The Upper Limb III

The Brachial Plexus

Anatomy

RHS 241

Lecture 12

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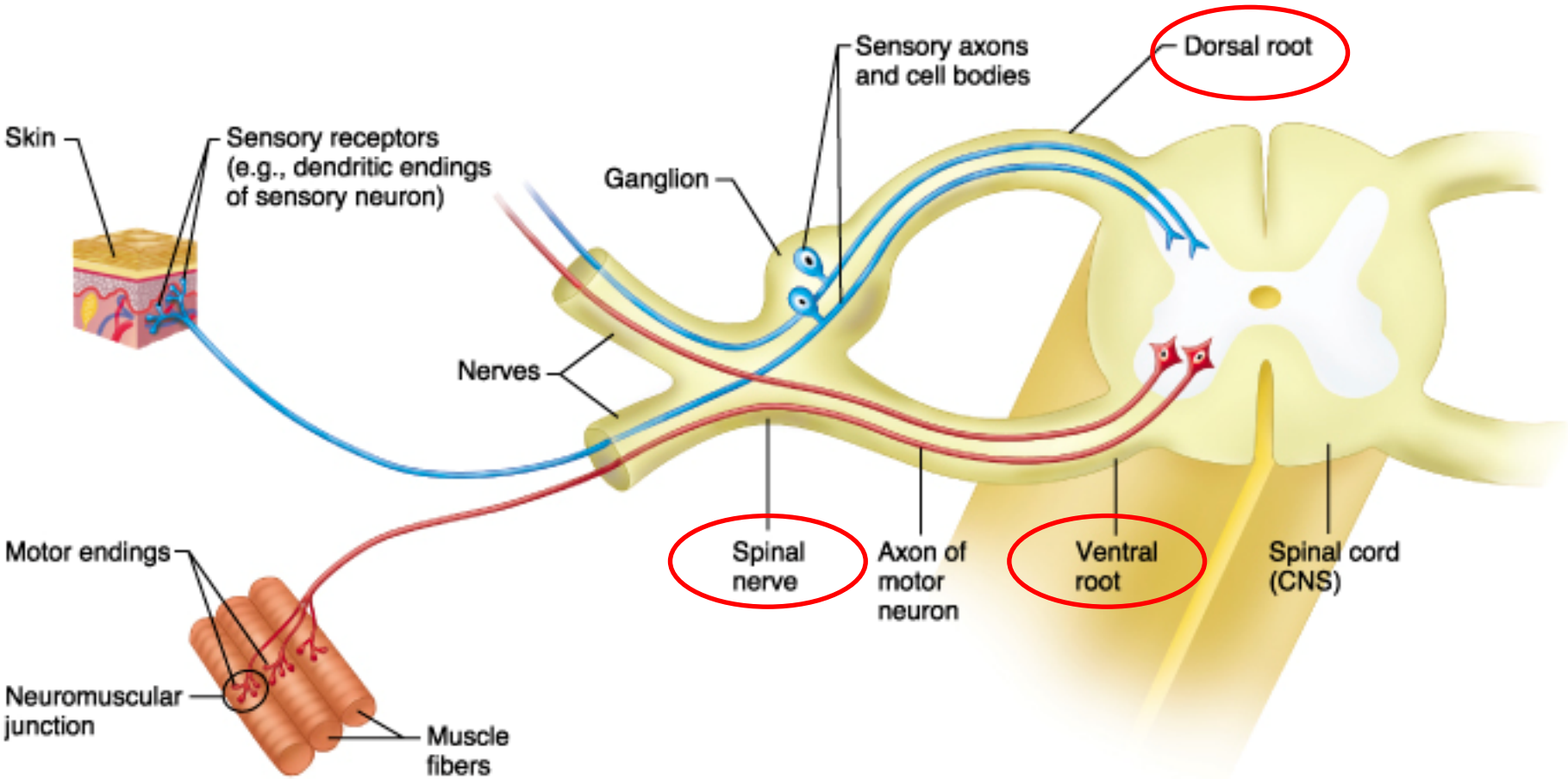
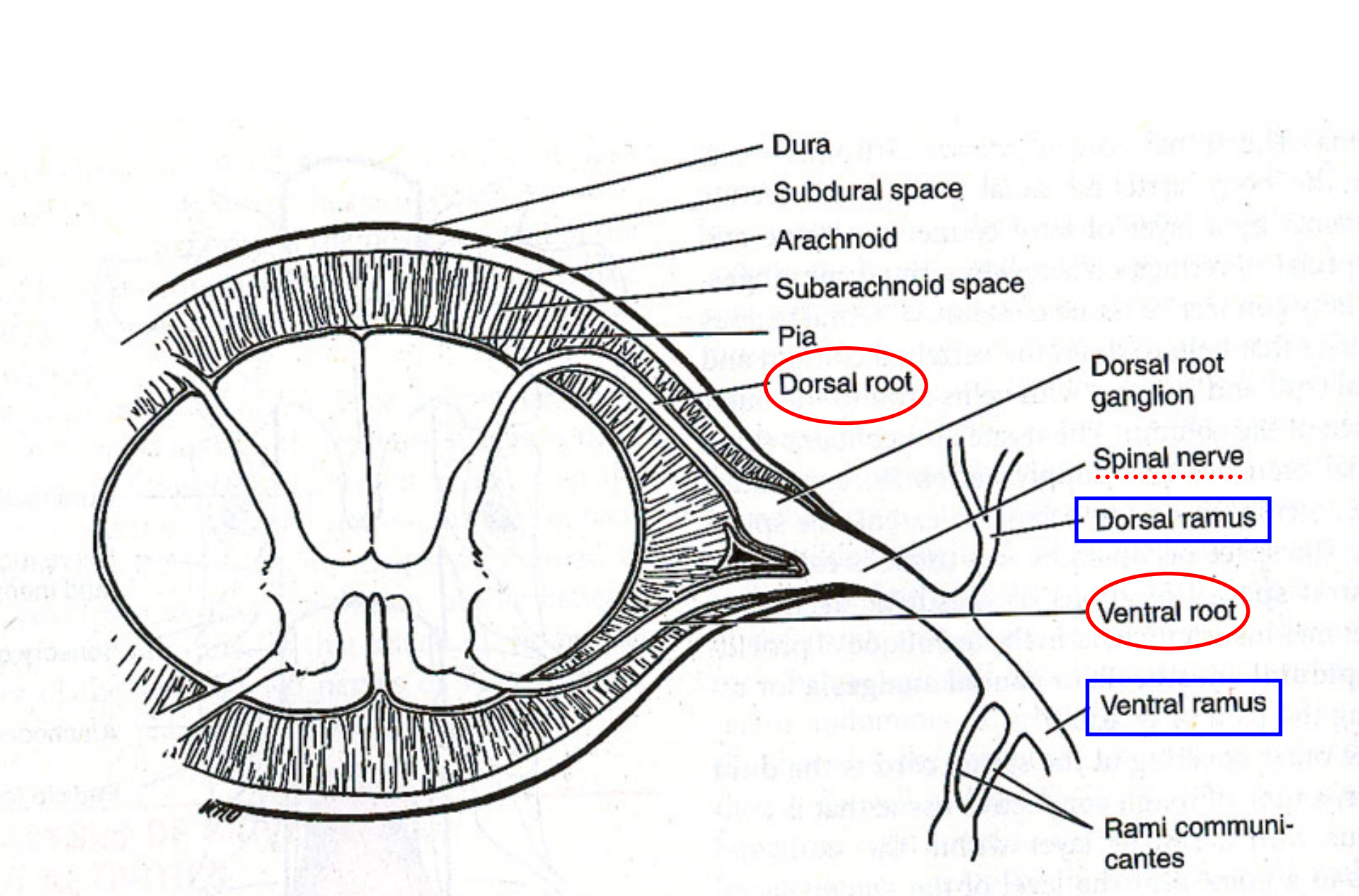
Brachial plexus

