

Objectives

- ✓ Spinal Nerves
- ✓ Nerve Plexus
- ✓ BP – Origin & Relations
- ✓ Formation
- ✓ Parts of BP
- ✓ Distribution - Nerve Supply – areas
- ✓ Anatomical Variations
- ✓ Applied Anatomy

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Spinal Nerves

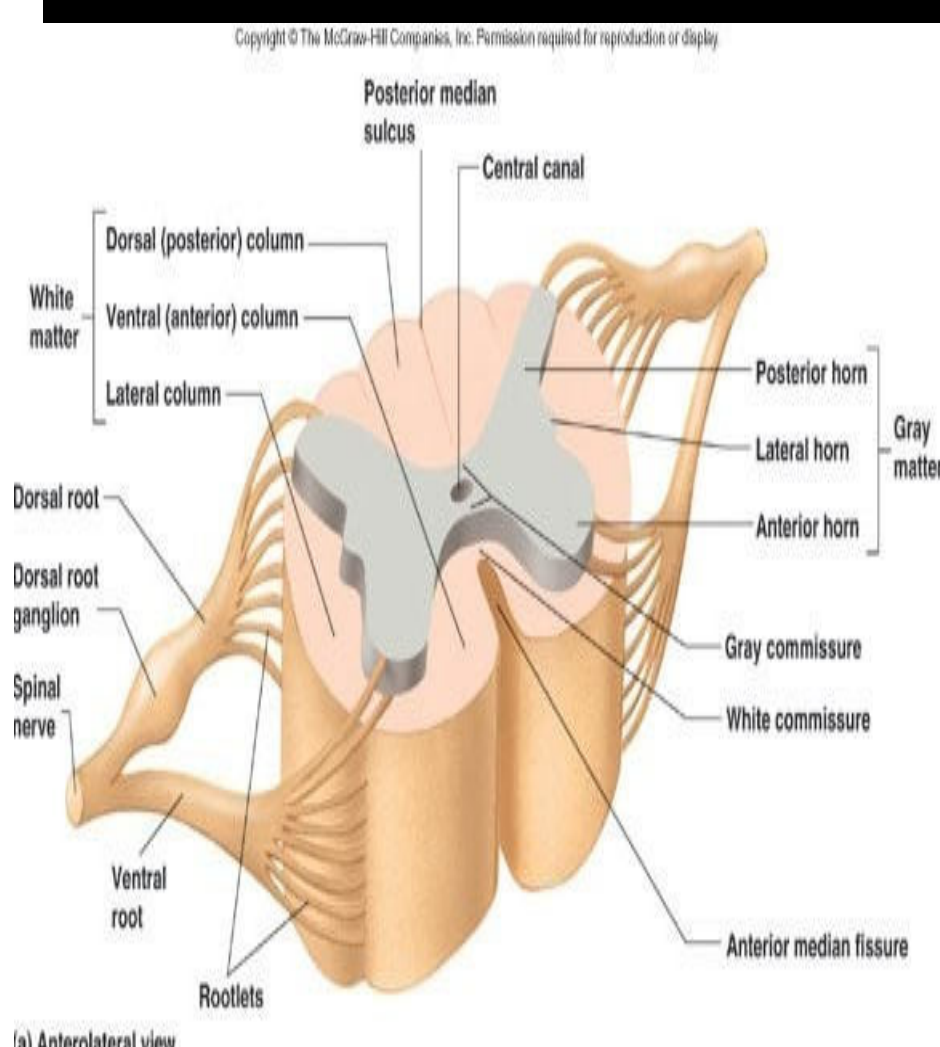
- ✓ Spinal nerves attach to the spinal cord via *roots*

✓ Dorsal root

- ✓ Has only sensory neurons
- ✓ Attached to cord via rootlets
- ✓ Dorsal root ganglion

✓ Ventral root

- ✓ Has only motor neurons
- ✓ No ganglion - all cell bodies of motor neurons found in gray matter of spinal cord



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Spinal Nerves

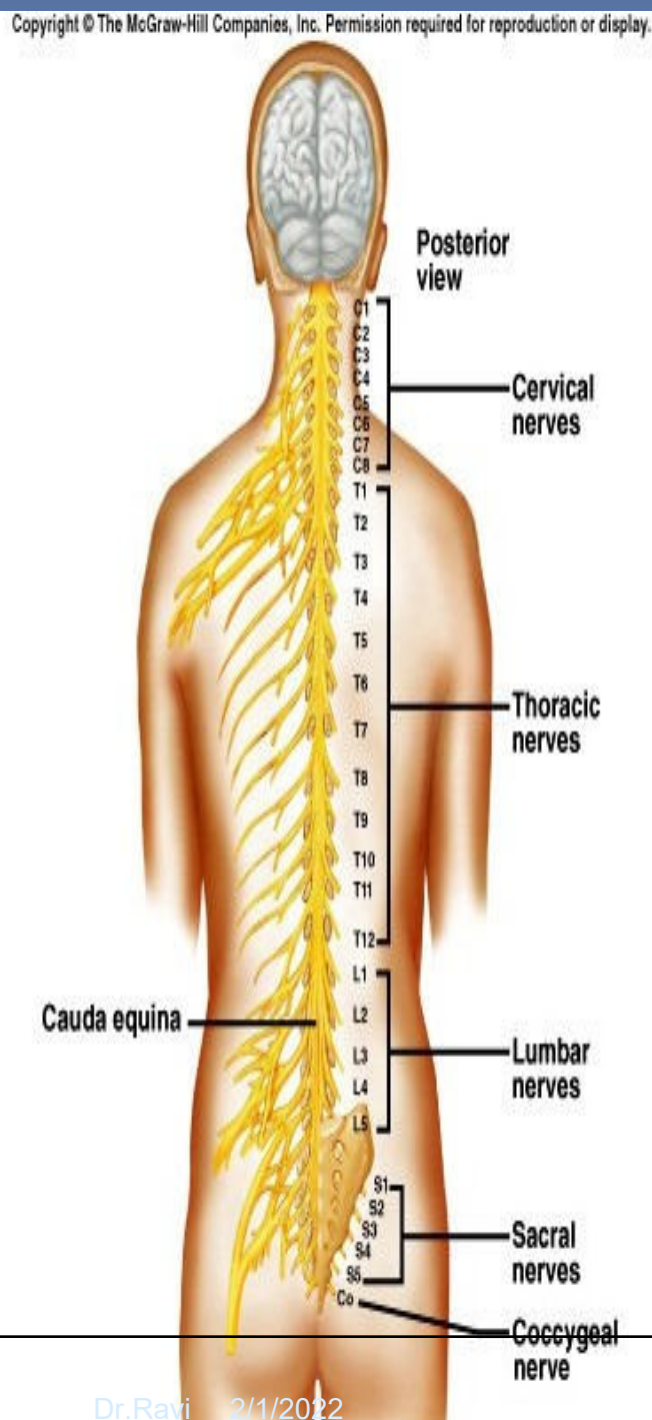
- ✓ 31 pair
 - ✓ each contains thousands of nerve fibers
 - ✓ All are *mixed nerves* have both sensory and motor neurons
- ✓ Connect to the spinal cord
- ✓ Exit from SC – Supplying the muscles & structures of the body

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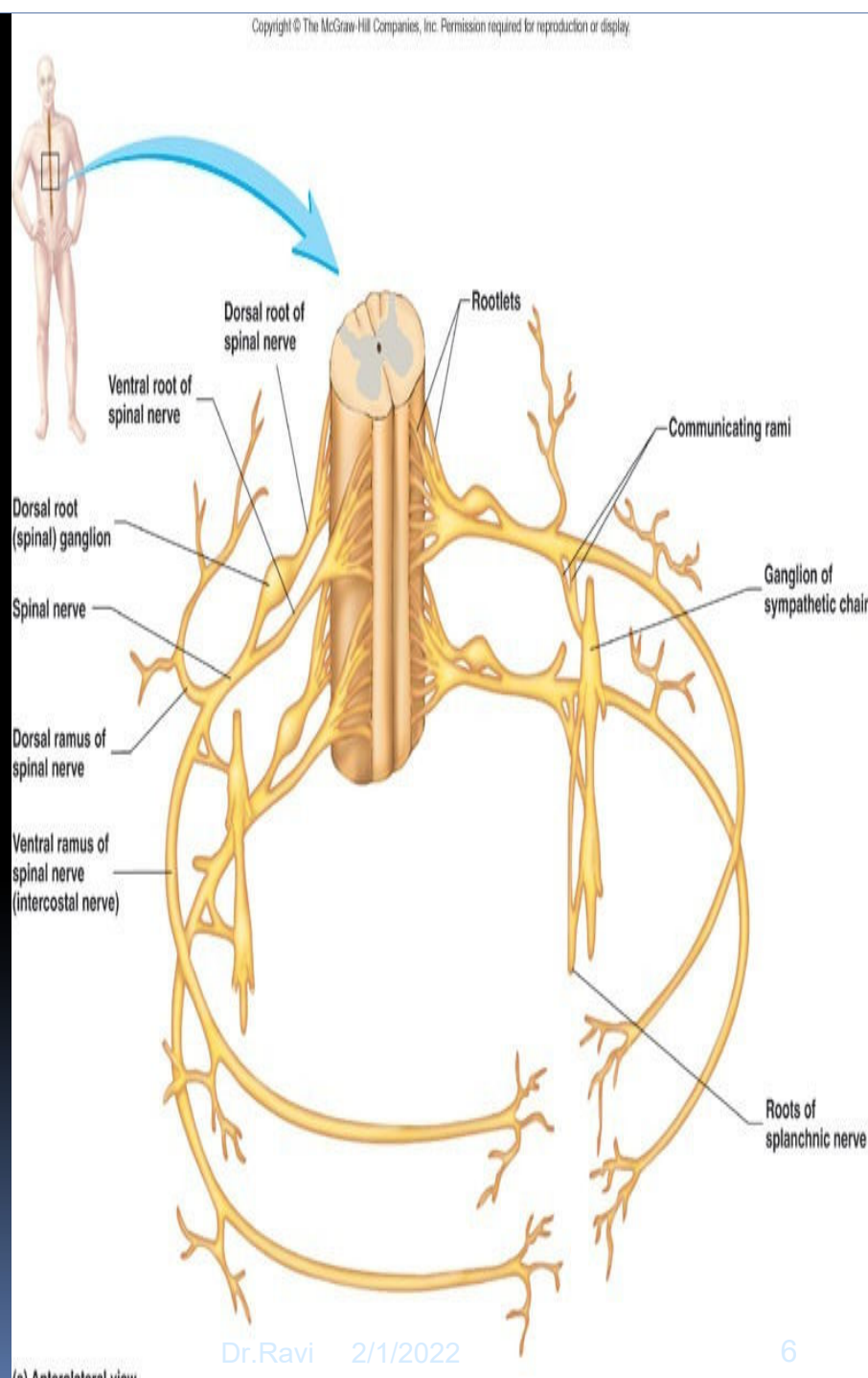
Spinal Nerves

