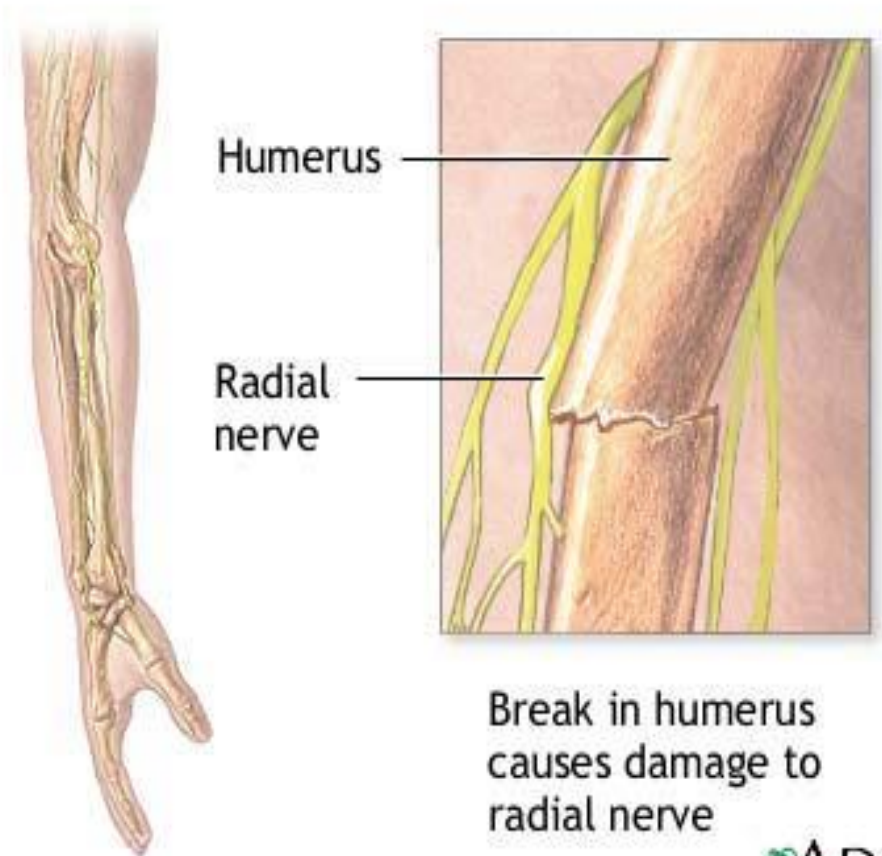
- Mechanism of injury
- Clinical Features



Radial Nerve Injury

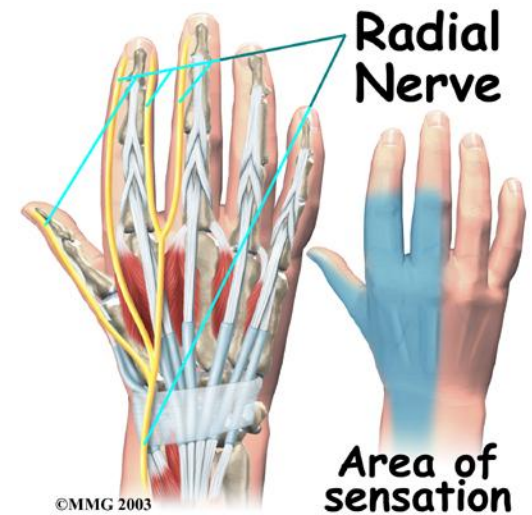
High lesions

- Mechanism of Injury
- Clinical Features



Radial Nerve Injury

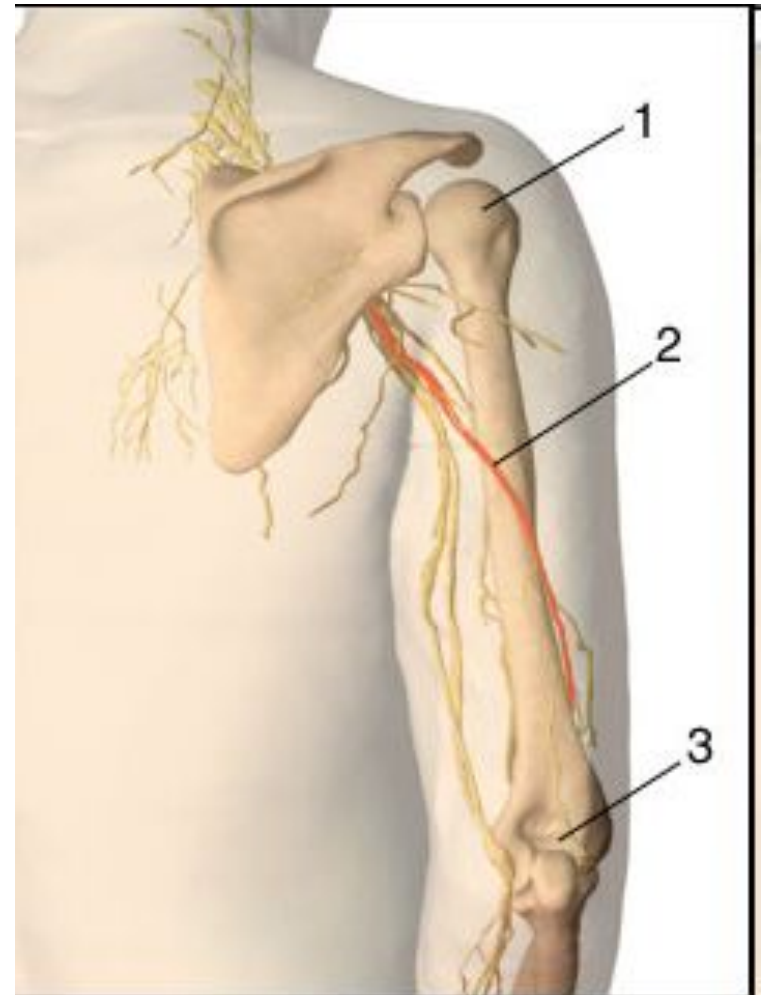
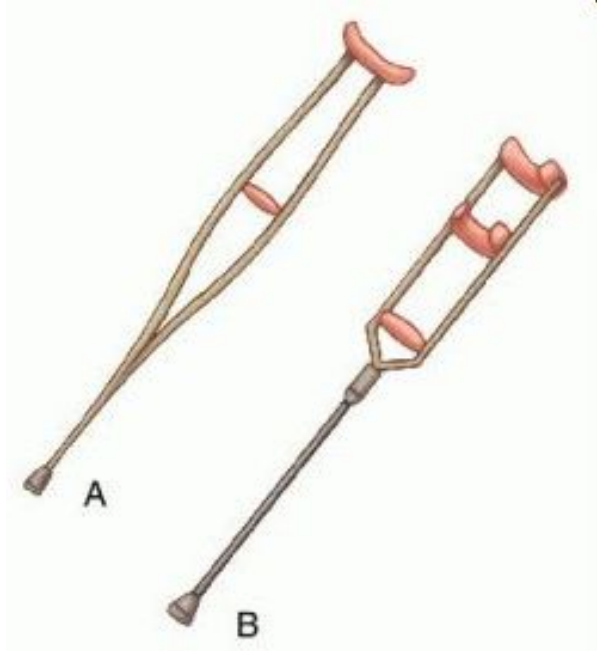
High lesions



Radial Nerve Injury

Very High lesions

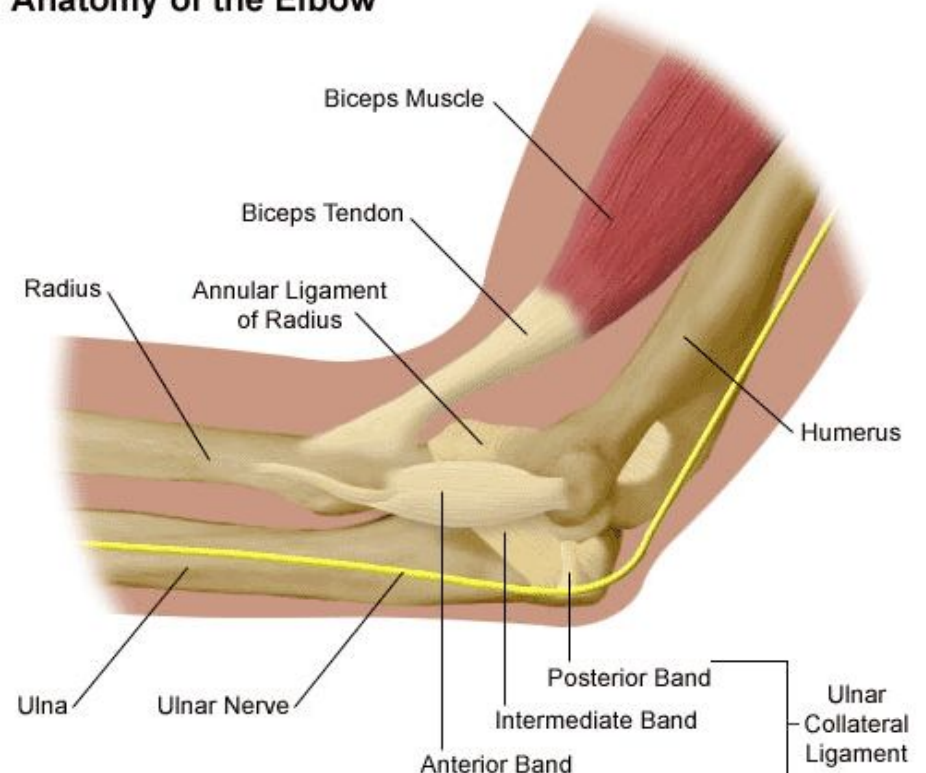
- 'Crutch' Palsy



Ulnar Nerve Injury

- Normal Function
- Site of Lesion
 - Low Lesions
 - High Lesions

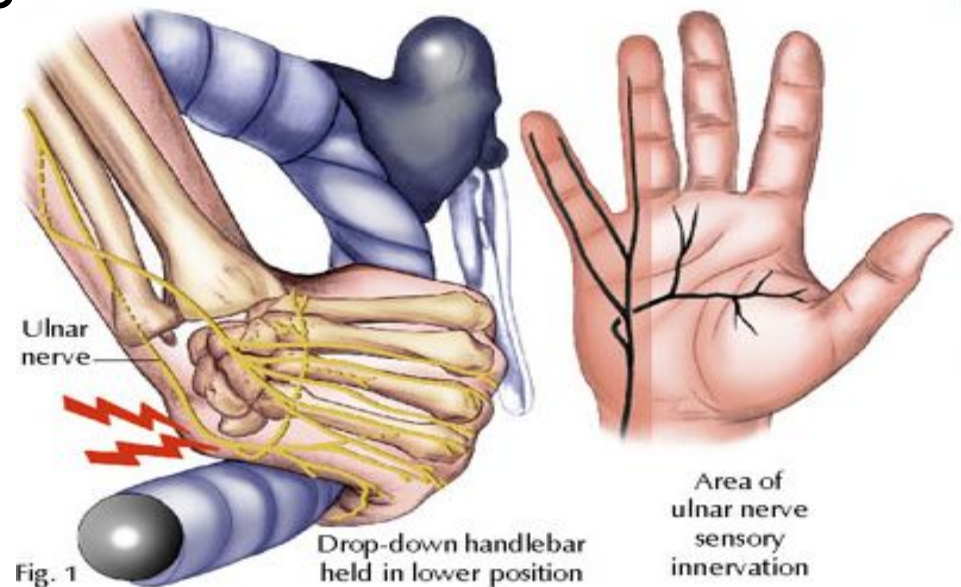
Anatomy of the Elbow



Ulnar Nerve Injury

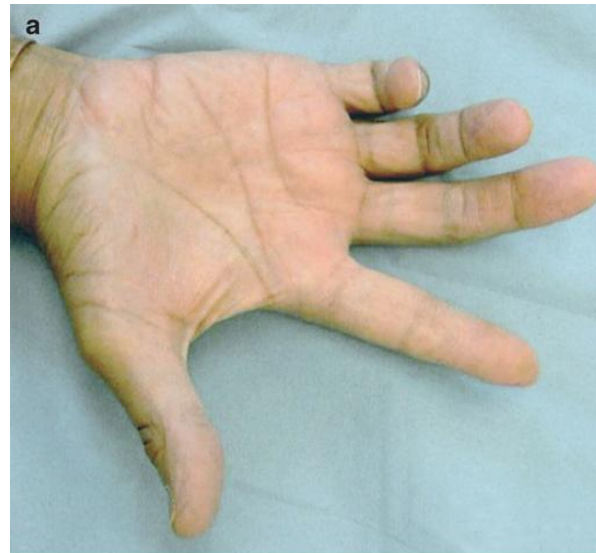
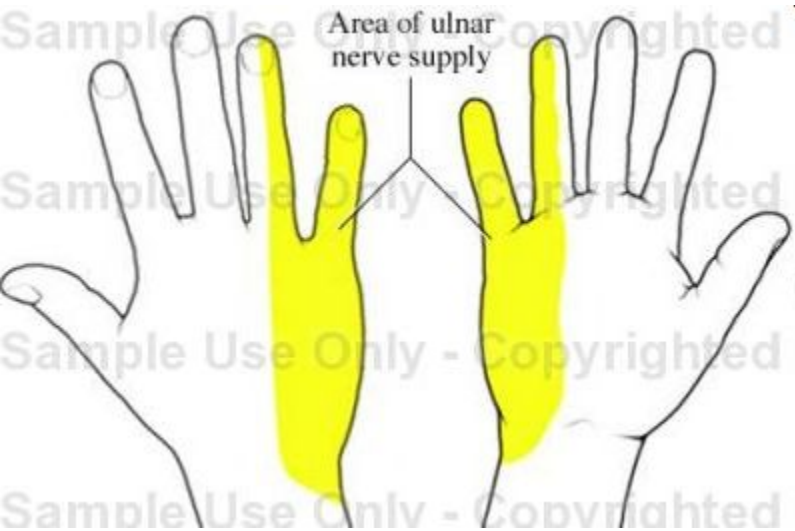
Low lesions