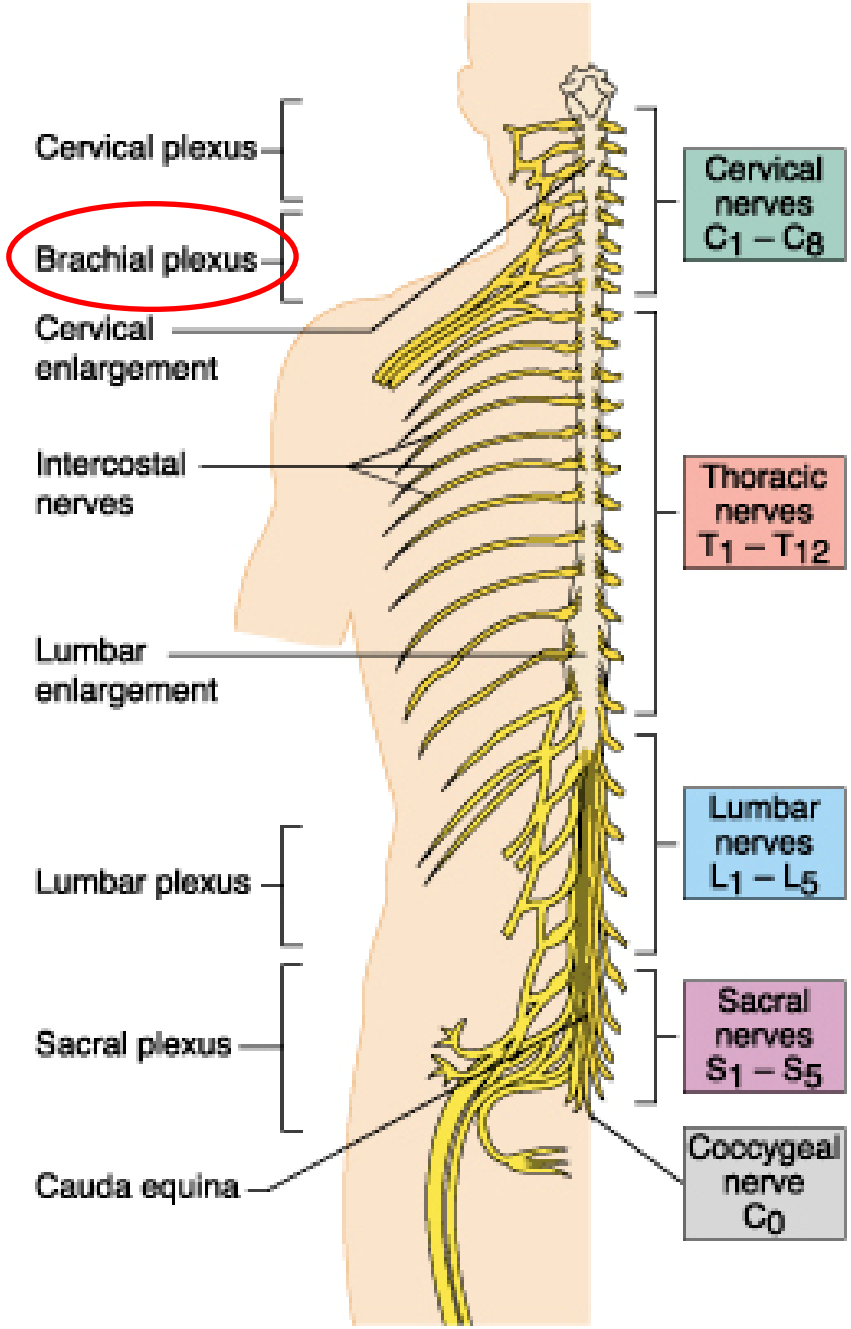
- Network of nerves supplying the upper limb
- Compression of the plexus results in **motor** & **sensory** changes within the upper limb
- The upper limb is innervated by **ventral rami** (just like the lower limb, and most muscles of the thoracic and abdominal walls)