- 8 pairs** of cervical nerves from C1 to C8
- 12 pairs** of thoracic nerves from T1-T12
- 5 pairs** of lumbar nerves from L1 to L5
- 5 pairs** of sacral nerves from S1 to S5
- 1 pair** of coccygeal nerves located at C zero (Co)



Formation of Rami

- ✓ Rami are lateral branches of a spinal nerve
- ✓ Rami contain both sensory and motor neurons
- ✓ Two major groups
 - ✓ Dorsal ramus
 - ✓ Neurons innervate the dorsal regions of the body
 - ✓ Ventral ramus
 - ✓ Larger
 - ✓ Neurons innervate the ventral regions of the body
 - ✓ Braid together to form *plexuses* (plexi)



(a) Anterolateral view

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Nerve Plexuses

- ✓ Nerve plexus
 - ✓ A nerve plexus is nothing more than a system or network of connected nerve fibers that link spinal nerves with specific areas of the body . A network of ventral rami.
- ✓ Ventral rami (except T₂-T₁₂)
 - ✓ Branch and join with one another
 - ✓ Form nerve plexuses
 - ✓ In cervical, brachial, lumbar, and sacral regions
 - ✓ Cervical plexus formed in thoracic region of s.c.

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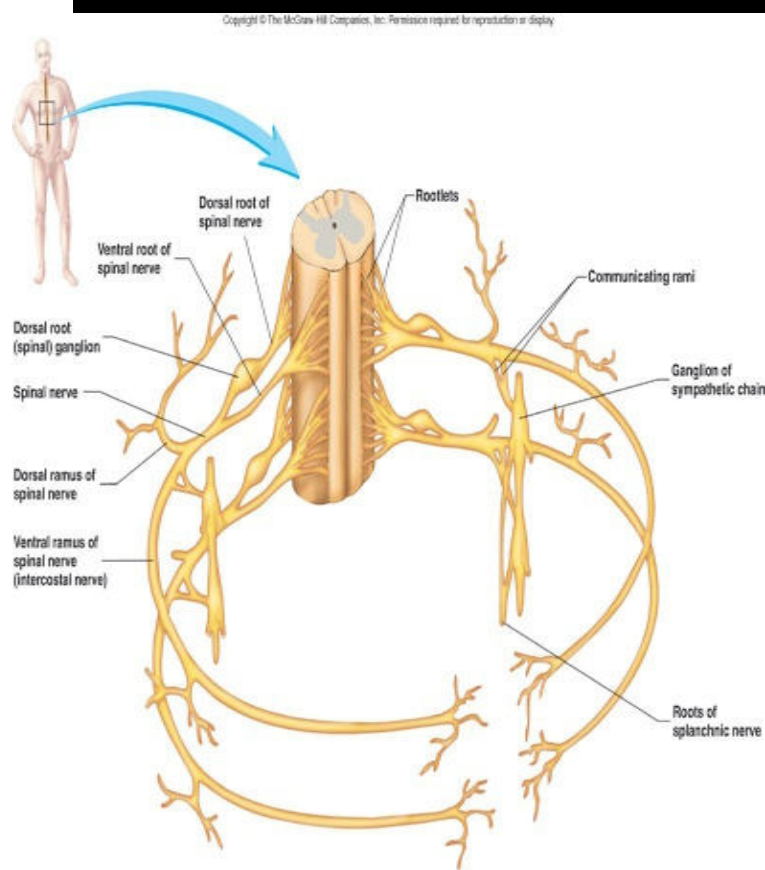
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Branches of Spinal Nerves

- ✓ Dorsal Ramus
 - ✓ Neurons within muscles of trunk and back
- ✓ Ventral Ramus (VR)
 - ✓ Braid together to form *plexuses*
 - ✓ Cervical plexus - VR of C1-C4
 - ✓ Brachial plexus - VR of C5-T1
 - ✓ Lumbar plexus - VR of L1-L4
 - ✓ Sacral plexus - VR of L4-S4
 - ✓ Coccygeal plexus -VR of S4&S5

Communicating Rami: communicate with sympathetic chain of ganglia

- ✓ Covered in ANS unit

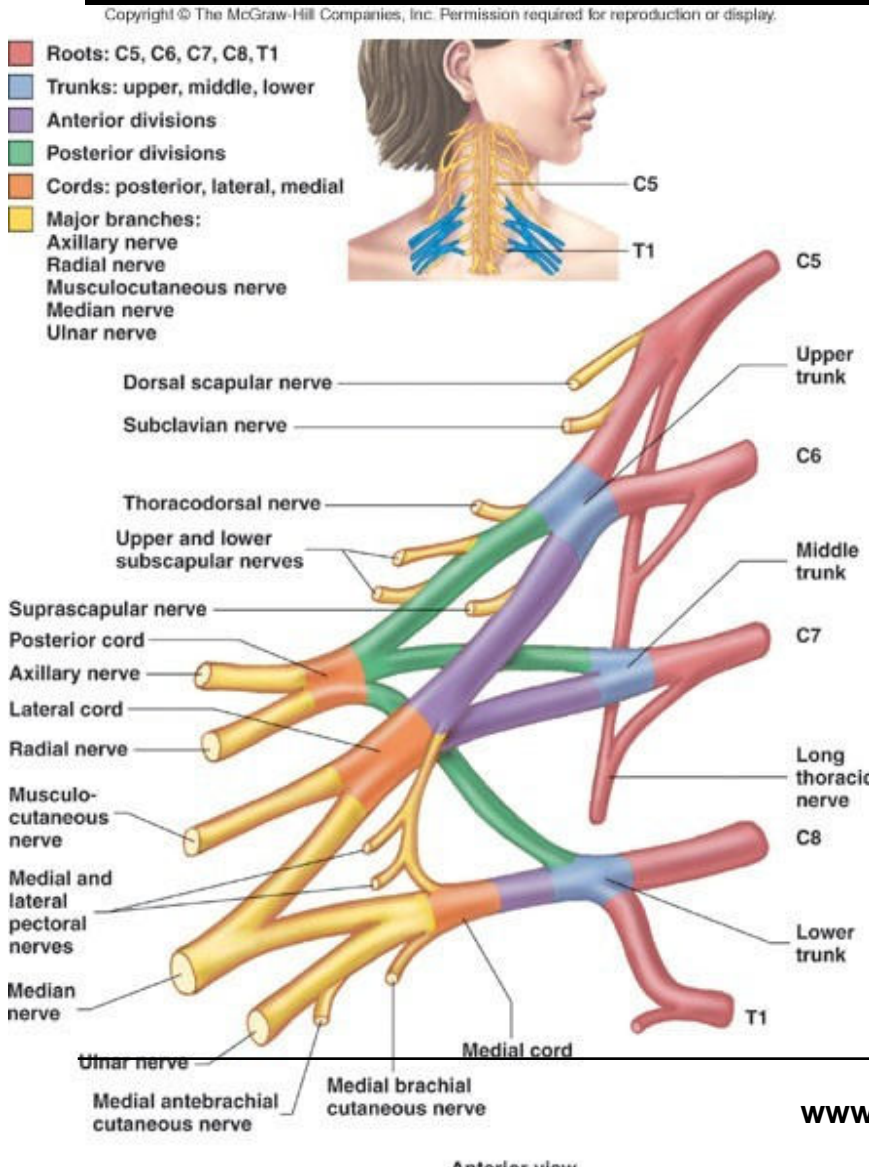


(a) Anterolateral view

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Brachial Plexus - Origin



- ✓ Formed by ventral rami of spinal nerves C5-T1
- ✓ Five ventral rami form
 - ✓ Roots / Trunks that separate into
 - ✓ Divisions that then form
 - ✓ Cords that give rise to Branches
- ✓ Major nerves
 - ✓ Axillary
 - ✓ Radial
 - ✓ Musculocutaneous
 - ✓ Ulnar
 - ✓ Median

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Relations - BP

- ✓ Plexus next passes **behind clavicle**, Subclavius, & transverse scapular vessels, & lies upon 1st digitation of Serratus anterior, & Subscapularis.