- Mechanism of Injury
- Clinical Features



Ulnar Nerve Injury

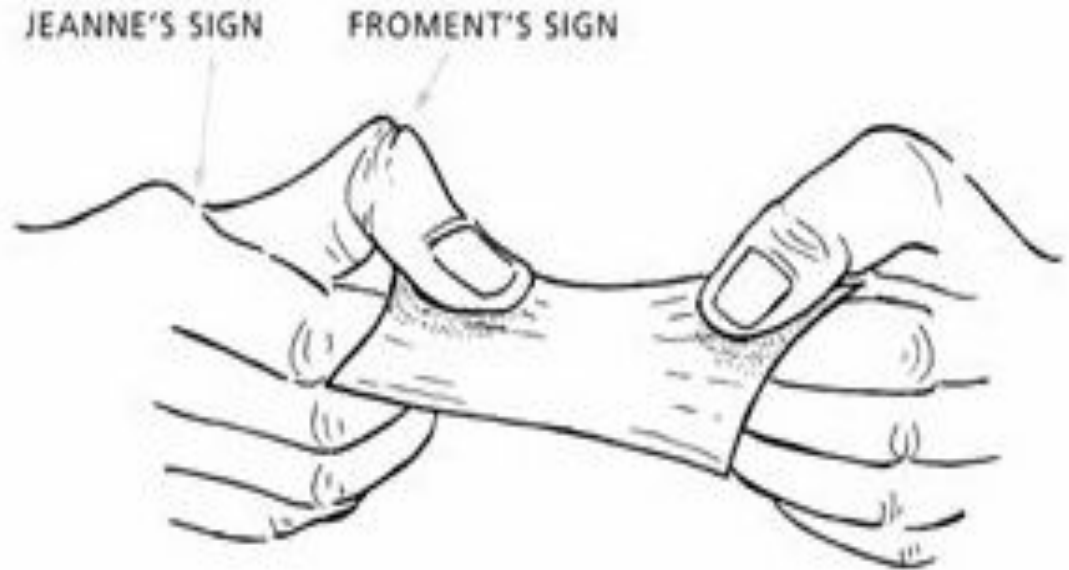
Low lesions



Ulnar Nerve Injury

Low lesions

Froment's Sign



Froment's sign results from weakness or absent adduction function of the thumb. The interphalangeal joint of the thumb will flex while pulling on a piece of paper. Jeanne's sign is hyperextension of the metacarpal joint of the thumb during pinch strength.

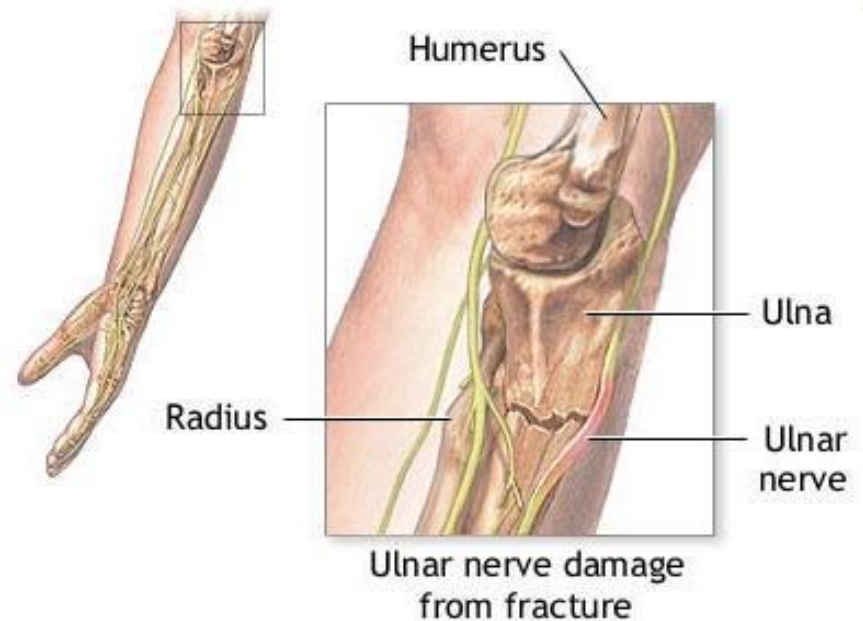
This weakness or absent function is seen in low ulnar nerve palsy.

Ulnar Nerve Injury

High lesions

- Mechanism of Injury
- Clinical Features
 - Less 'clawed' fingers

Ulnar Paradox



Ulnar Nerve Injury

High lesions



..Froment's sign

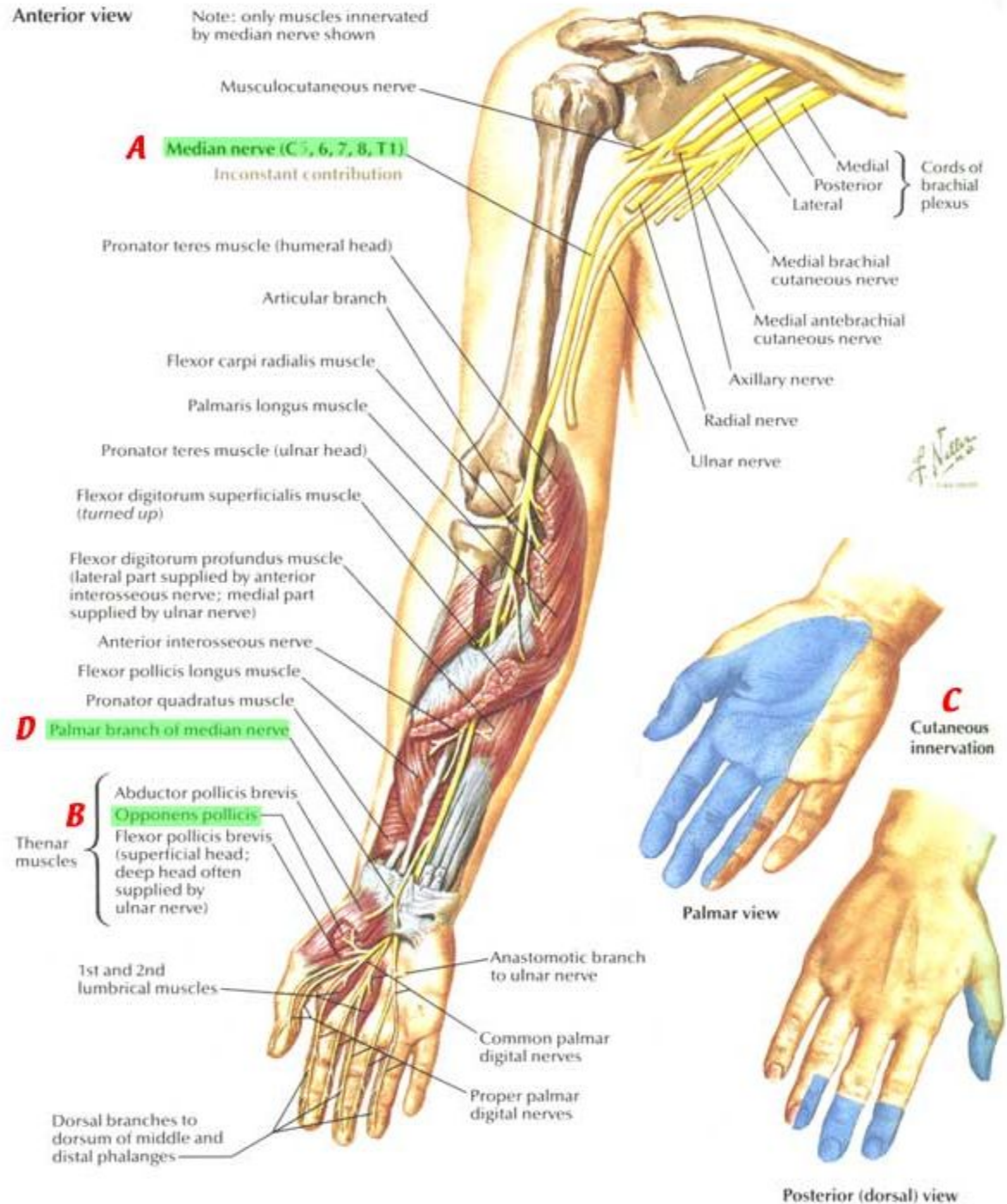


- Severe interosseous atrophy (arrow)
- Clawing of the ring and small finger

Median Nerve

Anterior view

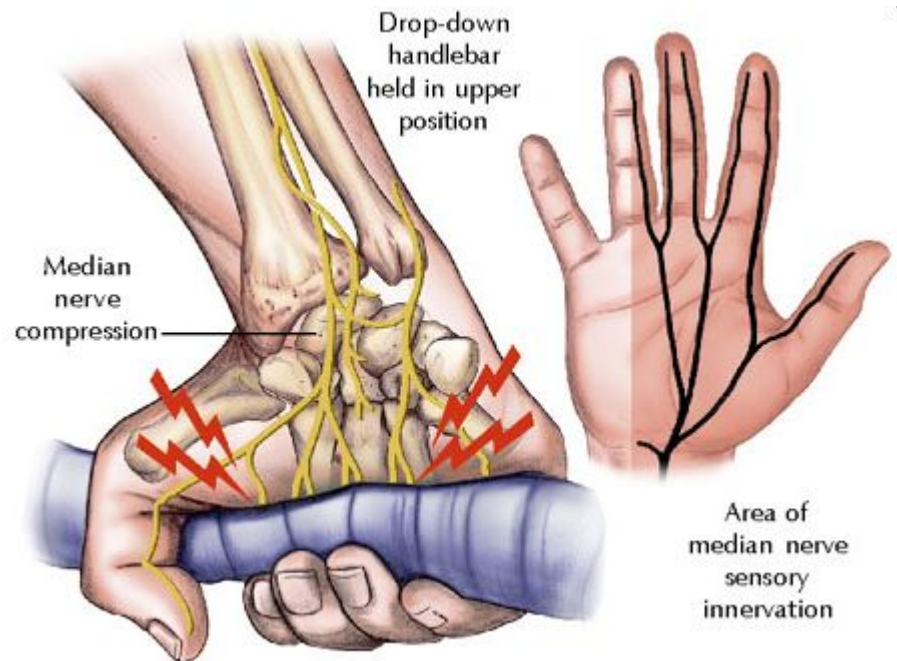
Note: only muscles innervated by median nerve shown