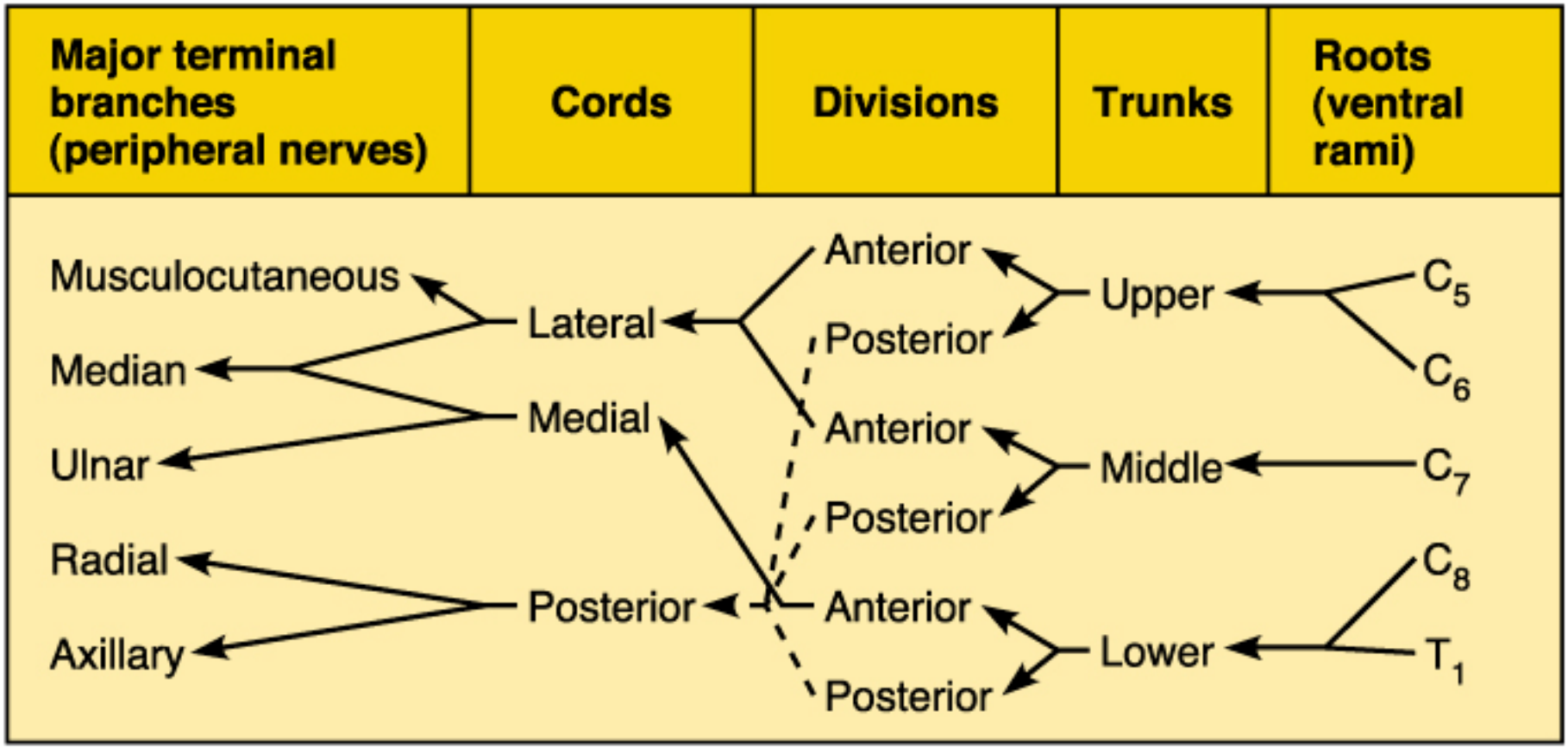

Dura
Subdural space
Arachnoid
Subarachnoid space
Pia
Dorsal root
Dorsal root ganglion
Spinal nerve
Dorsal ramus
Ventral root
Ventral ramus
Rami communi-cantes

Which structures are supplied by the dorsal rami of spinal nerves?

Spinal nerves



Brachial plexus



(c)

Brachial plexus components

Roots (5)

- The **ventral rami** of cervical spinal nerves (C5-C8, and T1)

- Lies within the **interscalene triangle** (boundaries: scalenus anterior to the front, scalenus medius to the back, & the superior surface of the 1st rib below)

Brachial plexus components

Trunks (3)

- *supraclavicular*

- **Upper (superior) trunk:** formed by the union of roots C5 & C6
- **Middle trunk:** the lateral extension of the C7 root
- **Lower (inferior) trunk:** formed by the union of roots C8 & T1

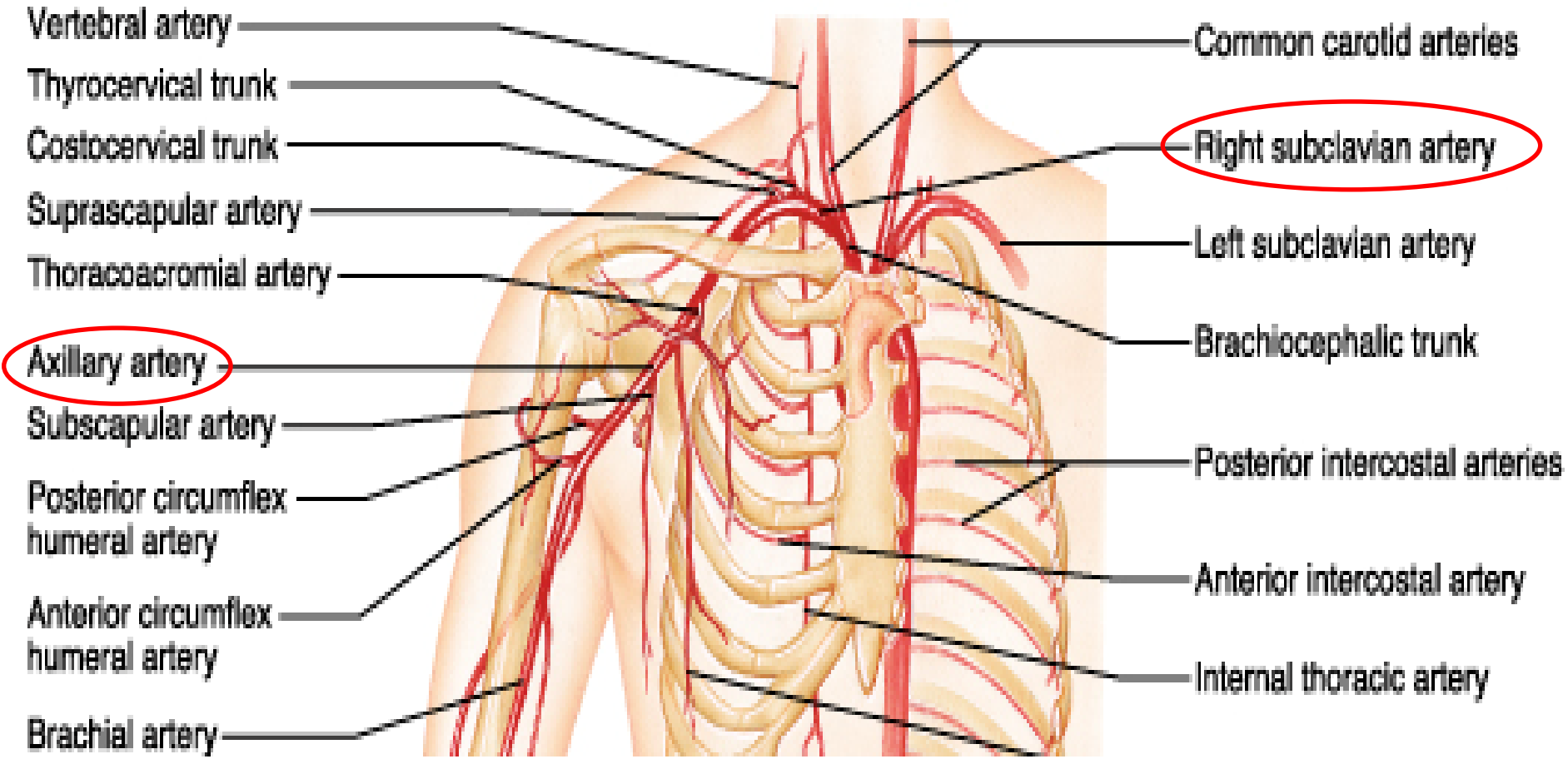
Brachial plexus components
Divisions (6)

- Each of the trunks of the brachial plexus divides into **anterior & posterior divisions**.

Brachial plexus components

Cords (3)

- Cords are named for their lateral, medial, and posterior relationship to the 2nd part of the **axillary artery**
- Deep to the **pectoralis minor**
- The **subclavian artery** changed its name to the axillary artery as it crossed the lateral boarder of the 1st rib


Vertebral artery
Thyrocervical trunk
Costocervical trunk
Suprascapular artery
Thoracoacromial artery
Axillary artery
Subscapular artery
Posterior circumflex humeral artery
Anterior circumflex humeral artery
Brachial artery
Common carotid arteries
Right subclavian artery
Left subclavian artery
Brachiocephalic trunk
Posterior intercostal arteries
Anterior intercostal artery
Internal thoracic artery

Brachial plexus components

Cords (3)

- **Lateral cord:** formed by the union of anterior divisions of the superior & middle trunks (C5, C6, & C7)
- **Medial cord:** formed by the anterior division of the inferior trunk (C8 & T1)
- **Posterior cord:** formed by the union of the three posterior divisions (C5 to T1)

Terminal nerves

- From the **lateral cord**:
  - the **musculocutaneous nerve**
  - the **lateral root of the median nerve**
  - the **lateral pectoral nerve**

Terminal nerves

- From the **medial cord**:
  - the **ulnar nerve (C8, T1)**
  - the **medial root of the median nerve**
  - the **medial pectoral nerve**