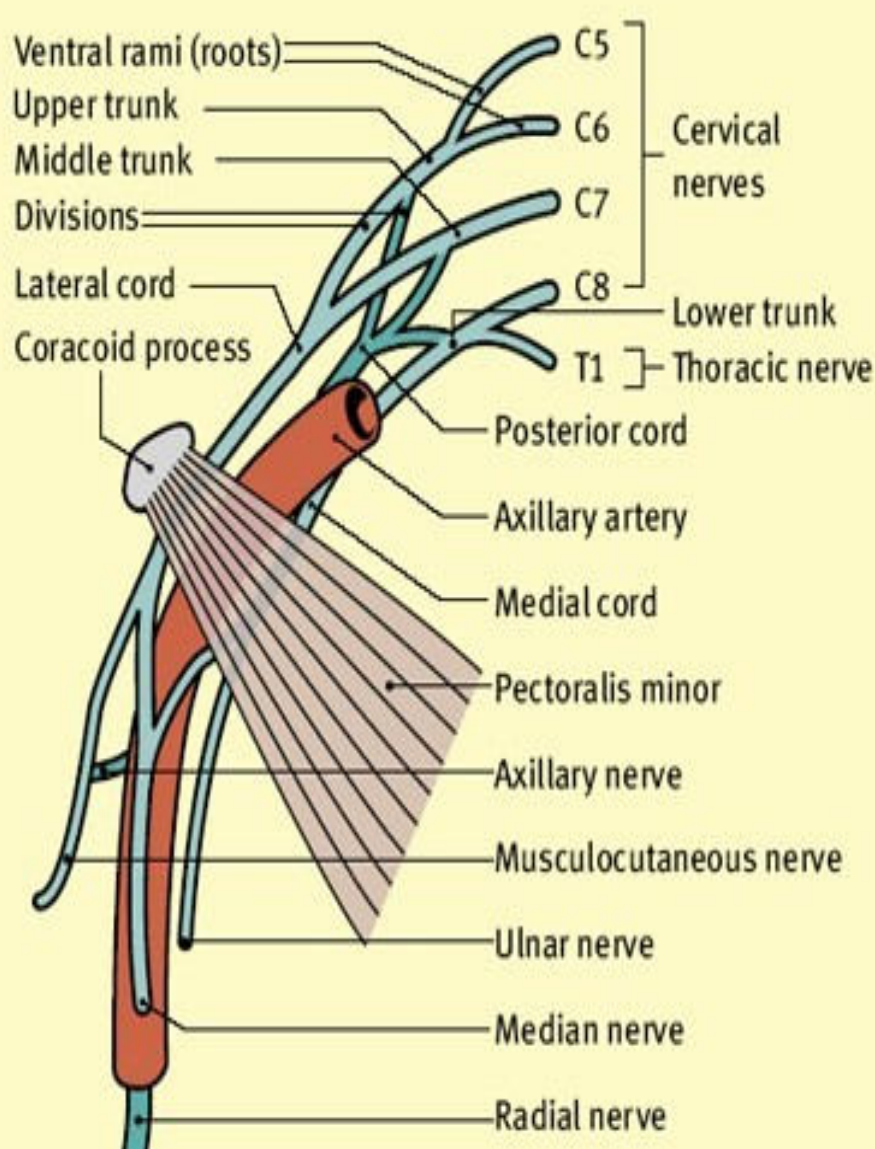
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Relations

- ✓ **In axilla** it is placed lateral to first portion of axillary artery; it surrounds 2nd part of artery, one cord lying medial to it, one lateral to it, and one behind it; at lower part of the axilla it gives off its terminal branches to upper limb.