Median Nerve Injury

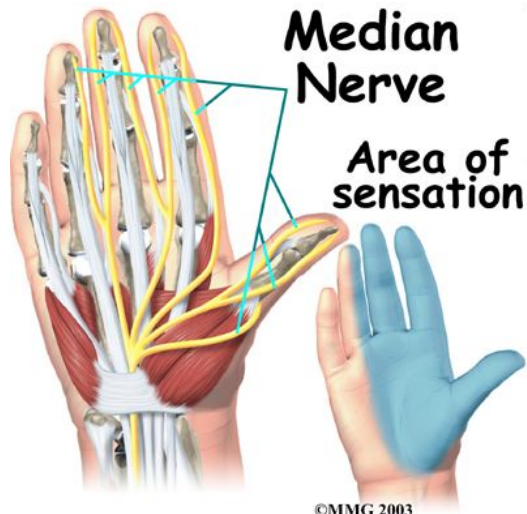
Low Lesions

- Mechanism of Injury
- Clinical Features



Median Nerve Injury

Low Lesions



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Median Nerve Injury

High Lesions

- Mechanism of Injury
- Clinical Features
 - Ape hand

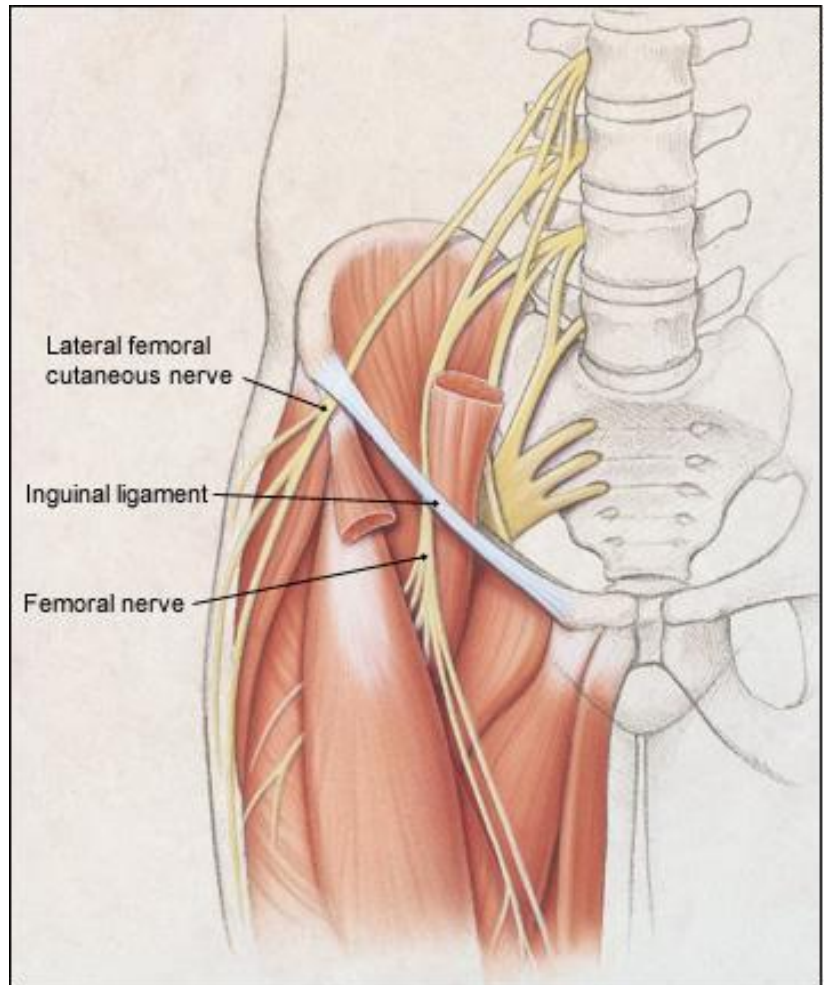


Nerve Injuries Affecting The Lower Limb



- Femoral Nerve
- Sciatic Nerve
- Peroneal Nerves

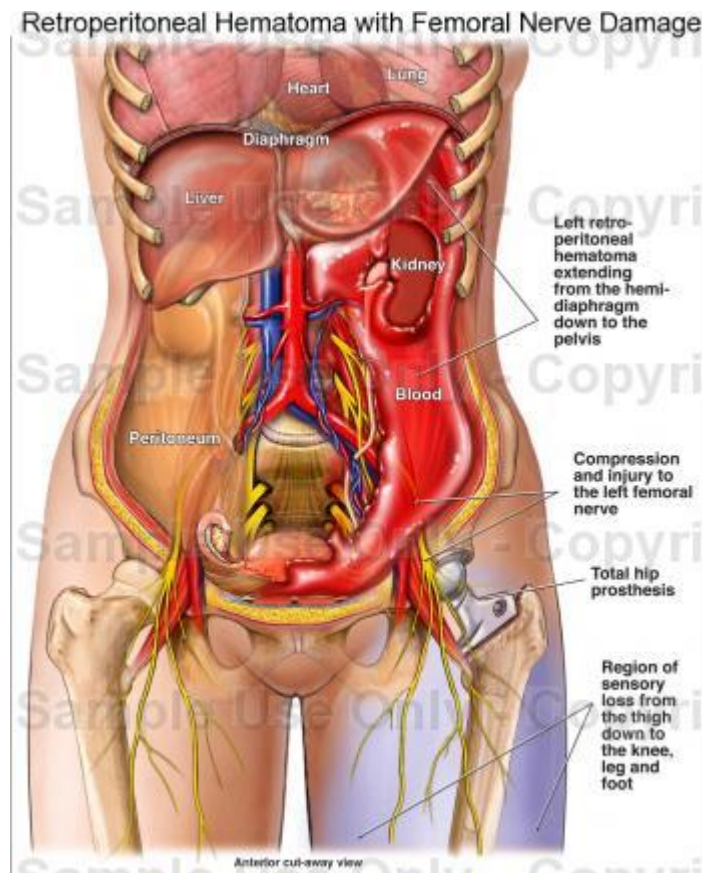
Femoral Nerve



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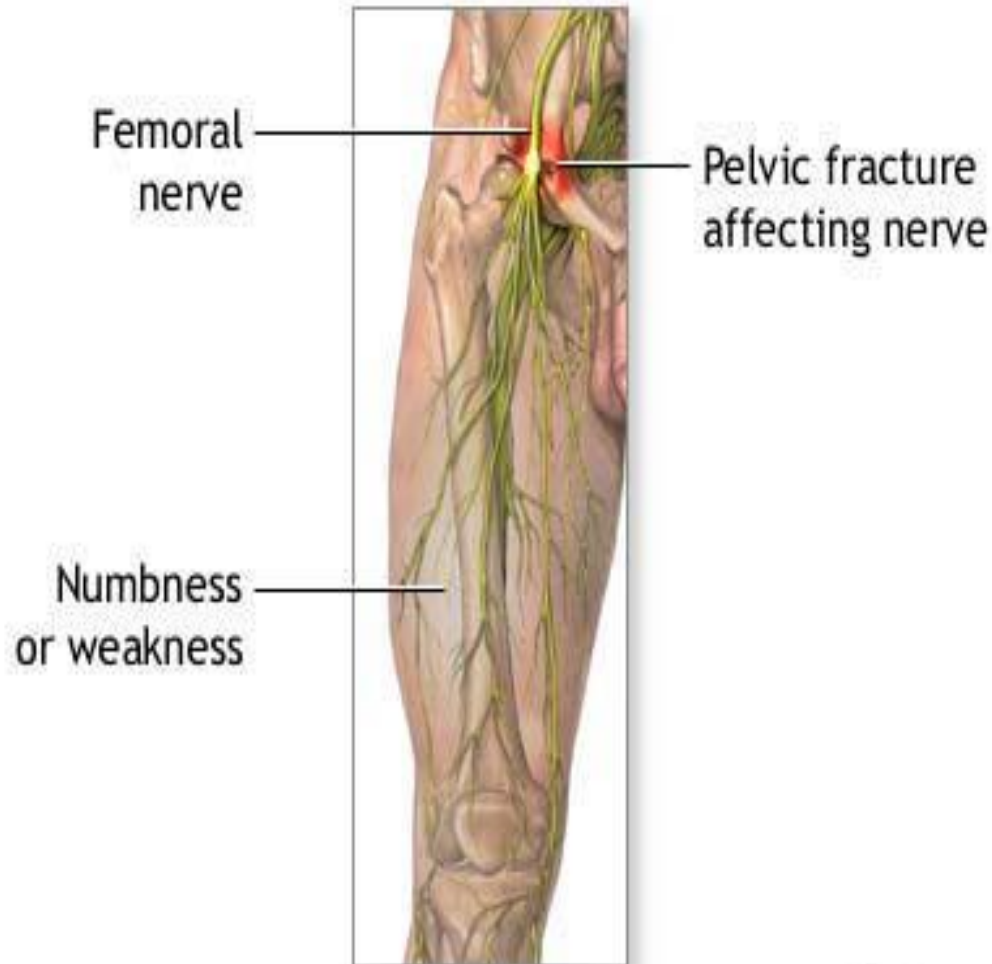
Femoral Nerve injury