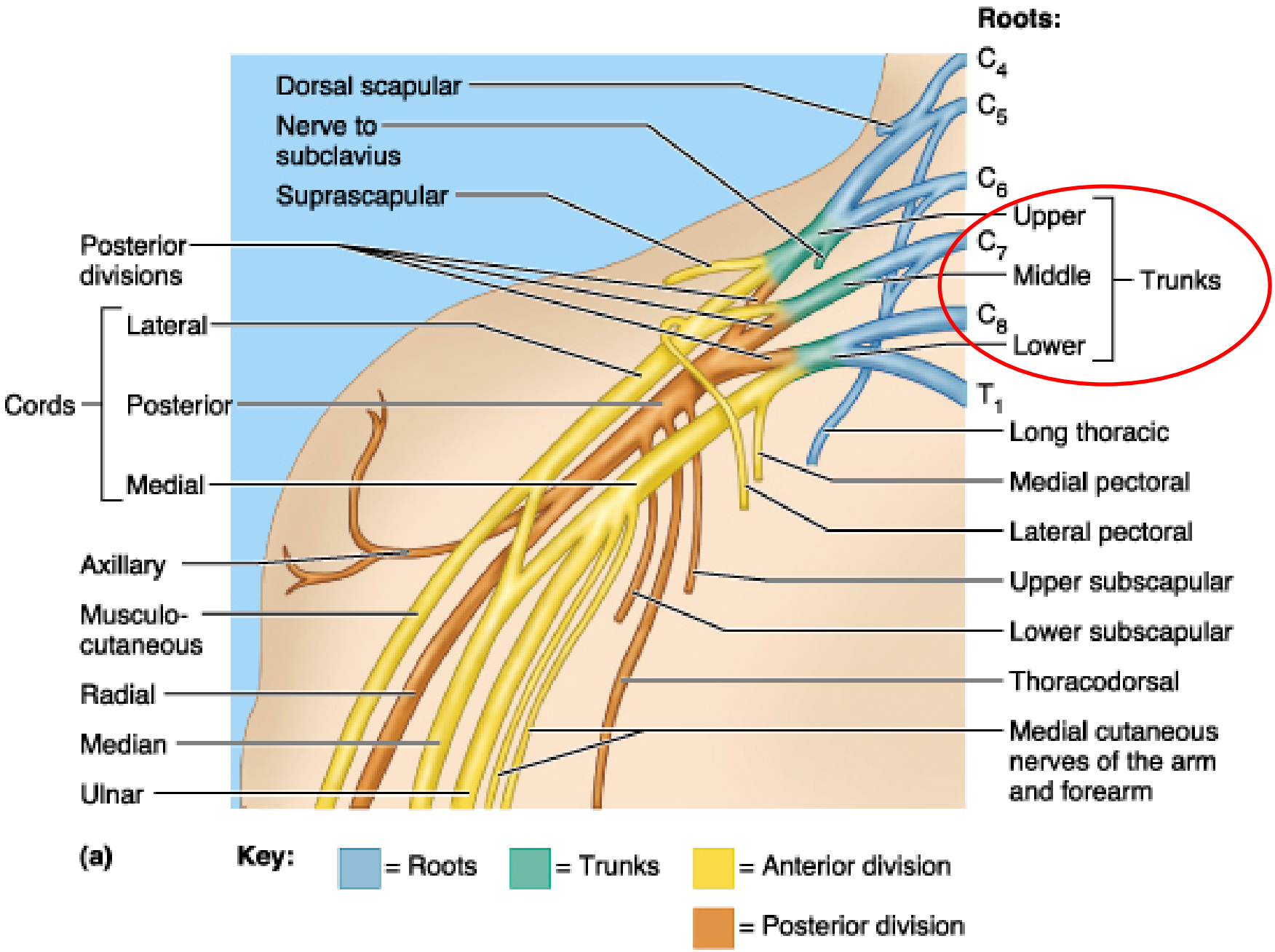
Terminal nerves

- From the **posterior cord**:
  - the **axillary nerve (C5, C6)**
  - the **radial nerve (C5-T1)**
  - the **thoracodorsal nerve**
  - the **upper & lower subscapular nerves**

Clinical note

- Each of the terminal nerves contain motor nerve fibers from at least two levels or segments of the spinal cord

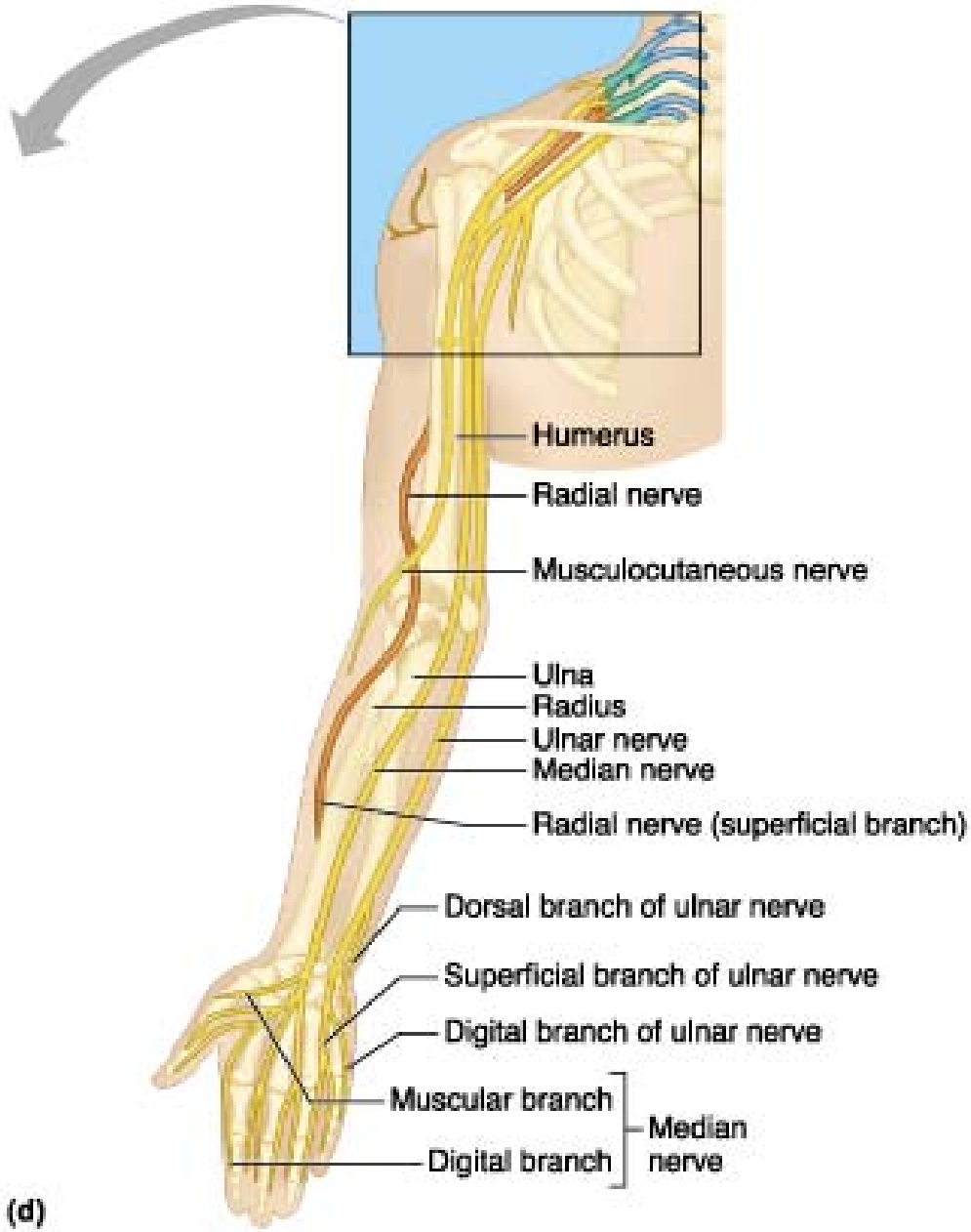
- Impingement of a single nerve root of the brachial plexus results in muscle weakness rather than paralysis