Relationship of the brachial plexus to the axillary artery

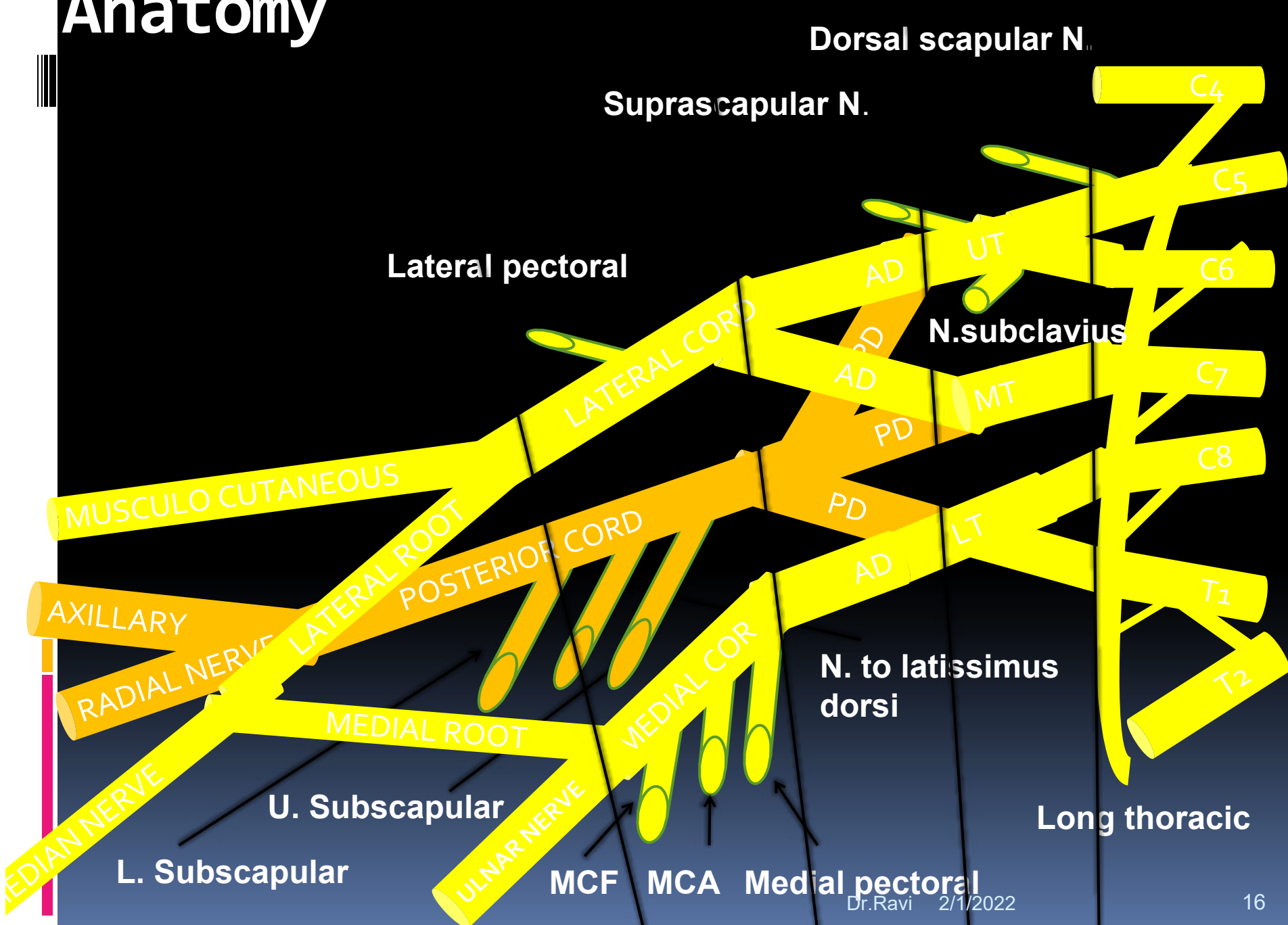


Posterior divisions and their branches dark green

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Anatomy

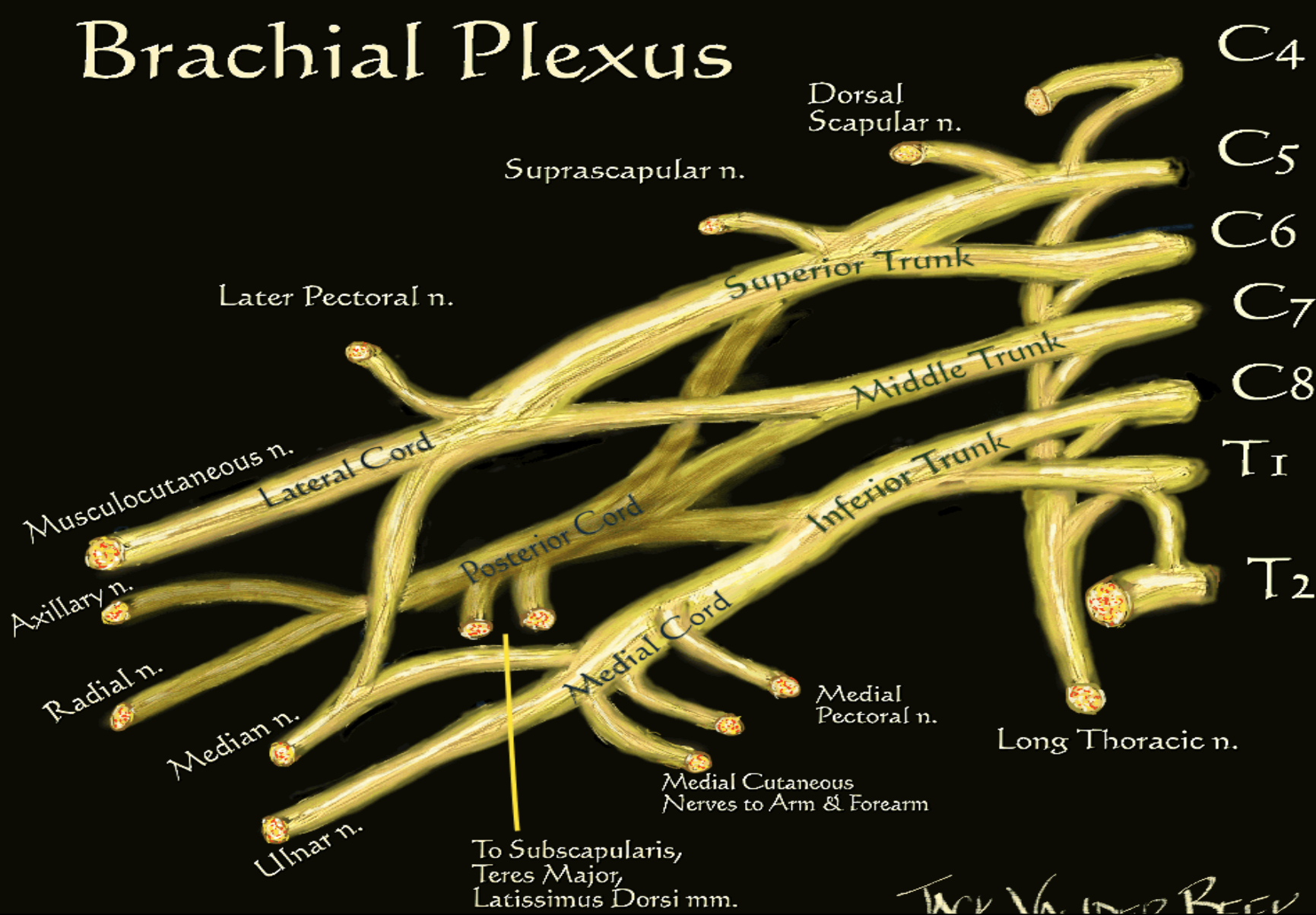
CORD & BRANCH DIVISION TRUNK ROOT



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Brachial Plexus



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Brachial Plexus Branches

Branches of the Roots

- Long thoracic nerve(C5,C6,C7)
- Dorsal scapular nerve(C5)
- N. to longus colli & scaleni

Branches of Trunks

- Suprascapular nerve(C5,C6)
- Nerve to subclavius(C5,C6)

Branches of Lateral Cord

- Lateral Pectoral (C5-C7)
- Musculocutaneous (C5-C7)
- Lateral root of Median Nerve (C5-C7)

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Brachial Plexus Branches

Branches of Medial Cord

- Medial pectoral(C8-T1)
- Medial cutaneous nerve of arm(C8-T1)
- Medial cutaneous nerve of forearm(C8-T1)
- Ulnar nerve(C7,C8,T1)
- Medial root of median nerve(C8-T1)

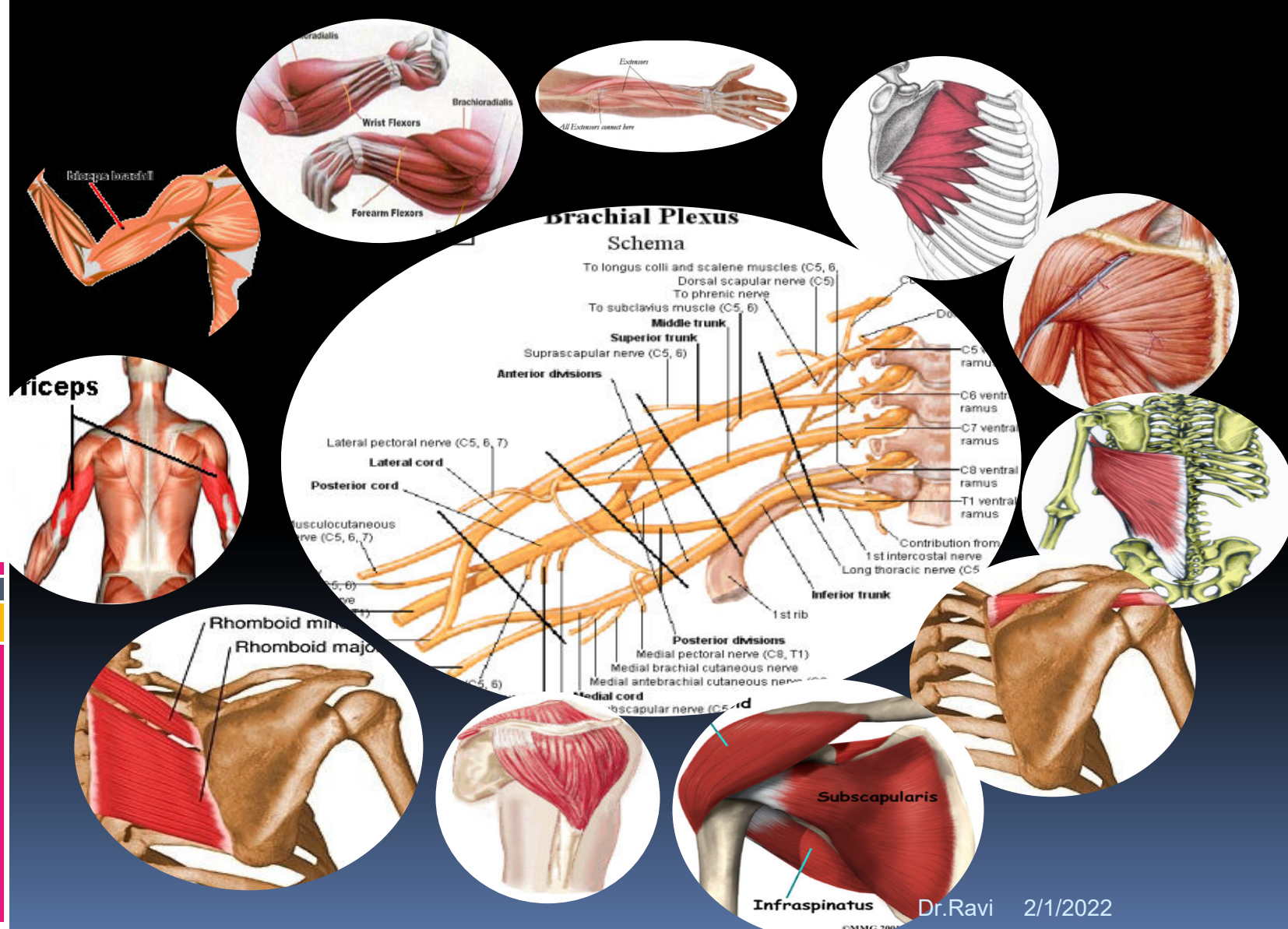
Branches of Posterior Cord

- Upper subscapular (C5,C6)
- Thoracodorsal (C6-C8)
- Lower subscapular (C5,C6)
- Axillary (C5,C6)
- Radial (C5-C8,T1)

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Muscles supplied by Brachial plexus



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Mode of Brachial Plexus Injuries

- Road traffic accident
- Penetrating injuries
- Surgical complications
- Birth Injuries
- Domestic violence and accidents

Traumatic Brachial Plexopathies

Penetrating injury

- Infraclavicular plexus commonly affected
- Knife, gun shot etc
- Less common incident
- direct contact, hematoma pseudoaneurysm

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Traumatic Brachial Plexopathies