Mechanism of injury



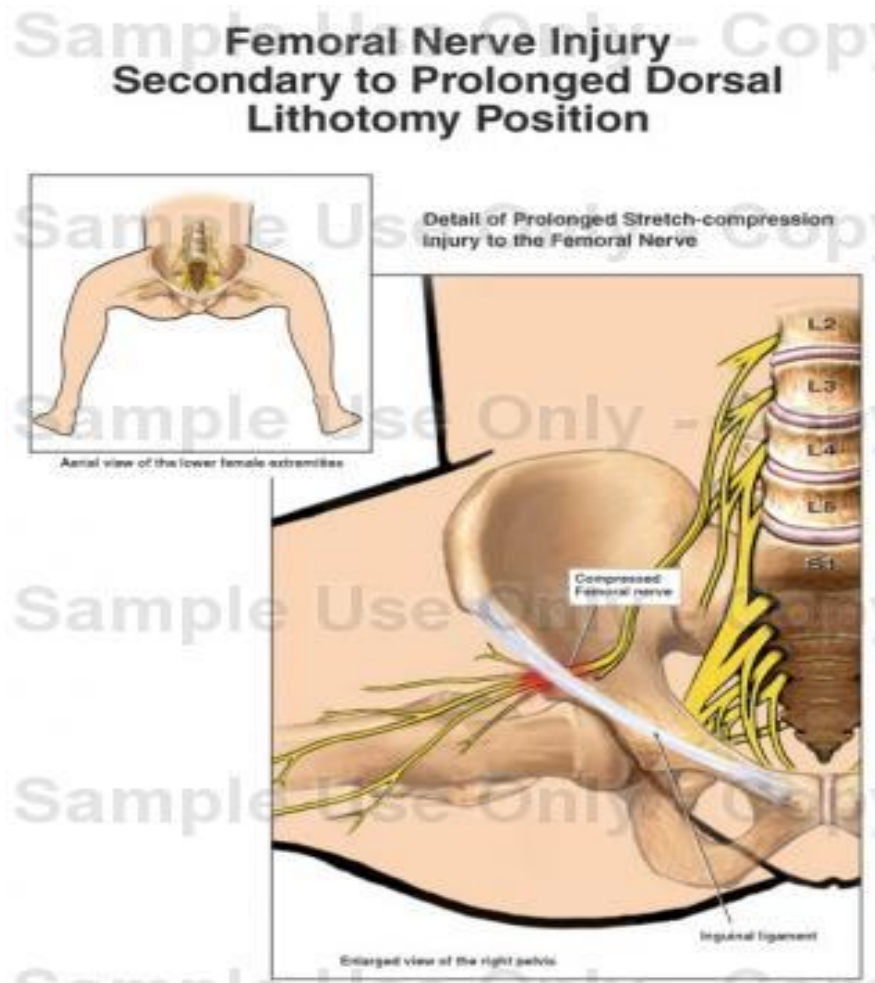
Femoral Nerve injury

Mechanism of injury



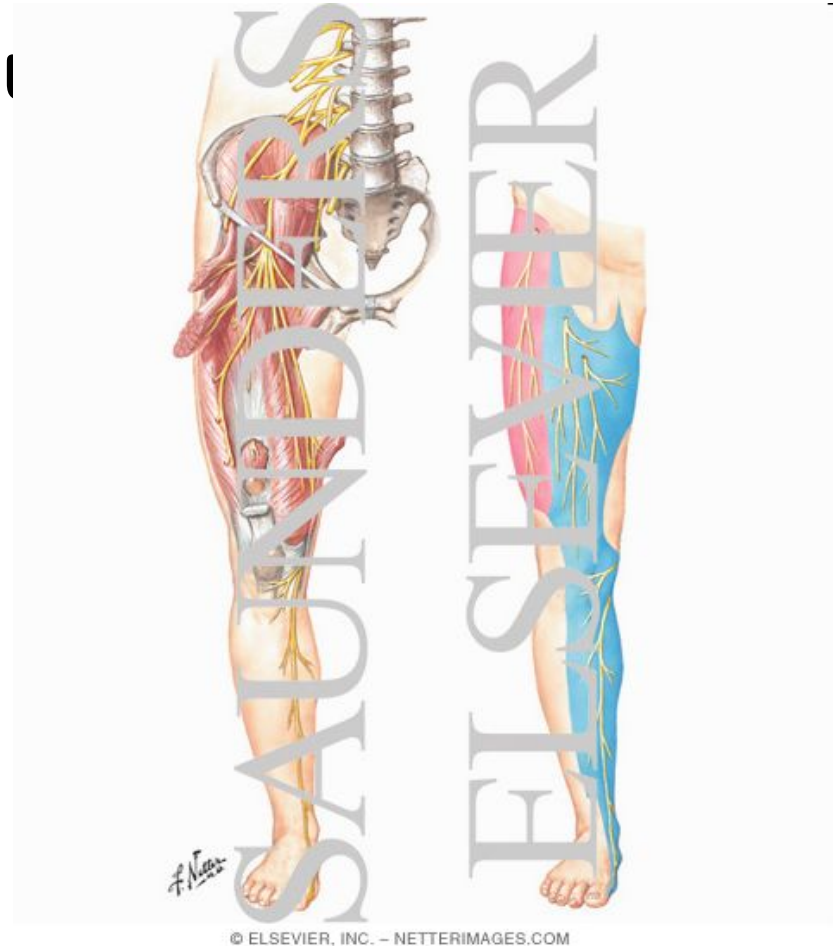
Femoral Nerve injury

Mechanism of injury

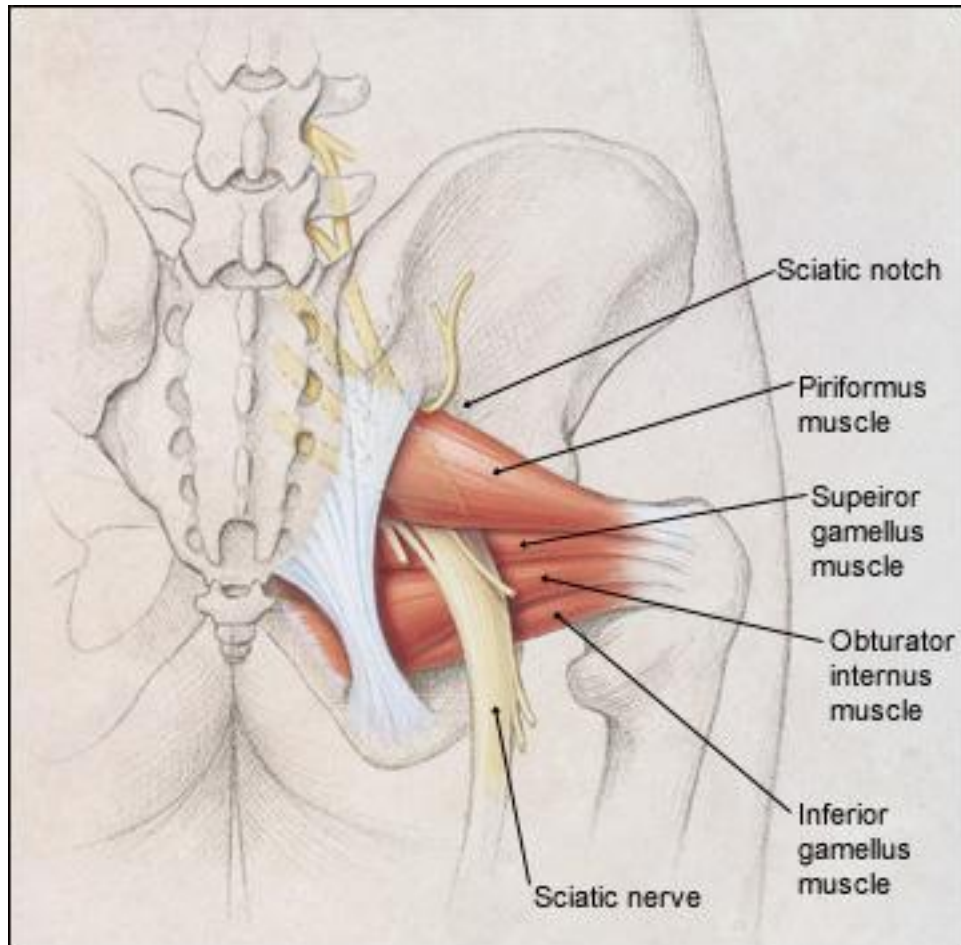


Femoral Nerve Injury

- Mechanism of Injury
- Clinical Features
- Management



Sciatic Nerve

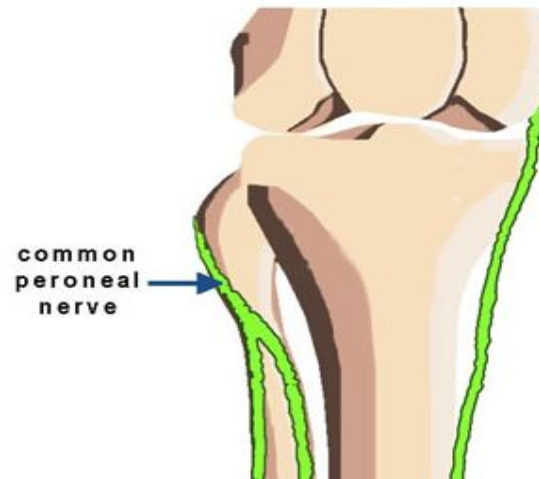
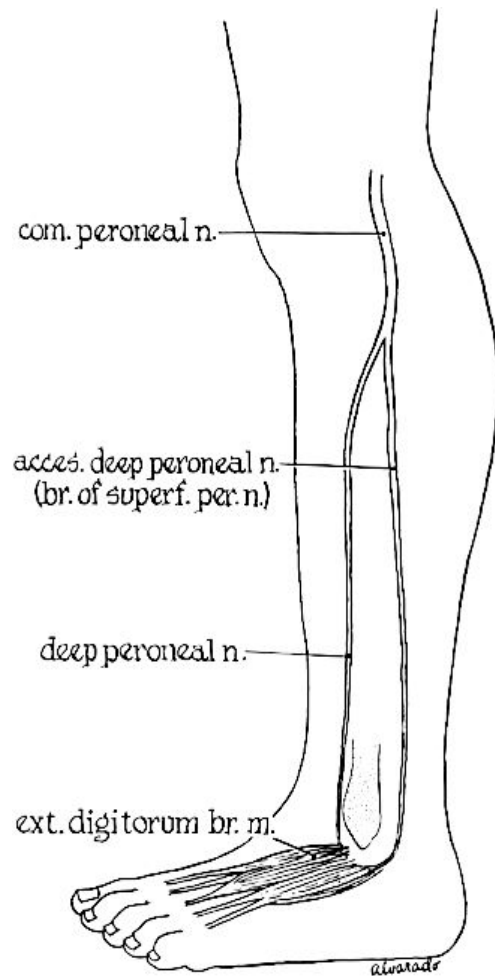
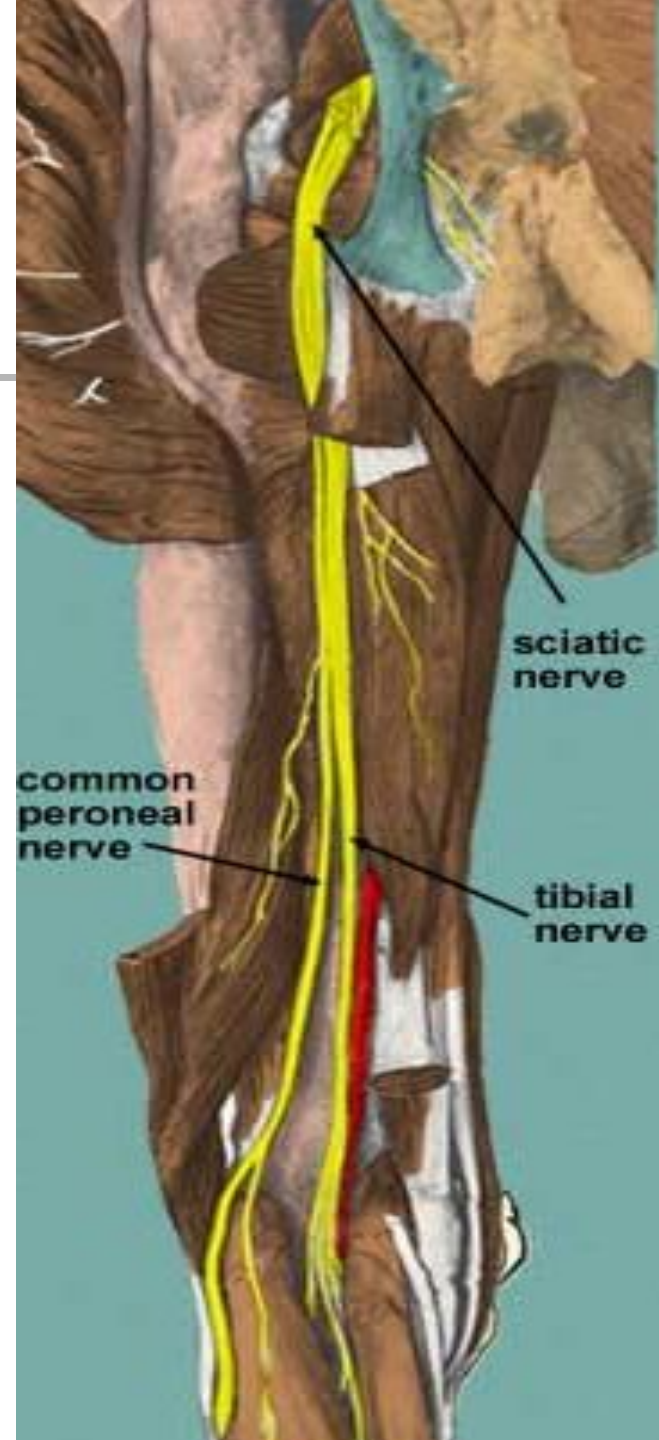


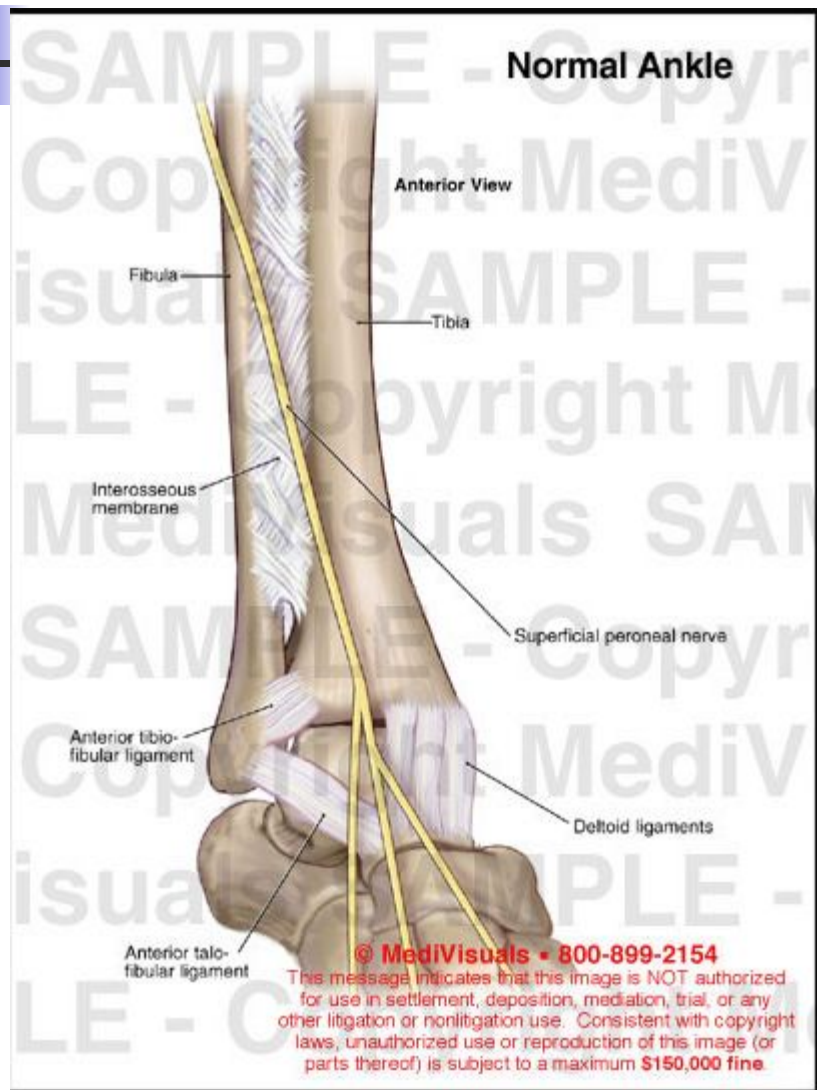
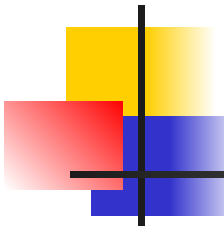
Sciatic Nerve injury

- Mechanism of Injury
- Clinical Features
 - Complete
 - Partial
- Management
 - Repair
 - Splintage
 - Tendon Transfer
 - Amputation
- Iatrogenic Sciatic Nerve I