Brachial plexus- relationships

- **Compression** or **impingement** of the brachial plexus result from structural changes at one or more of the following sites:

  - Intervertebral formaina
  - Interscalene triangle
  - Costoclavicular space
  - Pectorlais minor / coracoid process space



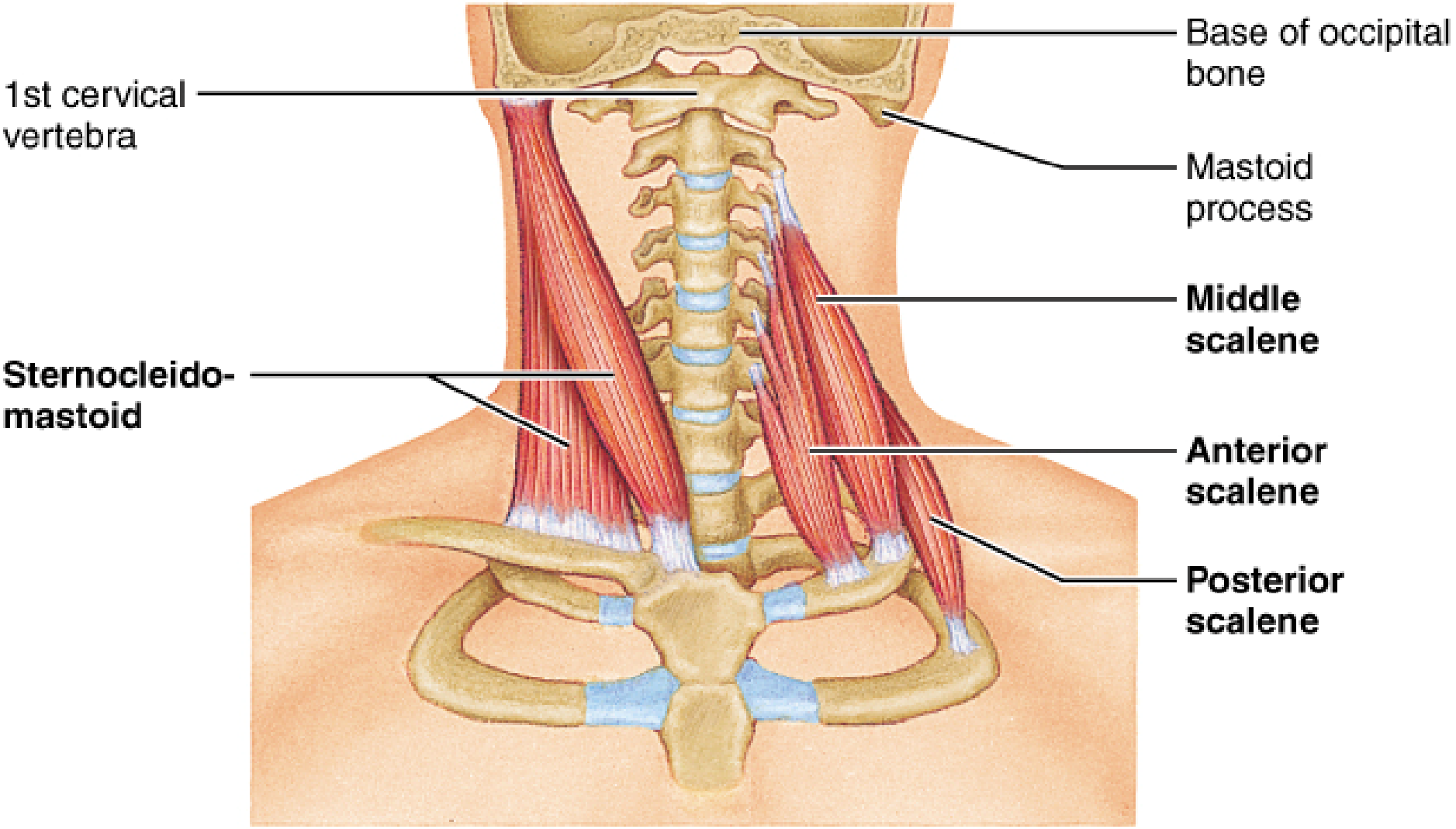
Intervertebral formaina

- Paired openings located posterior to the bodies of adjacent vertebrae
- Transmit the spinal nerves and accompanying vessels
- Where does spinal nerve C1 exit the vertebral column?
- What are the structural changes that could lead to narrowing of the IVF?

Interscalene triangle

- **Boundaries:**

  - Anteriorly: scalenus anterior muscle
  - Posteriorly: scalenus medius muscle
  - Inferiorly: the superior surface of the 1st rib (between the costal attachment of the scalenus anterior and medius muscles)



(a) Anterior view

Interscalene triangle

- **Content:**

  - The **roots of the brachial plexus** (C5-T1)

  - **Subclavian artery** (which becomes the axillary artery as it crosses the lateral boarder of rib1)

Clinical note

- Any structure (such as a cervical rib) which reduces the size of the interscalene triangle

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can compromise blood flow and innervation to the upper limb