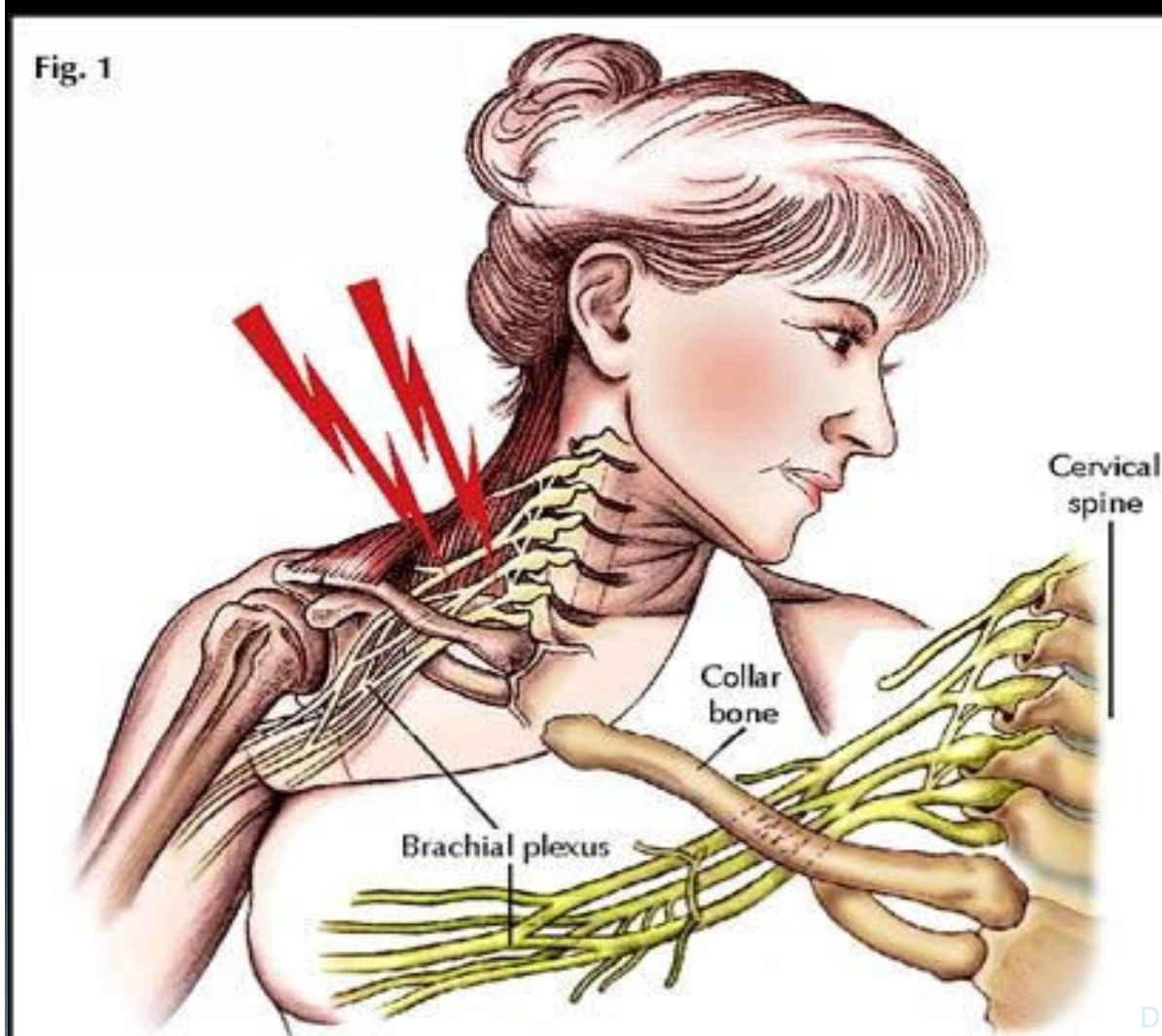
Closed traction injuries

- Supraclavicular injuries- forced separation of **head and shoulder**
- Infraclavicular injuries- forced separation of **arm from the torso** (hyper abduction)
- **Root avulsion**- more serious
- Ventral roots are more prone to injury- lesser calibers, thinner dural sac

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Tractional Brachial Plexus Injury



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Obstetric Brachial Plexopathies

Five pattern of injuries

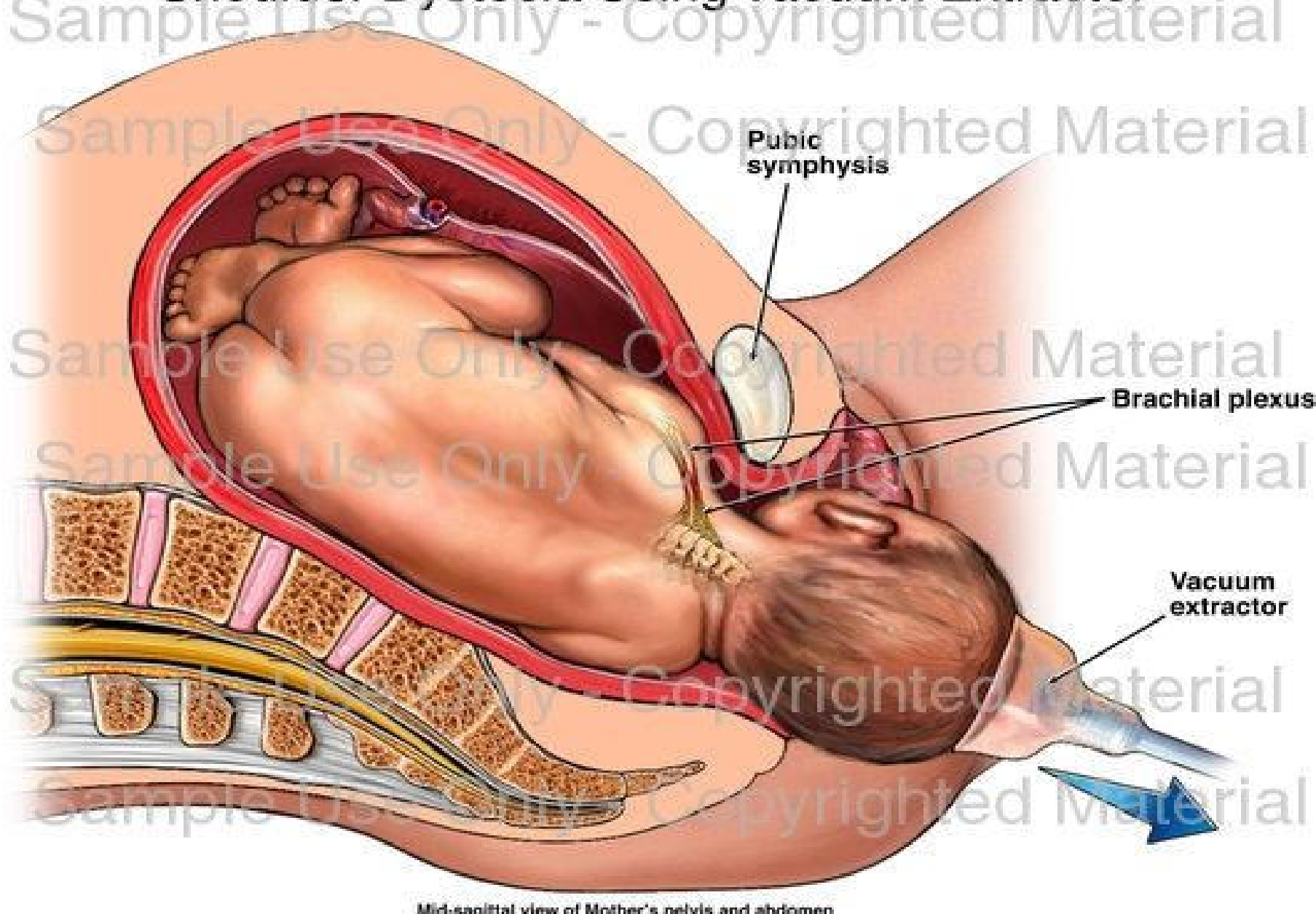
C5,C6(Erb's palsy)

C5-T1 with some finger flexion sparing

C5-T1 with flail arm and Horner's syndrome

C5-T1 with Horner (Klumpke's palsy)

Shoulder Dystocia Using Vacuum Extractor



Mid-sagittal view of Mother's pelvis and abdomen

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Erb's Paralysis

- Injury of upper trunk at Erb's point, caused by traction on arm at birth or due to accident
- Nerve root avulsion from cord, involved C5 & C6 causing paralysis of deltoid, biceps, brachialis, brachioradialis & supinator muscles
- **Abduction, lateral rotation of arm & flexion & supination of forearm lost**
- **Waiter's tip position** (Adduction & medial rotation of arm, extension of elbow and pronation of forearm)

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- Sensory loss over the arm



Waiter's tip deformity

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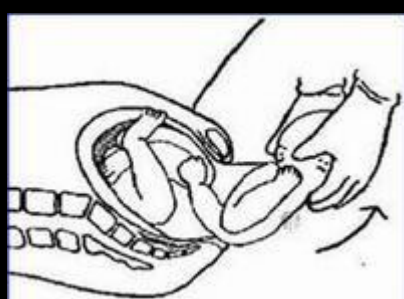
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Upper brachial plexus

Erb-Duchenne palsy

- Results from excessive displacement of the head to the opposite side and depression of the shoulder on the same side