Peroneal Nerves

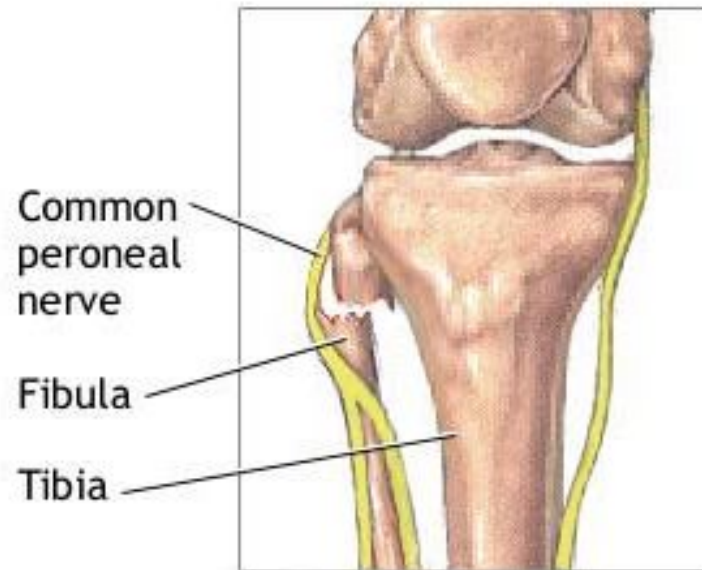




Peroneal Nerves Injury

Common Peroneal Nerve Injury

- Mechanism of Injury
- Clinical Features
 - Motor
 - Sensory



Broken fibula causes damage to peroneal nerve



Peroneal Nerves Injury

Common Peroneal Nerve Injury



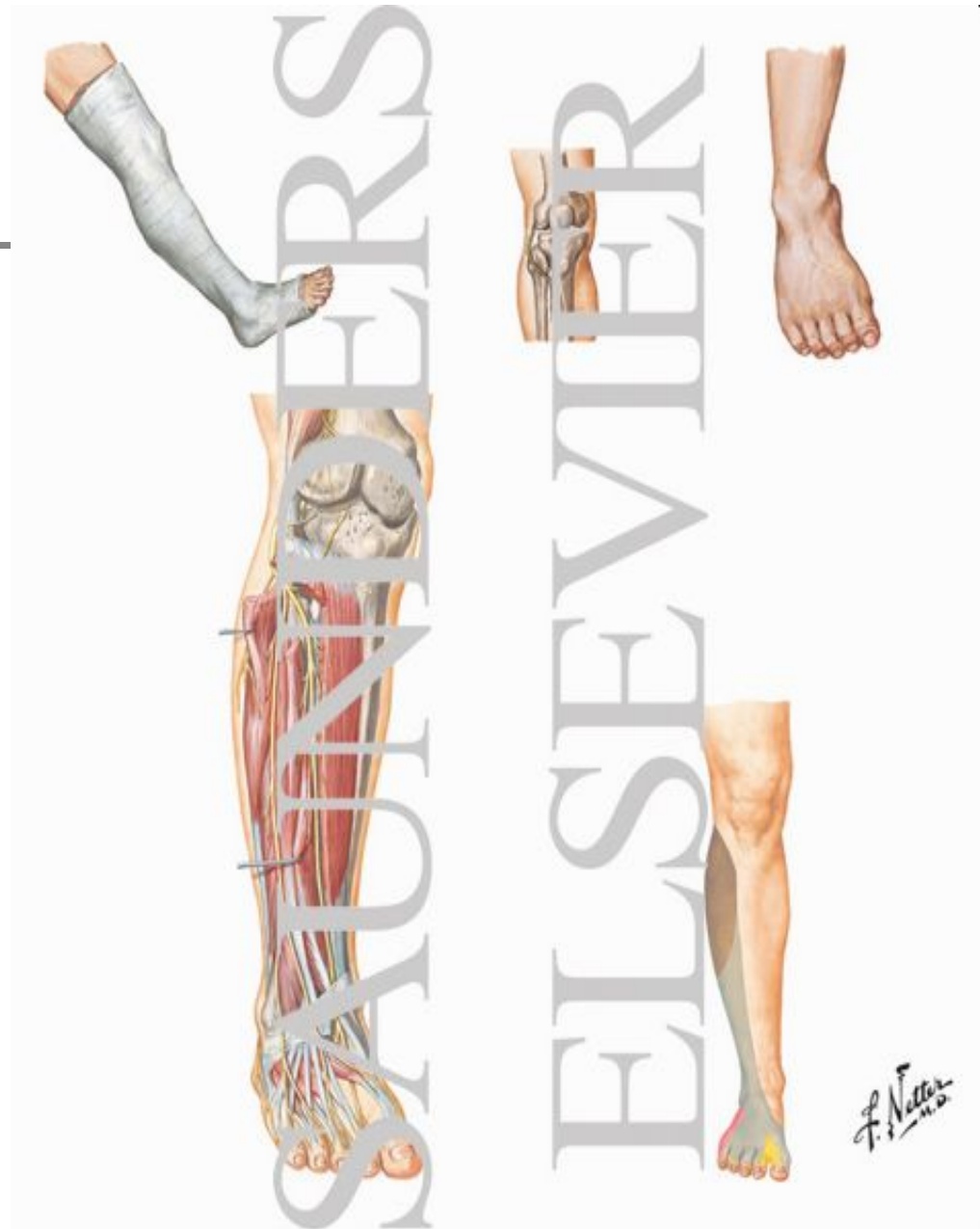
Foot Drop



Peroneal Nerves

Injury

- Superficial Branch
- Deep Branch
- Management



Nerve Entrapment Syndromes



- Median Nerve Entrapment
- Ulnar Nerve Entrapment
- Thoracic Outlet Syndrome



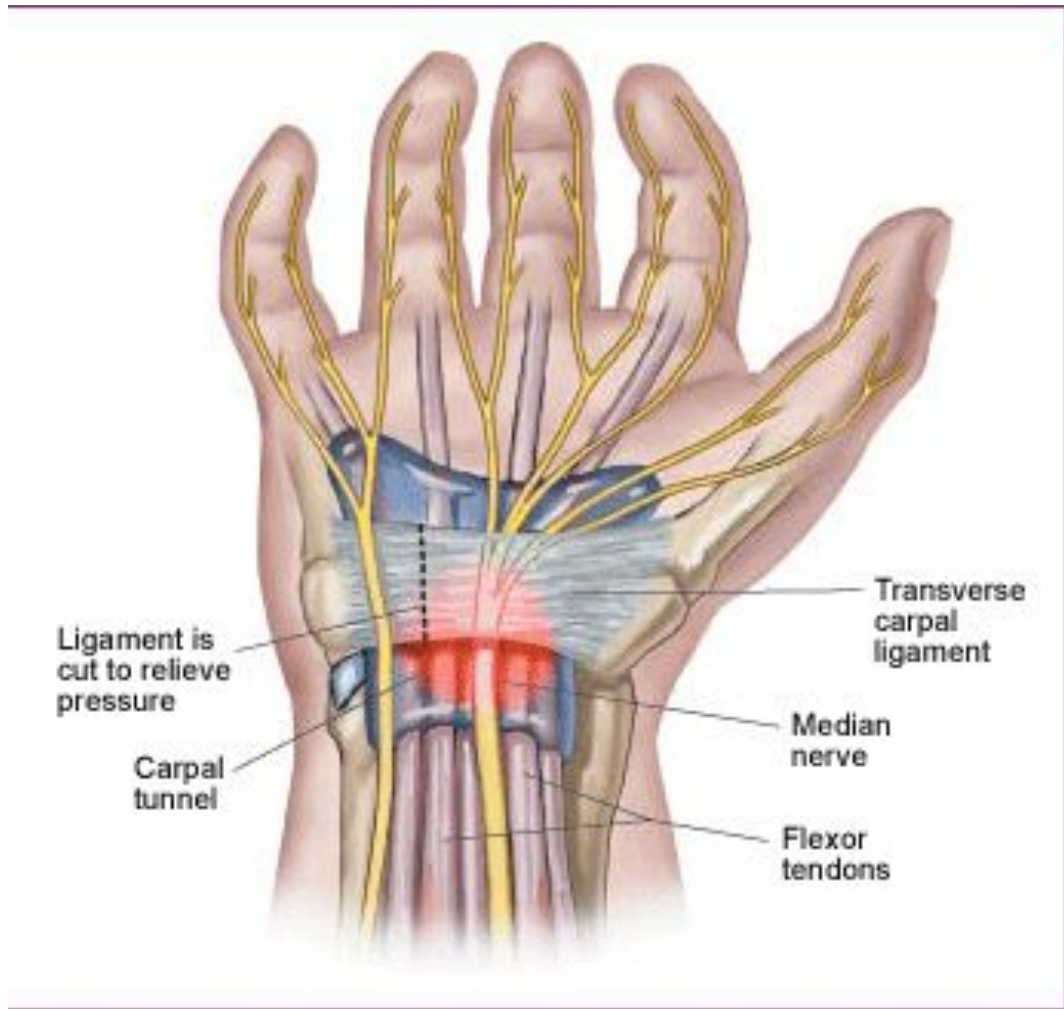
Nerve Entrapment Syndromes

- **Common Sites**
 - Carpal Tunnel
 - Cubital Tunnel
 - Fascial Septa of the Forearm
 - Tarsal Tunnel
 - Inguinal Ligament
 - Thoracic Outlet