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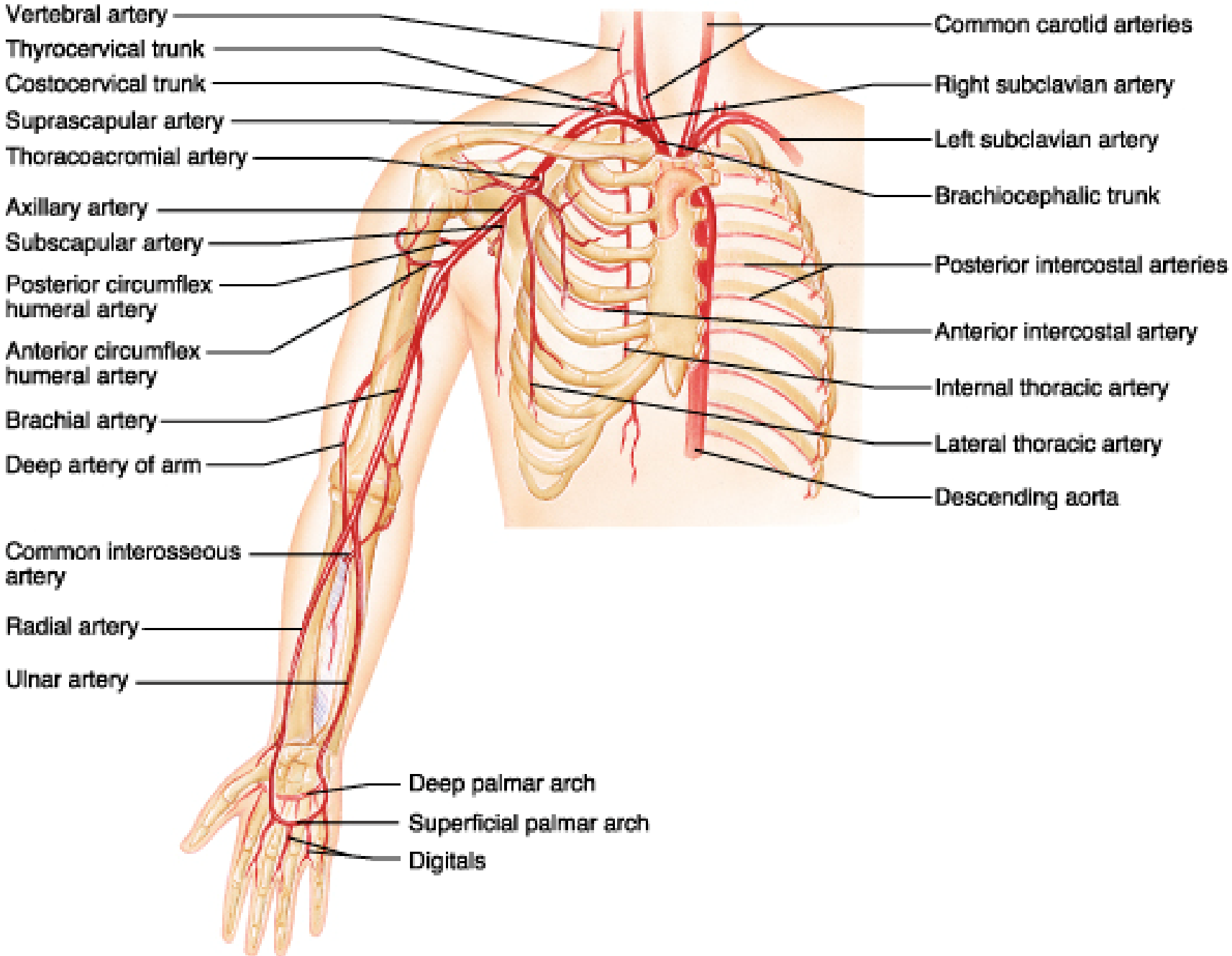
reduced radial pulse, paresthesia, and/or motor weakness (venous return is not impaired)

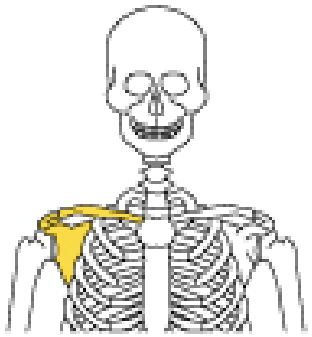


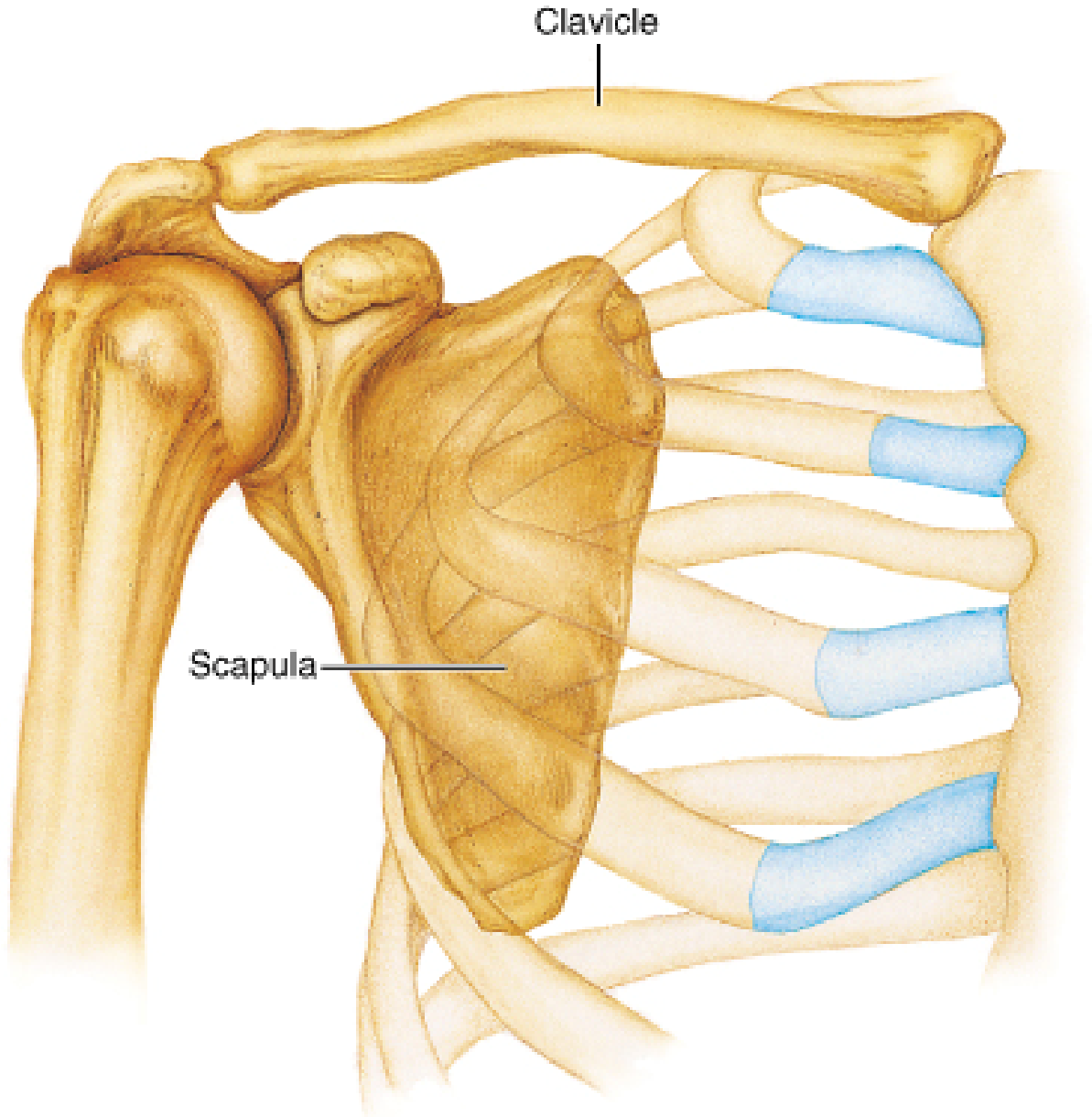
Q: What would you ask a patient to do to reduce the dimensions of the interscalene triangle?

A: feel the radial pulse then abduct, extend, and externally rotate the arm, deep breath and rotate the head toward the arm tested. If there is a compression of the subclavian artery, then the pulse will diminish.