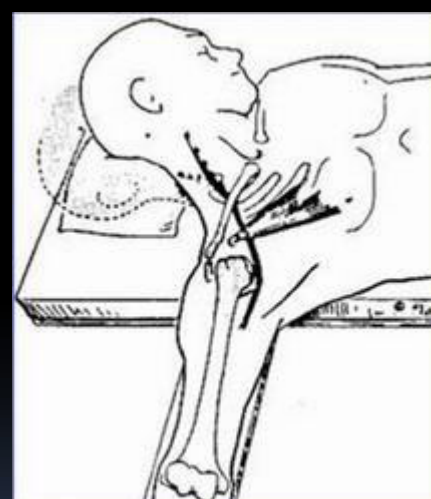
Difficult labour



Motorcycle fall



Malposition of the upper limb on the operation table

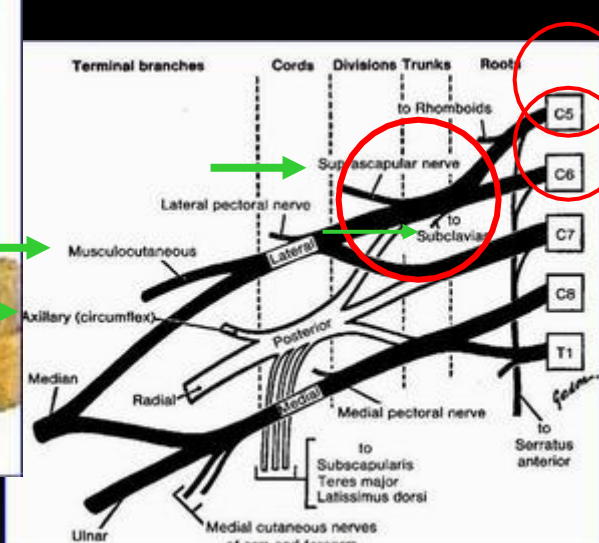
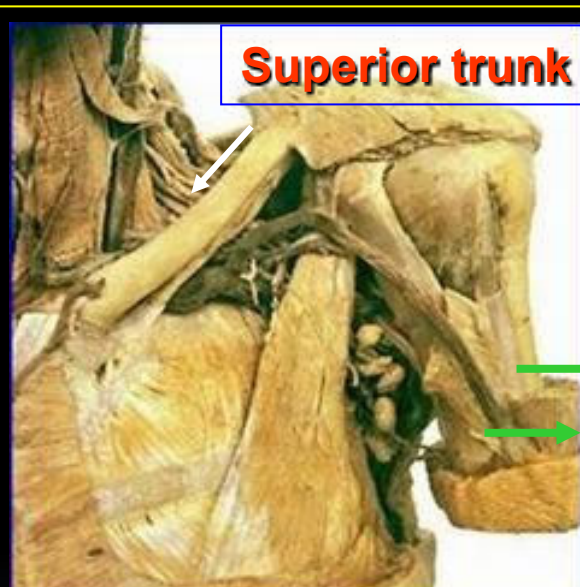


- Abrasions on the face and shoulder show how this motorcyclist pulled his entire plexus apart

Upper brachial plexus

Erb-Duchenne palsy

- The lesion produced is similar to that produced by a stab or bullet wound in the neck affecting the superior trunk of the brachial plexus



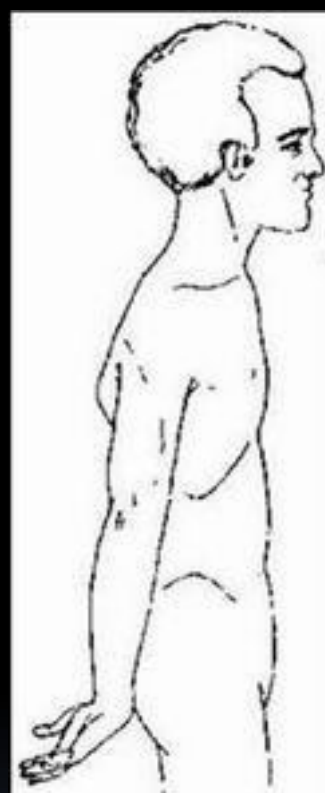
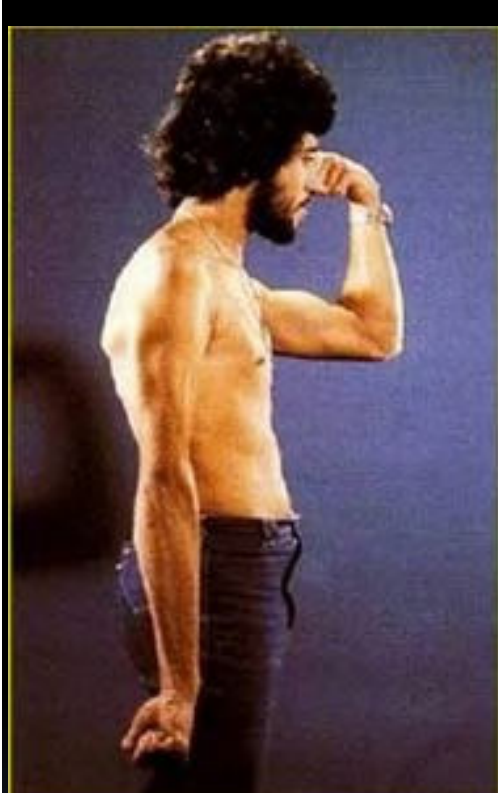
- Affects C5 & C6 roots or the **superior trunk**
- suprascapular nerve, nerve to subclavius, musculocutaneous, and axillary nerves are affected

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Upper brachial plexus

Erb-Duchenne palsy



- Abduction, lateral rotation, and flexion at the shoulder are affected**

- limb hangs by side adducted and medially rotated by unopposed pectoralis major

- forearm extended and pronated because action of biceps is lost**

- Affects C5 & C6 roots or the **superior trunk**
- suprascapular nerve, nerve to subclavius, musculocutaneous, and axillary nerves are affected

Waiter's tip position

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Klumpke's Paralysis

Injury of lower trunk

Caused due to **hyper abduction of arm** (extended arm in a **breach delivery**, a fall on a **outstretched arm**)

C8, T1 & some time C7 are involved

Intrinsic muscles of hand & flexors of wrist (C6, C7, C8) & fingers (C8, T1) are affected

Claw hand deformity & anesthesia along the ulnar border of the forearm & hand

Horner's syndrome (injury to sympathetic fibers to head & neck)

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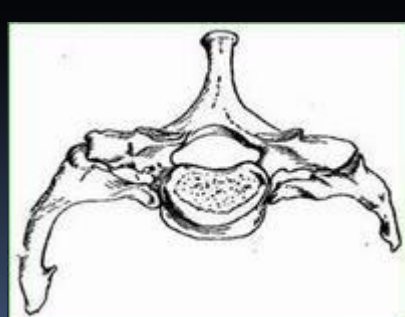
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Lower brachial plexus

Klumpke palsy

- results from excessive abduction of the arm as in during labor**

- or when a person falls from a height grasping something to save himself**



Cervical rib



Note the transverse process of C7

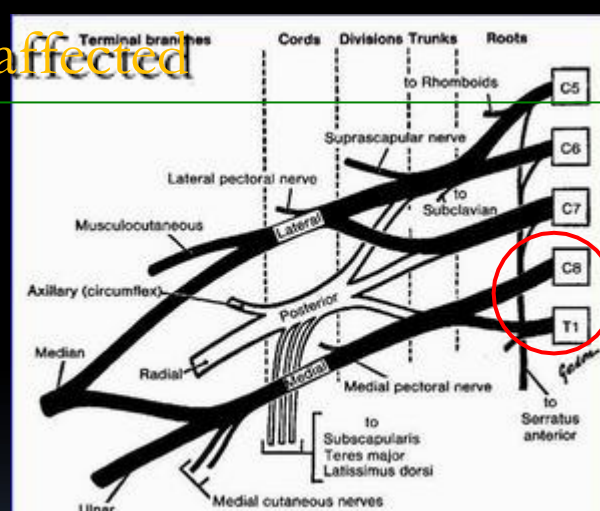
Lower brachial plexus

Klumpke palsy

Affects C8&T1

Claw hand

- Small muscles of the hand are affected



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Klumpke's Paralysis



Horner's syndrome

Ptois, myosis, enophthalmos and loss of ciliospinal reflex

Claw hand deformity

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Supraclavicular Brachial Plexopathies

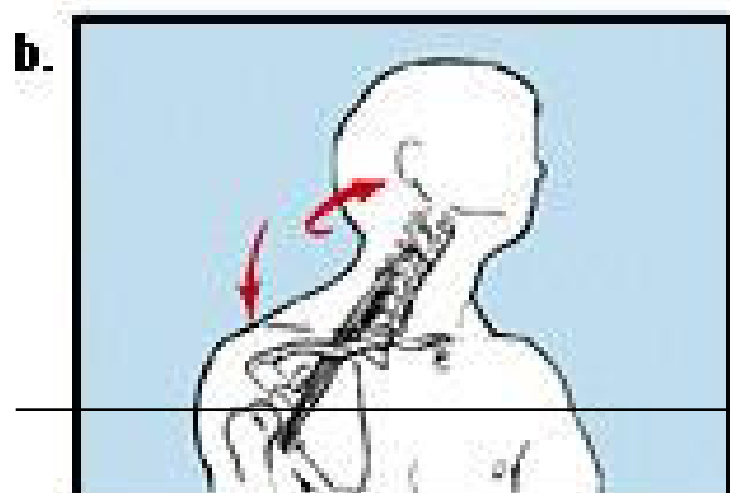
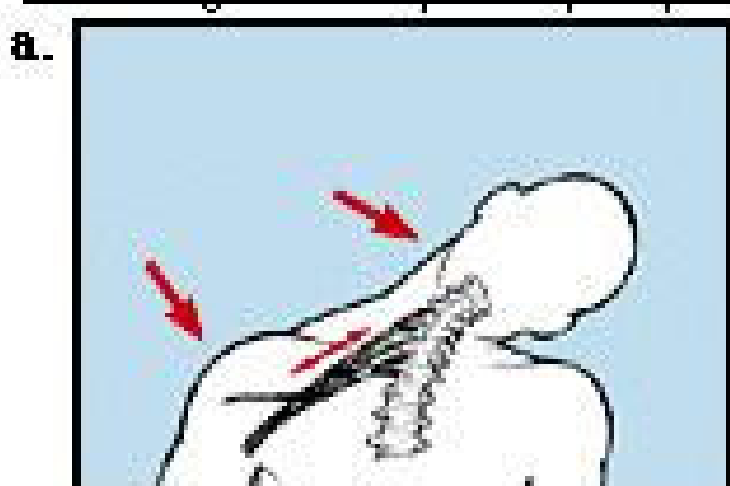
Burner syndrome (stinger syndrome)