- **Risk factors**

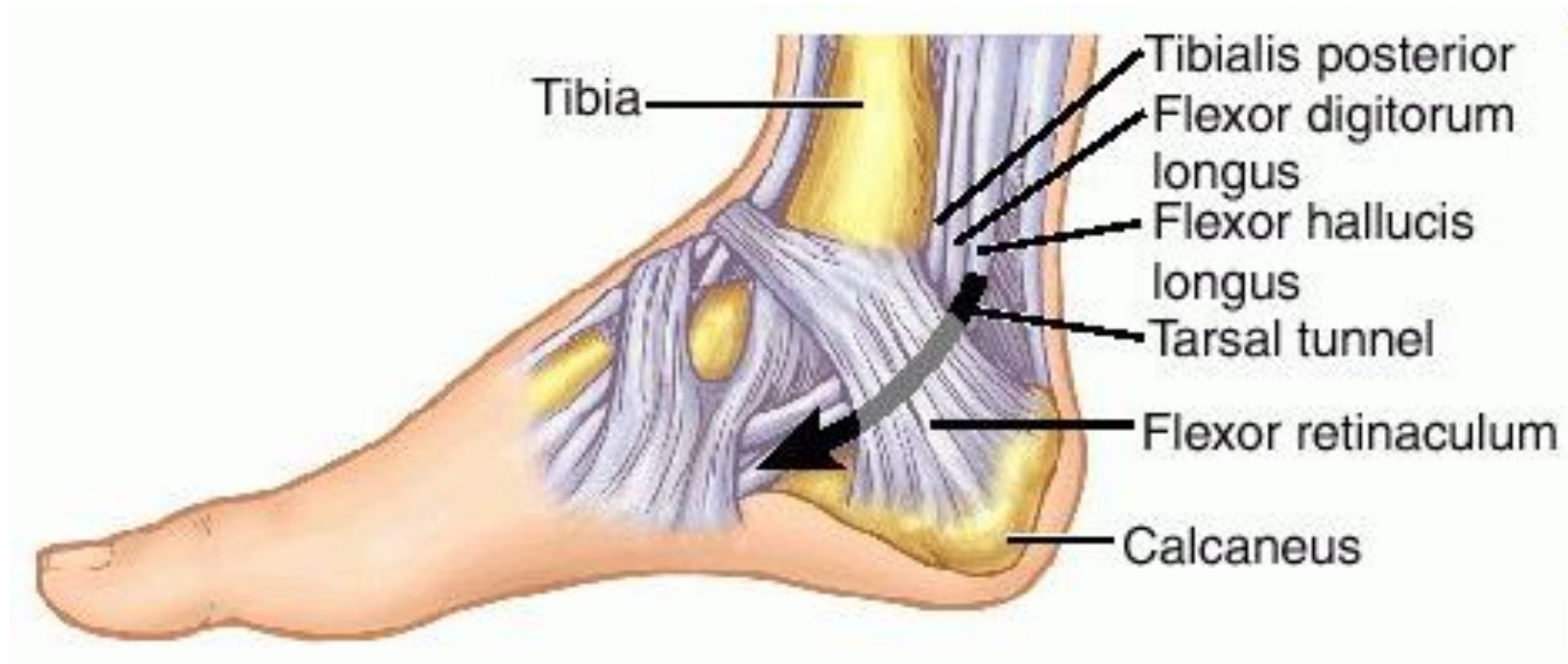
Nerve Entrapment Syndromes

Carpal Tunnel



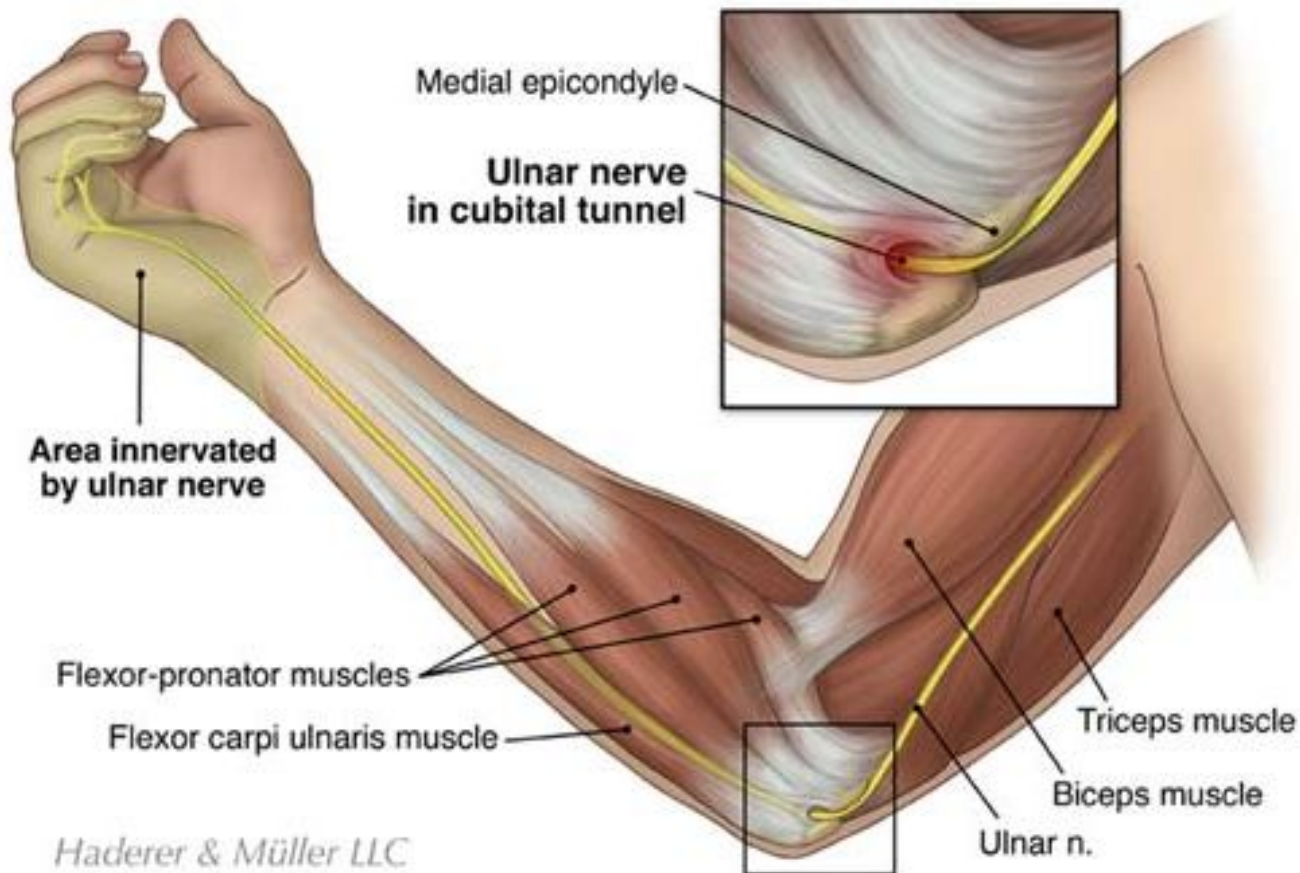
Nerve Entrapment Syndromes

Tarsal Tunnel



Nerve Entrapment Syndromes

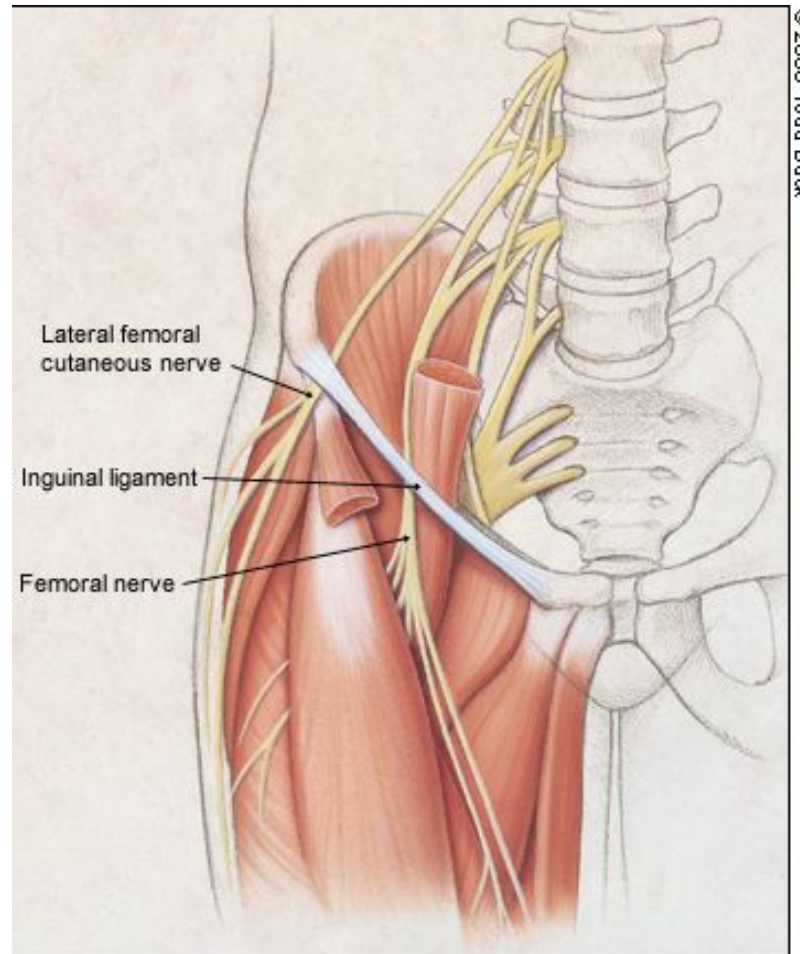
Cubital Tunnel



Haderer & Müller LLC

Nerve Entrapment Syndromes

Inguinal Ligament



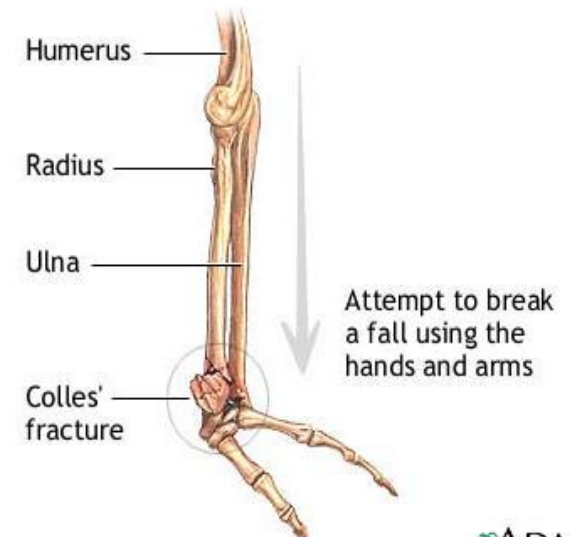
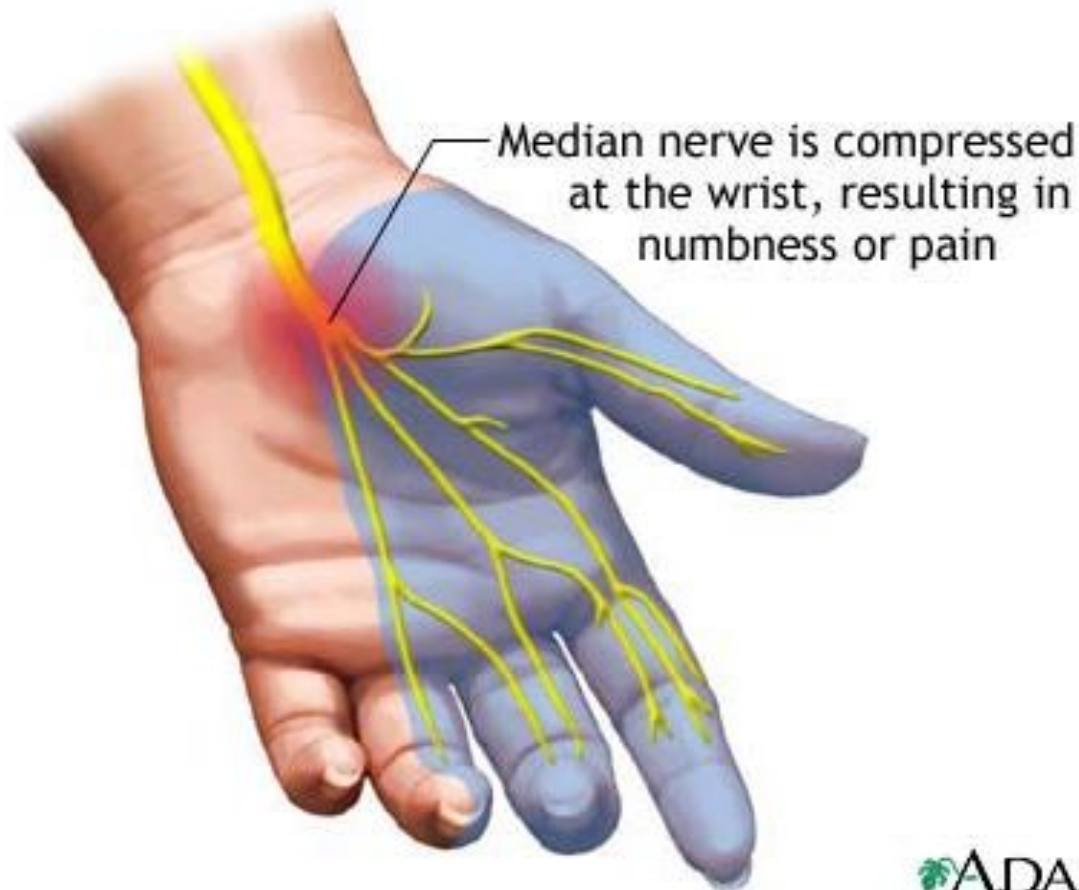
Nerve Entrapment Syndromes

Clinical Features

- **History**
 - Pain or Numbness
 - Intermittent
 - Related to specific postures
 - Median Entrapment
 - Ulnar Entrapment
- **Physical Examination**
 - Site of Compression
 - Examine for local causes
- **Investigations**
 - NCS

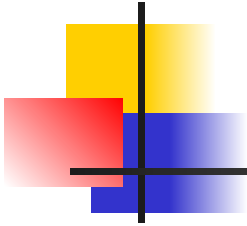
Nerve Entrapment Syndromes

Clinical Features



Nerve Entrapment Syndromes

Clinical Features

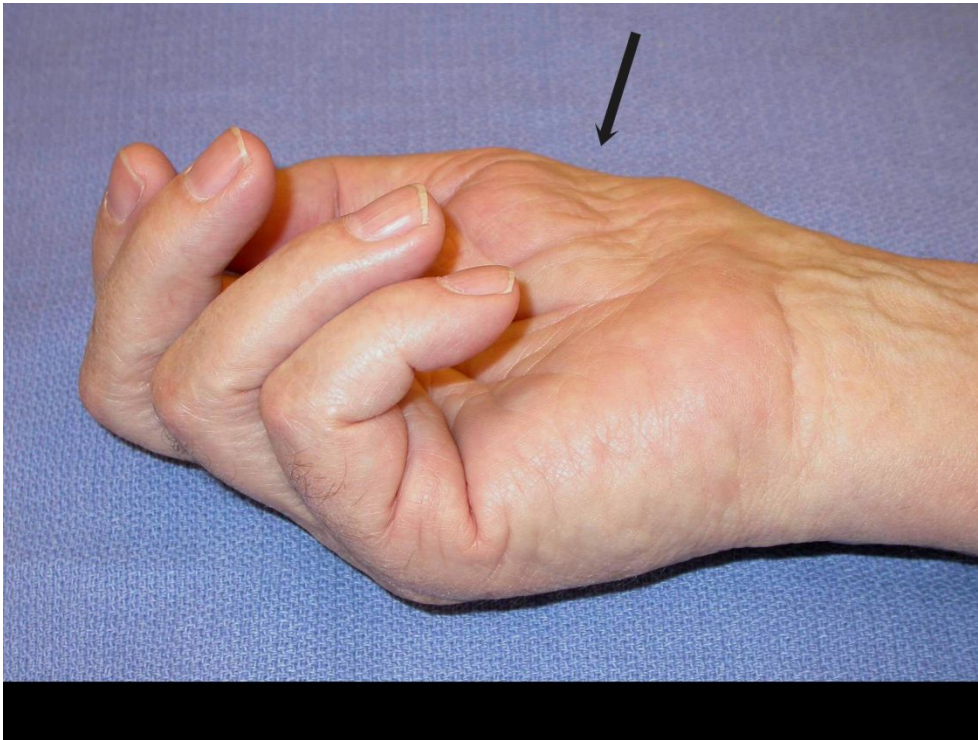
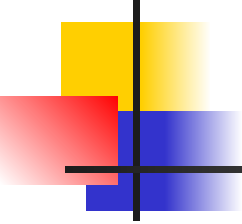