- Forceful separation of head & shoulder (lateral neck extension & shoulder depression after a blunt force to head & neck)
- Presented with unilateral sharp burning pain in neck radiating to arm
- Classical C6 distribution, C5 may also be affected
- Male sports person
- Permanent neurological dysfunction is rare

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Burner syndrome (Stinger syndrome)



Winging of Scapula

- Serratus anterior stabilizes the scapula
- Winging occurs due to weakness in serratus anterior
- Injury to the nerve to serratus anterior (long thoracic nerve)
- Injury occurs during surgery or due to infection
- Pushing and/or punching defect



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Winging scapula:

- Injury to the long thoracic nerve
- Resulting from the blows on the posterior triangle of the neck
- Serratus anterior muscle paralysed
- Inability to protract & rotate the scapula during the abduction of the arm above the head
- Medial border and inferior angle of the scapula elevated



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Supraclavicular Brachial Plexopathies

Rucksack palsy (cadet palsy, pack palsy)

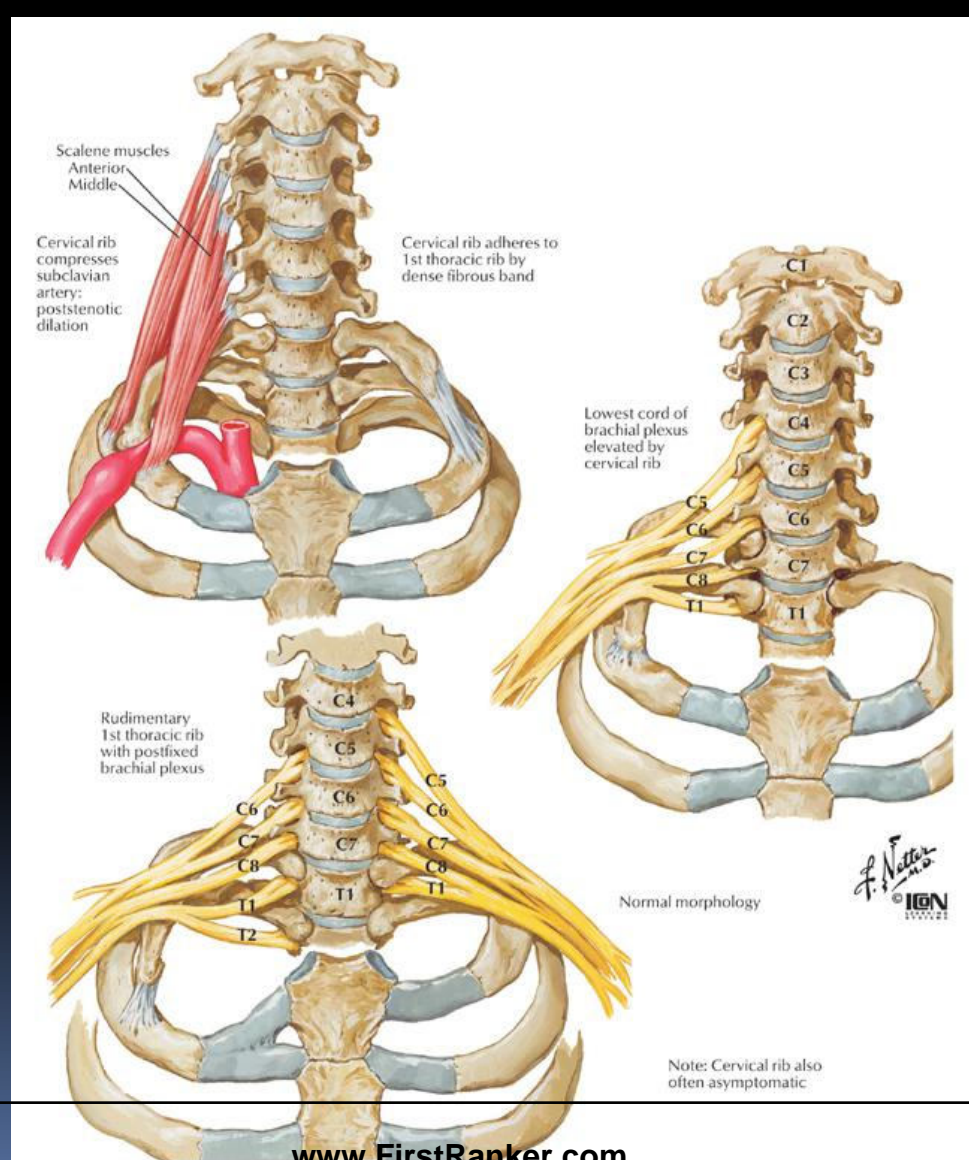
- Classical presentation –pain weakness associated with wearing a backpack
- Sensory involvement and most are due to demyelinating conduction block (neuropraxia) of brachial plexus



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Cervical rib

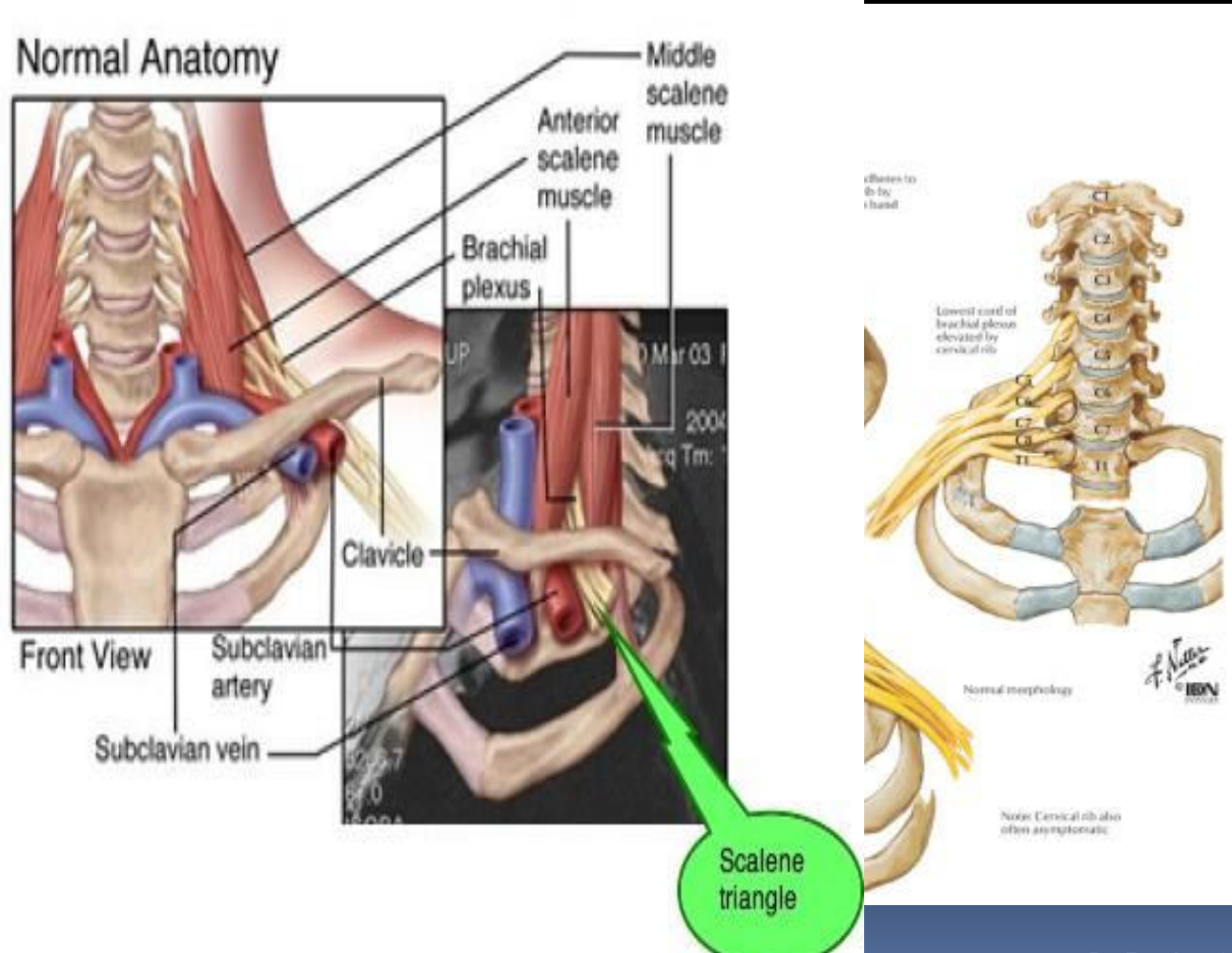


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True neurogenic thoracic outlet syndrome



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Thoracic outlet syndrome

- Compression of subclavian artery and lower trunk of brachial plexus in the area of the clavicle.
- This can happen when there is an extra cervical rib
- There may be pain in neck & shoulders, & numbness in the last 3 fingers & inner forearm.
- radial pulse may be easily obliterated by movements of the arm, particularly with arm extended & abducted at shoulder.

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True neurogenic thoracic outlet syndrome

- Brachial plexus fibers compromised by a translucent band extending from rudimentary cervical rib to 1st rib
- C8 and T1 fibers are mostly affected
- Presented with pain, paresthesia in the neck shoulder and along the medial border of hand
- Weakness of the muscles in the hand
- symptom & sign of vascular compromise



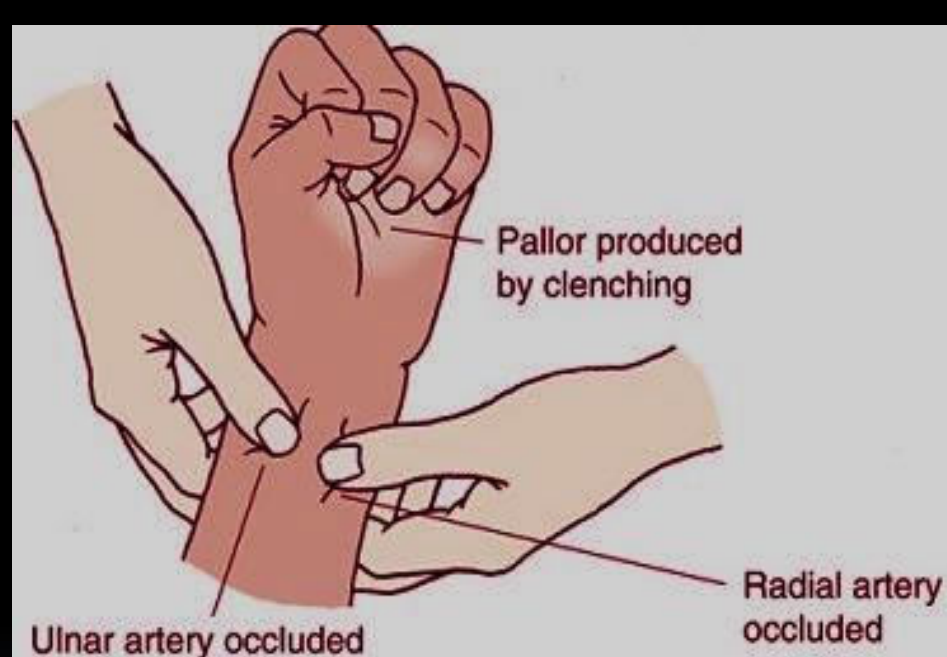
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True neurogenic thoracic outlet syndrome



Adson's Maneuver



Allen's Test

Management-Surgical lysis of fibrous band or resection of cervical rib

Supraclavicular Brachial Plexopathies

Pancoast Syndrome

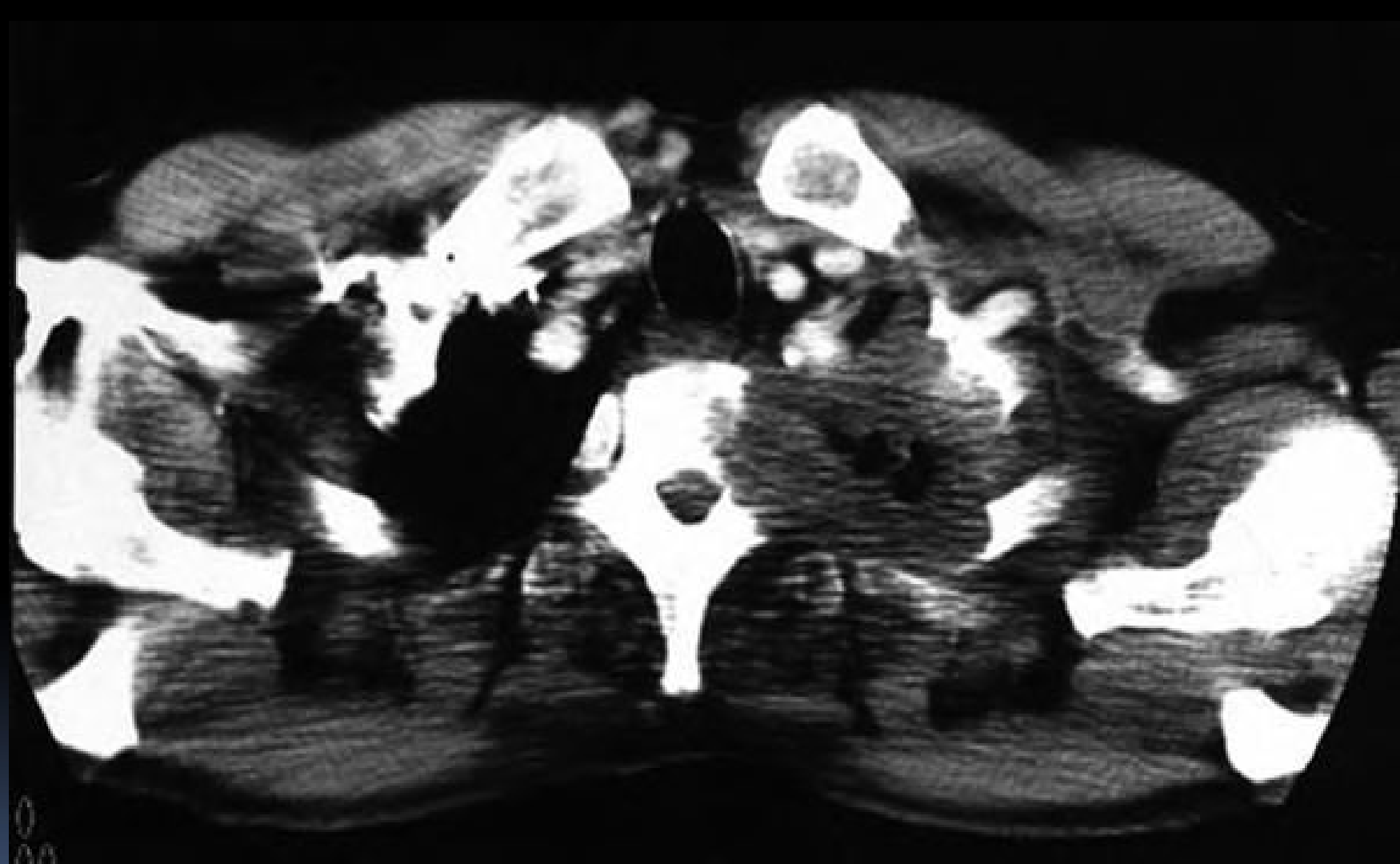
- Superior lobe carcinoma of lung, mainly NSCC
- Compression of T1 as only pleura separates lung from T1
- Shoulder pain radiating in an ulnar distribution down the arm
- Shoulder pain worse at night
- Associated with Horner syndrome



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Pancoast Tumor



CT Chest- Pancoast Tumor Invading T1

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Infraclavicular Brachial Plexopathies

- **Crutch palsy**: radial nerve compression
- **Midshaft clavicular fracture**: medial cord injury

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Nonspecific Brachial Plexopathies

Neuralgic Amyotrophy

- Frequently involves long thoracic, axillary and supraclavicular nerves
- Presenting feature: abrupt shoulder or upper arm pain, often nocturnal onset
- Pain abates after 7-10 days
- 50% associated with infection

1. The middle trunk of the brachial plexus is formed by anterior rami of which spinal cord segments?
 - a. C7
 - b. C6 and C7
 - c. C6
 - d. C5 and C6
 - e. C7 and T1

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2. Postoperative examination revealed that the medial border and inferior angle of the left scapula became unusually prominent (projected posteriorly) when the arm was carried forward in the sagittal plane, especially if the patient pushed with outstretched arm against heavy resistance (e.g., a wall). What muscle must have been denervated during the axillary dissection?
 - A. Levator scapulae
 - b. Pectoralis major
 - c. Rhomboideus major
 - d. Serratus anterior
 - e. Subscapularis

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3. A person sustains a left brachial plexus injury in an auto accident. After initial recovery the following is observed:
 - 1) the diaphragm functions normally,
 - 2) there is no winging of the scapula,
 - 3) abduction cannot be initiated, but if the arm is helped through first 45 degrees of abduction, patient can fully abduct arm.From this amount of information and your knowledge of formation of the brachial plexus where would you expect injury to be:
 - a. Axillary nerve
 - b. Posterior cord
 - c. Roots of plexus
 - d. Superior trunk
 - e. Suprascapular nerve

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4. In a case of Erb's palsy, where roots C5 and C6 of the brachial plexus are avulsed (torn out) which muscle is paralyzed?
 - A. Latissimus dorsi
 - b. Pectoralis minor
 - c. Supraspinatus
 - d. Trapezius
 - e. Triceps brachii