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Nerve Entrapment Syndromes

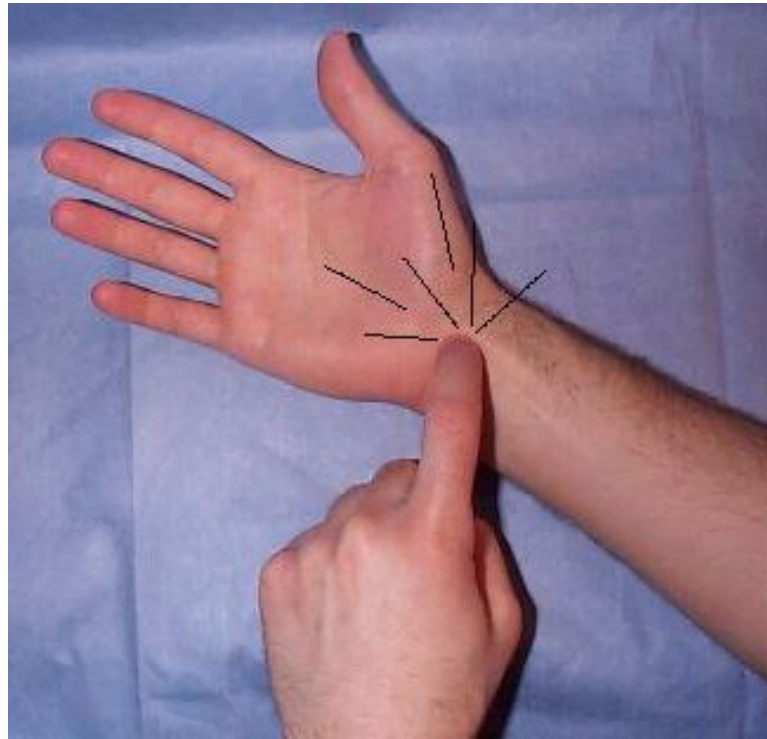
Clinical Features



**Thenar Atrophy
in
Advance Carpal Tunnel
Syndrome**

Nerve Entrapment Syndromes

Tinel's Sign



Nerve Entrapment Syndromes

Phalen's Test





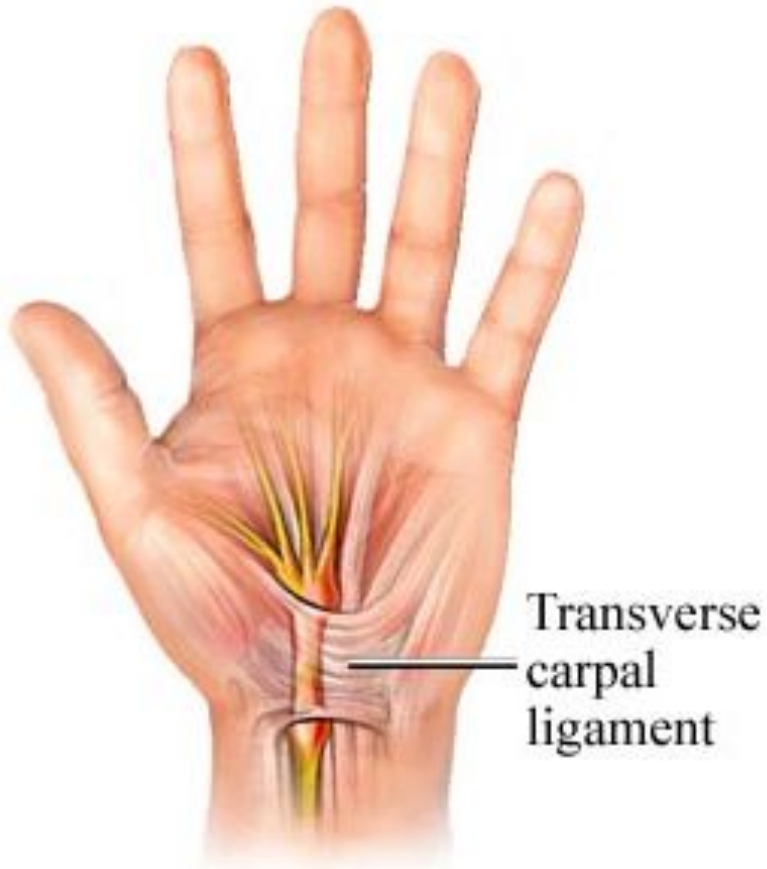
Nerve Entrapment Syndromes

Treatment

- Simple measures
- Local corticosteroids
- Surgery
 - Median Nerve Decompression
 - Ulnar Nerve Decompression

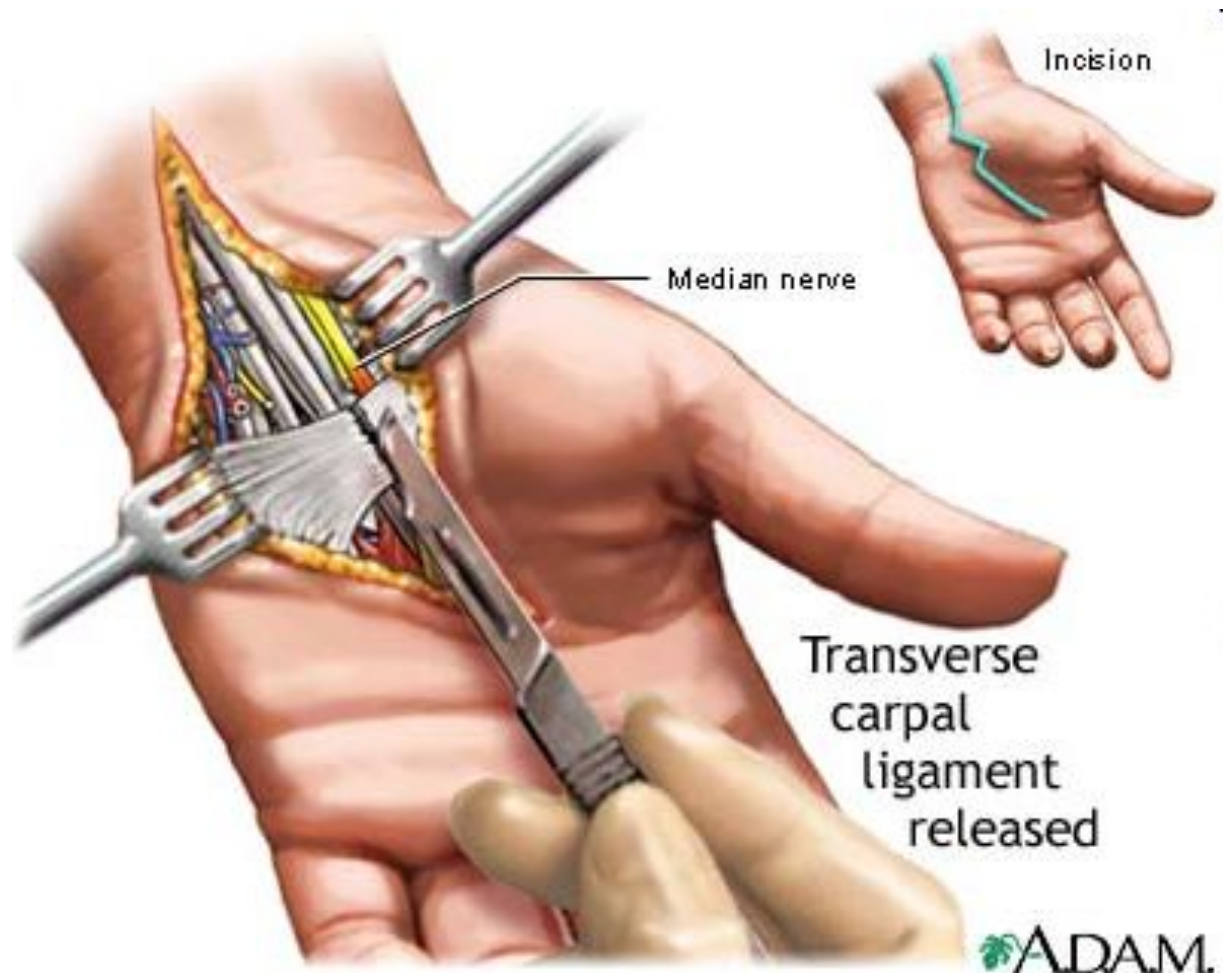
Carpal Tunnel Syndrome

Treatment



Carpal Tunnel Syndrome

Treatment

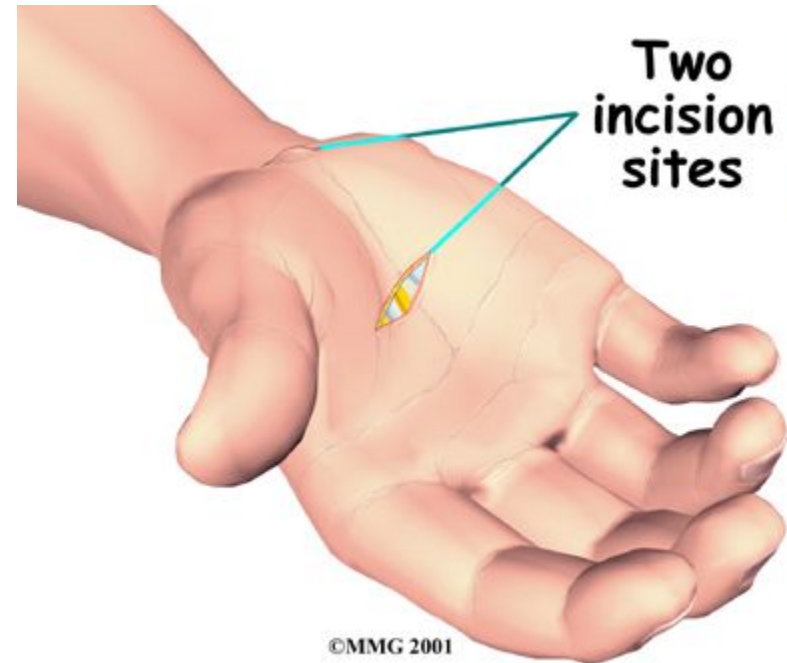
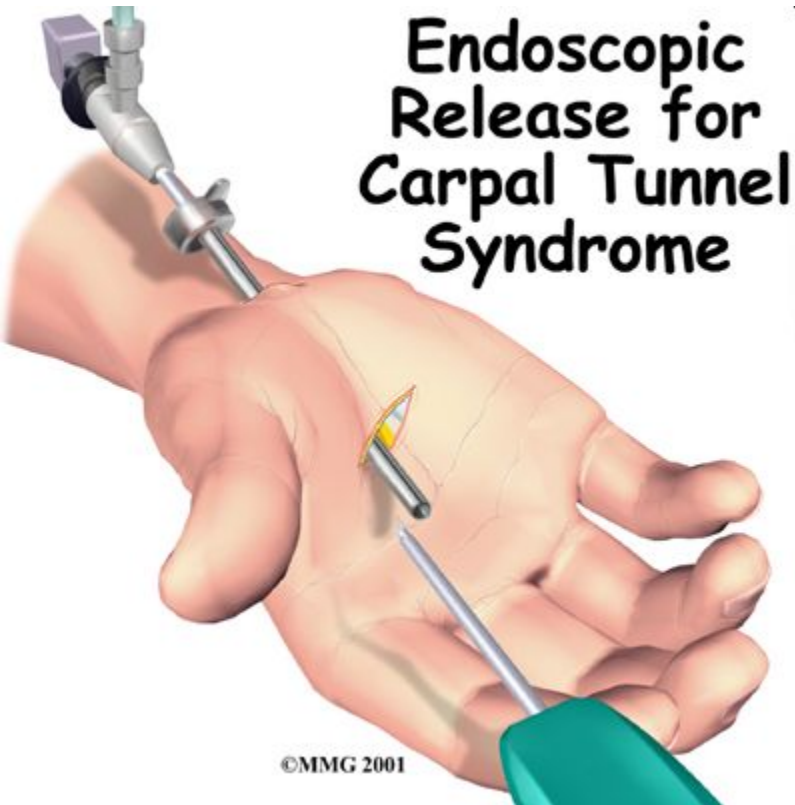


Carpal Tunnel Syndrome

Treatment

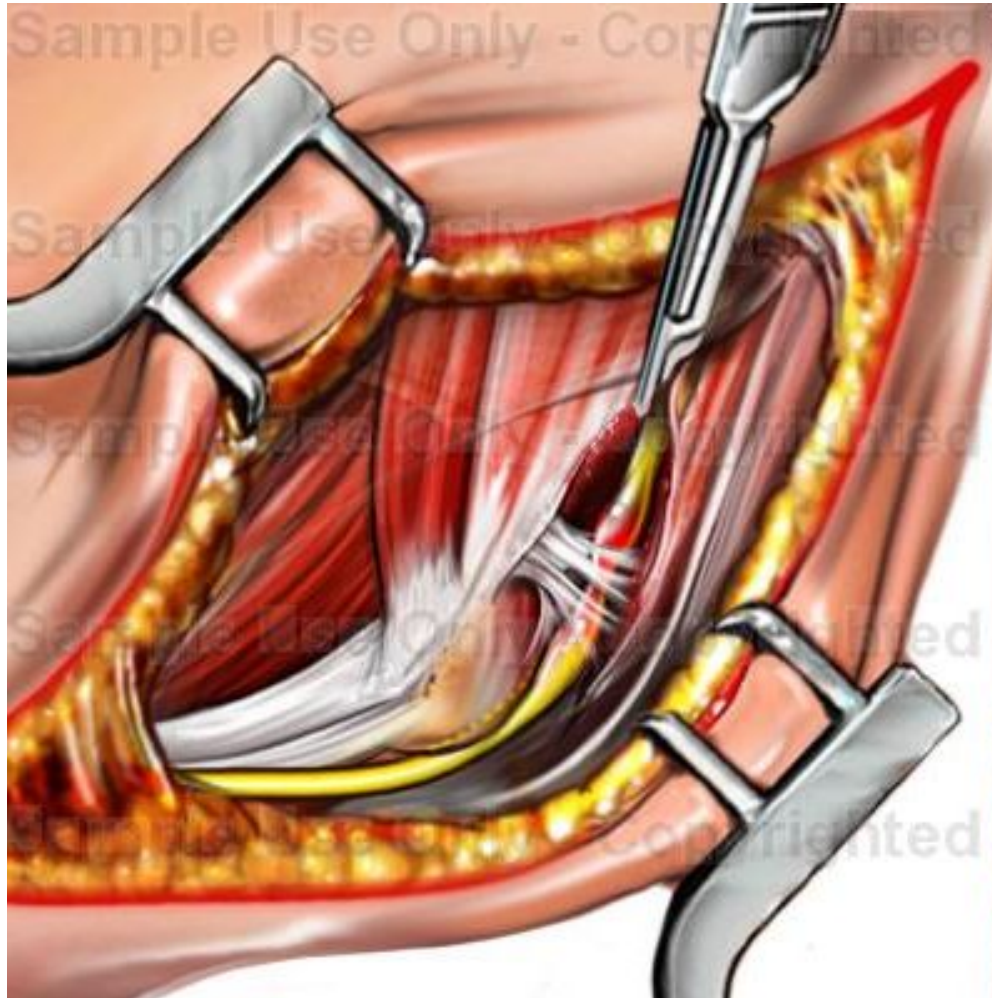


Endoscopic
Release for
Carpal Tunnel
Syndrome



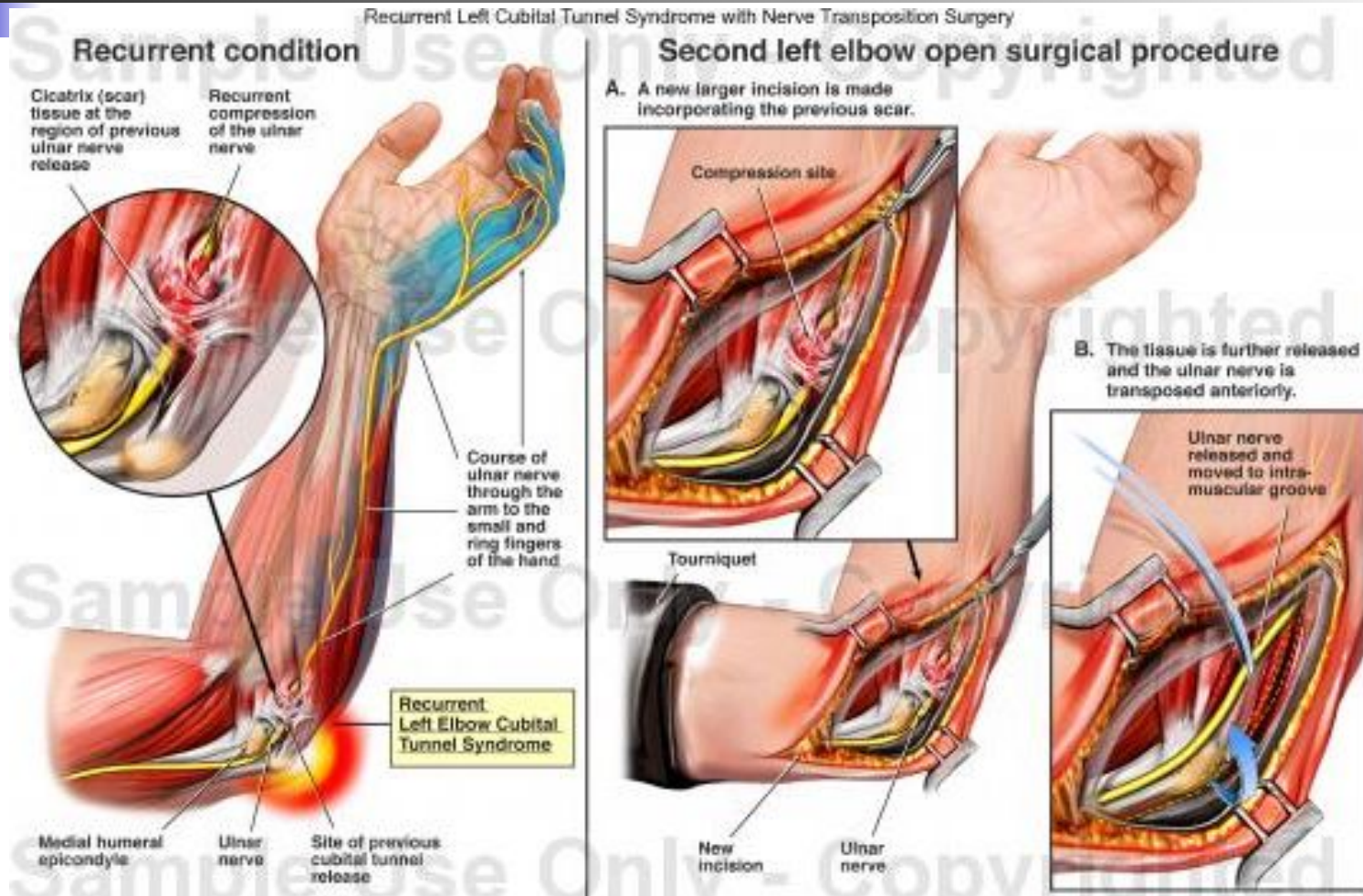
Ulnar Entrapment Syndrome

Treatment



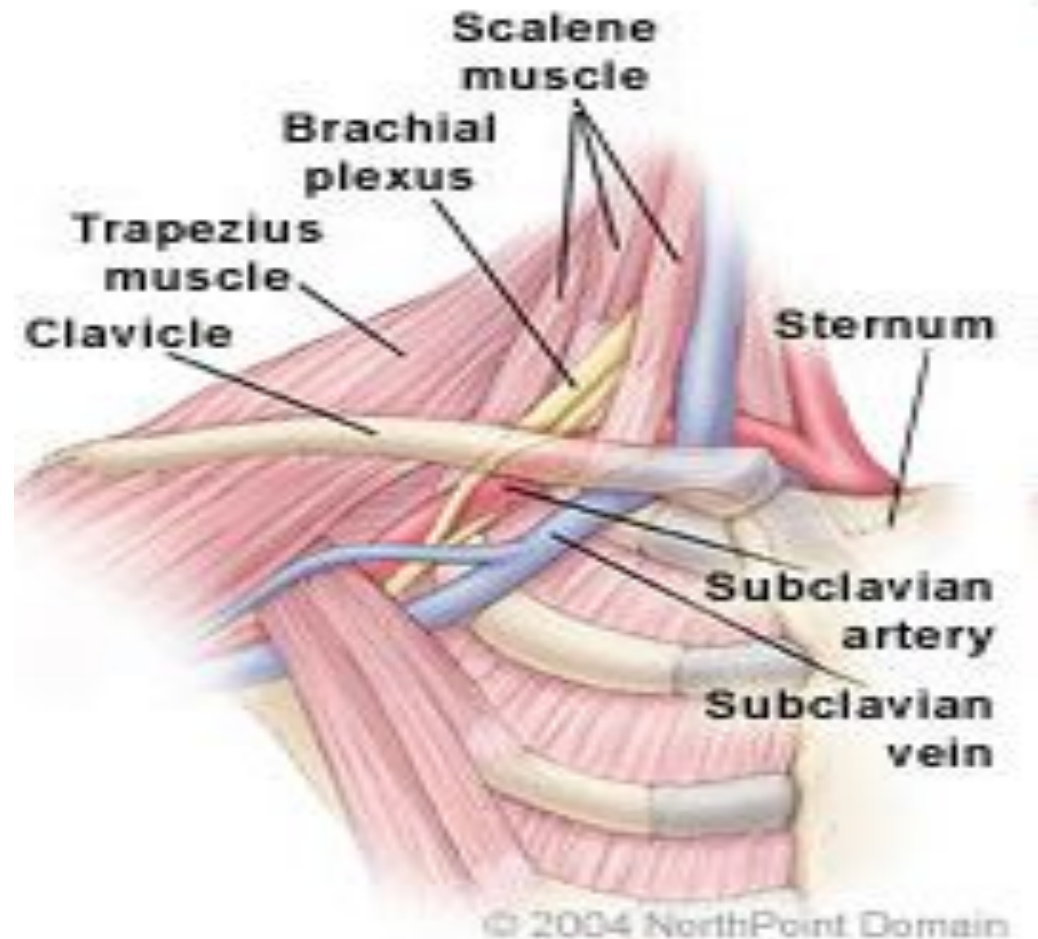
Ulnar Entrapment Syndrome

Treatment



Thoracic Outlet Syndrome

- Nerve and vascular compression
- Extra rib
- Late presentation





Thoracic Outlet Syndrome

Clinical Features

- History
 - Symptoms
 - Timing
 - Aggravated factors

- P/E
 - Neurological
 - Vascular

Thoracic Outlet Syndrome

Adson's Test



Thoracic Outlet Syndrome

Wright's Test





Thoracic Outlet Syndrome

Investigations

- X-Rays
- Electrodiagnostic Tests
- Angiography & Venography

Thoracic Outlet Syndrome

Differential Diagnosis

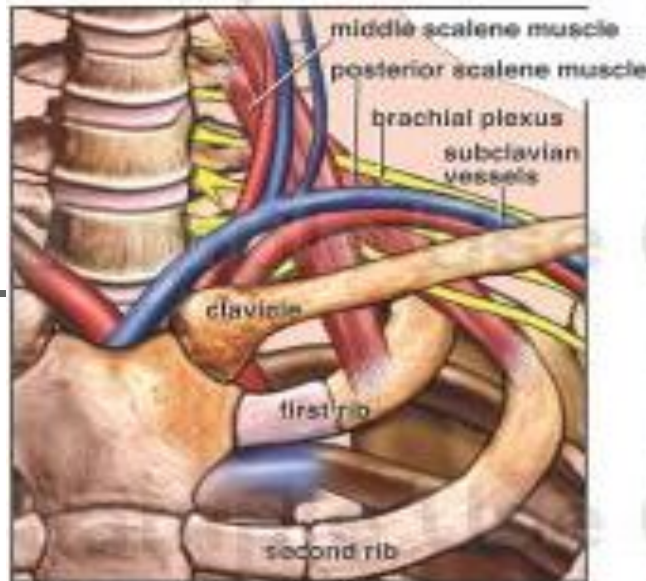
- Tumours of the lower cervical cord or cervical vertebrae.
- Cervical Spondylosis
- Pancoast's Syndrome
- Ulnar Nerve Compression

Thoracic Outlet Syndrome

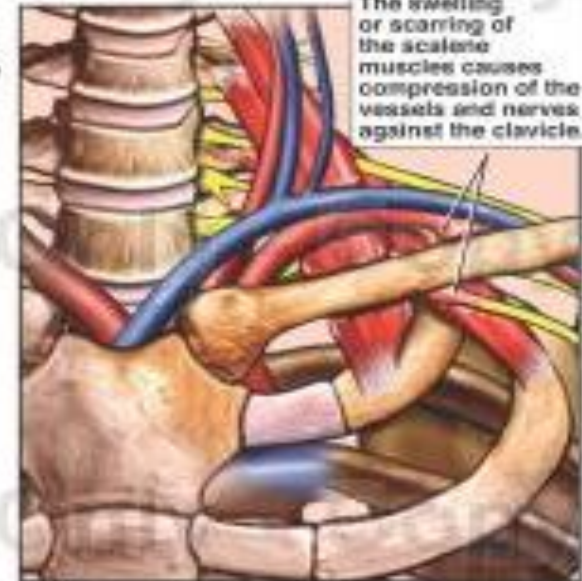
Treatment

- Conservative
- Operative
 - Supraclavicular Approach
 - Transaxillary Approach

Normal Anatomy



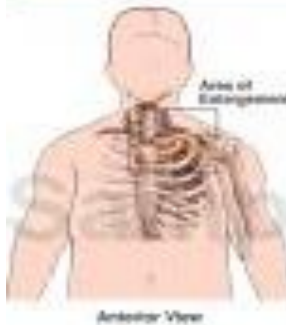
Post-Accident Condition



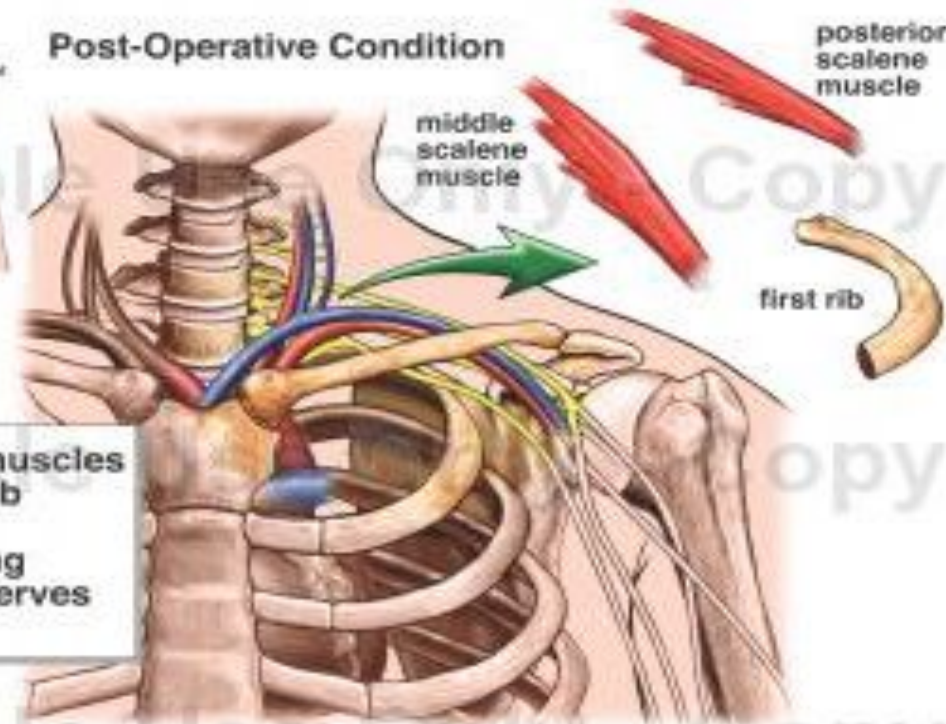
The swelling or scarring of the scalene muscles causes compression of the vessels and nerves against the clavicle.

ANTERIOR VIEW OF LEFT SHOULDER REGION

Post-Operative Condition



Anterior View



The scalene muscles and the first rib are removed, decompressing the brachial nerves and vessels.

Thoracic Outlet Syndrome

Treatment



Prognosis

Age: MI factor

Level of injury: second MI factor

Sharp transections

.Repair delay