Costoclavicular space

- **Boundaries:**
  - Clavicle: approximately middle third
  - First rib: approximately middle third





(a) Articulated pectoral girdle

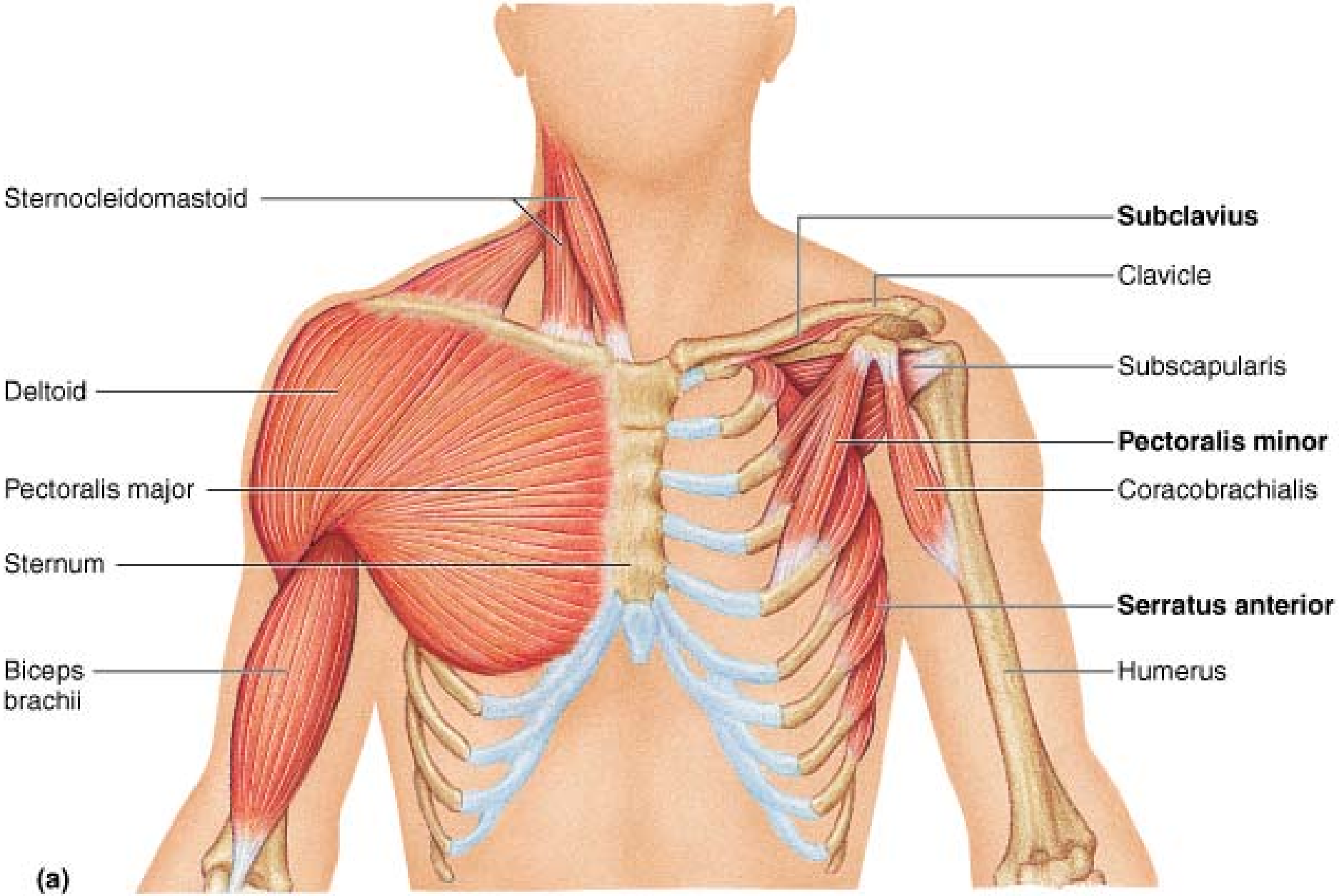
Costoclavicular space

- **Content:**

  - Brachial plexus
  - Axillary artery
  - Axillary vein

The pectoralis minor/ coracoid process space

- Pectoralis minor (from ribs 3-5 to coracoid process)
- The brachial plexus lies posterior to the pectoralis minor, inferior to the coracoid process, and inferomedial to the head of the humerus



Brachial plexus lesions

- Most common in **young men** thrown from their motorcycles or during **difficult deliveries**

Brachial plexus lesions

Closed injuries:

Can occur in 2 ways:

1. Violent lateral flexion of the neck with depression of the shoulder, or forced abduction of the arm

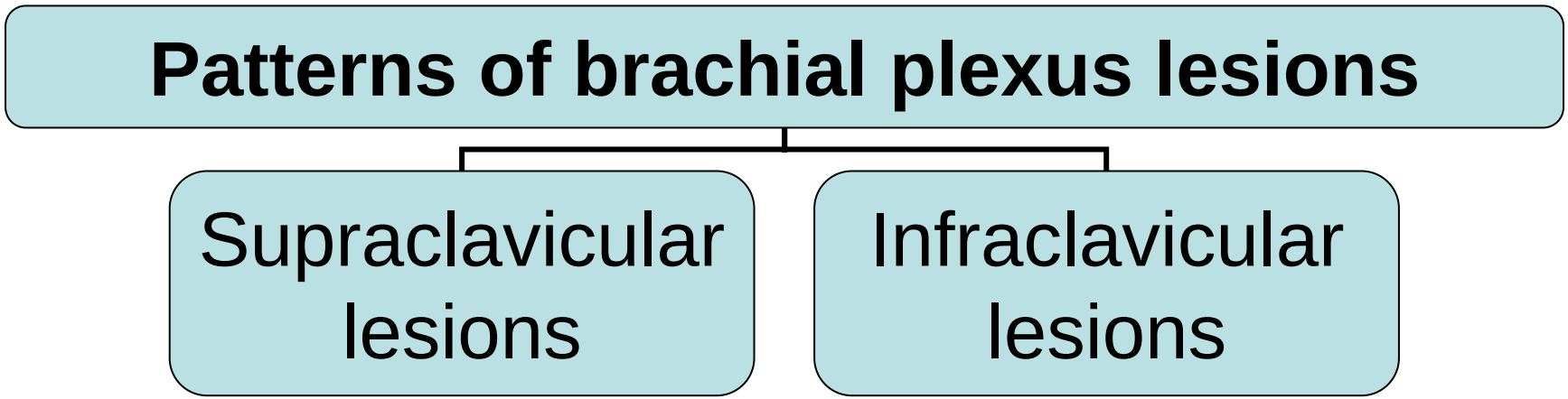
2. At birth during difficult deliveries

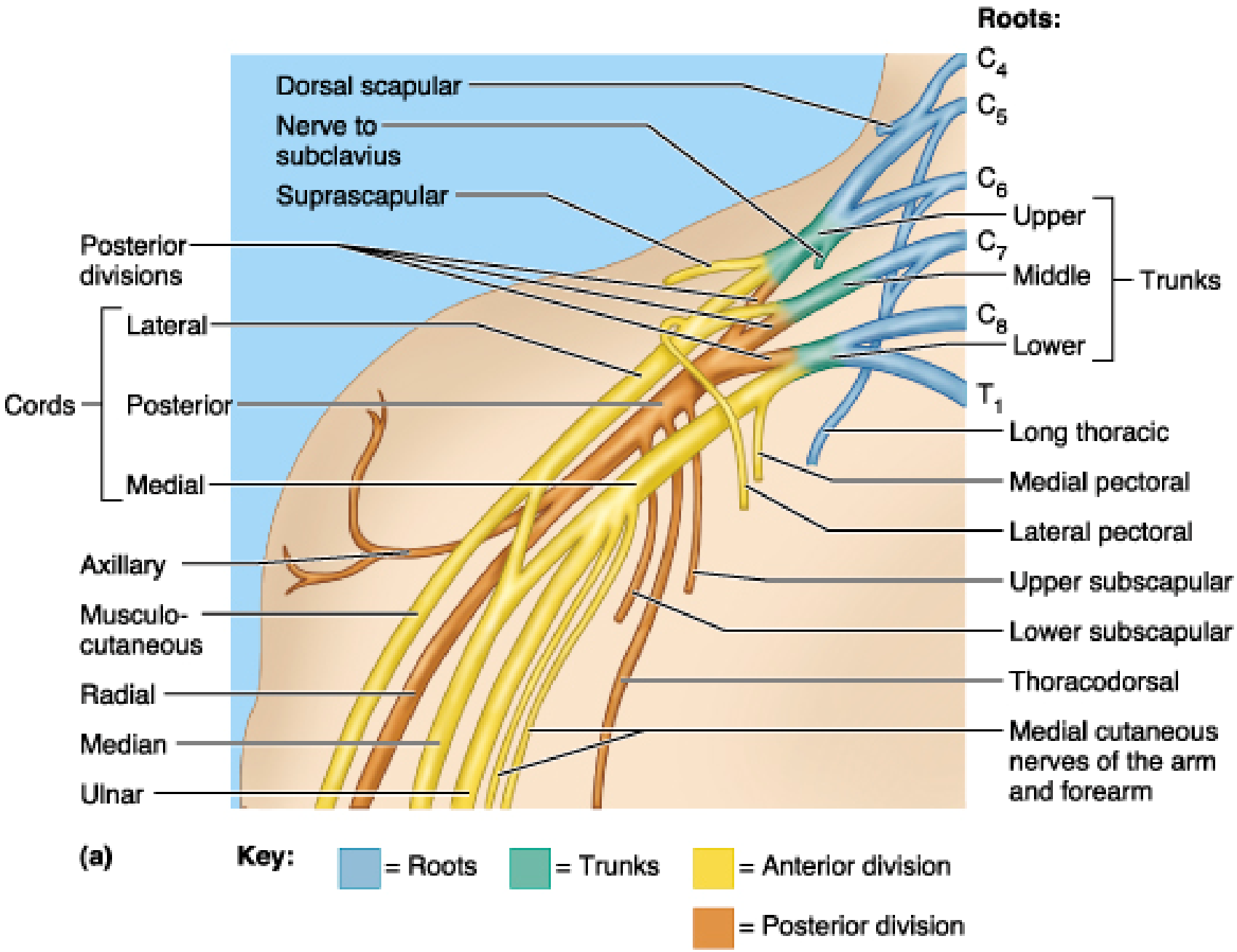
Brachial plexus lesions

Open injuries:

- Rare

- Caused by falling objects such as glass or steel


Patterns of brachial plexus lesions
Supraclavicular lesions
Infraclavicular lesions



Supraclavicular lesions

Trauma:

- Mechanism of injury: blows to the head and shoulder cause violent ***lateral flexion*** of the cervical spine and ***depression*** of the shoulder ⟶ **tear the *upper cords***

- Example: motorcyclists landing on the head and shoulder

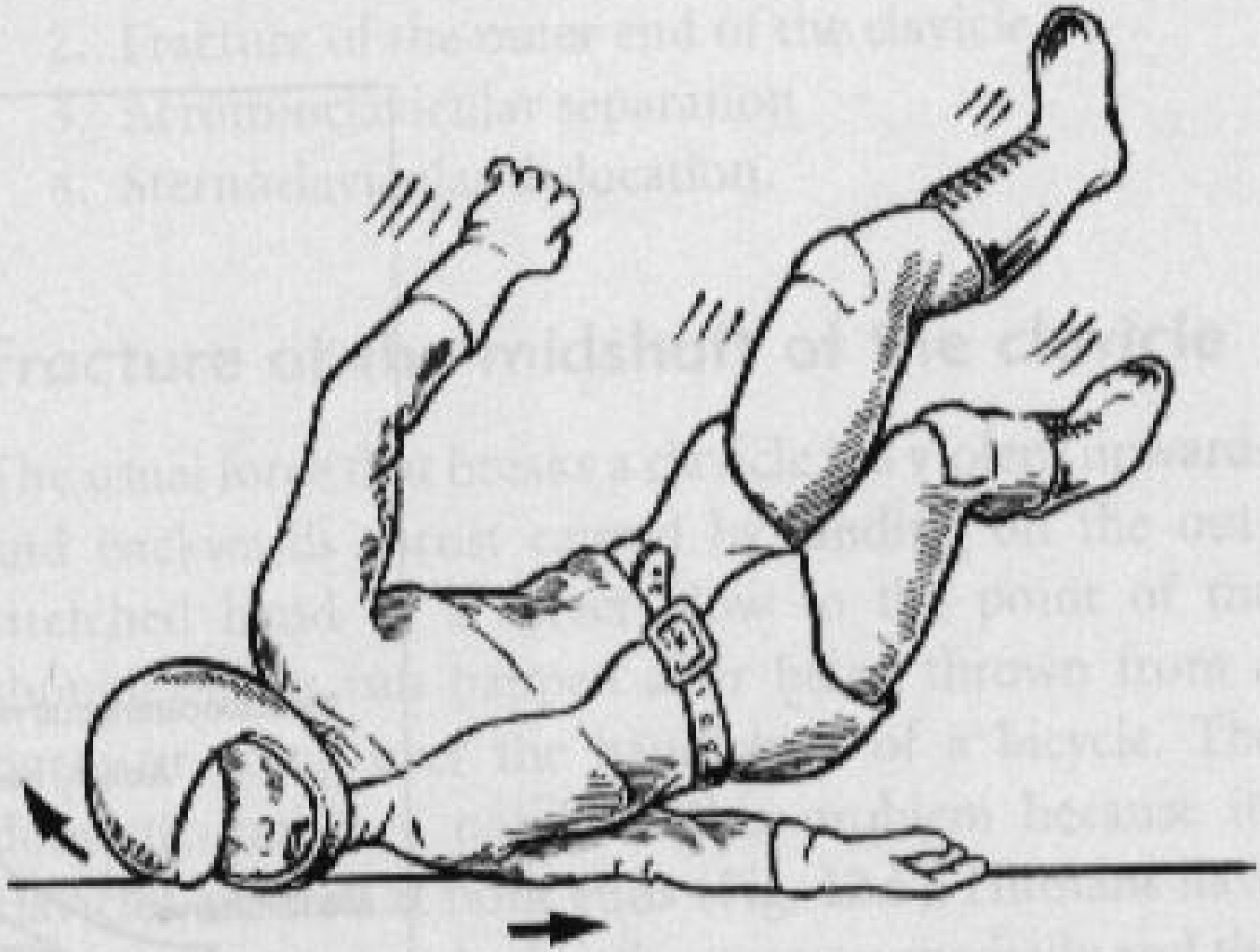


Fig. 12.1 Traction injury of the brachial plexus. Violent abduction of the neck and shoulder can tear the upper cords of the brachial plexus.

Supraclavicular lesions

Obstetric palsy:

- When the **upper cords** are damaged at birth

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weak deltoid, elbow flexors, wrist extensors, supinator

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“waiter’s tip” position of the arm (*Erb’s palsy*)

Erb’s palsy

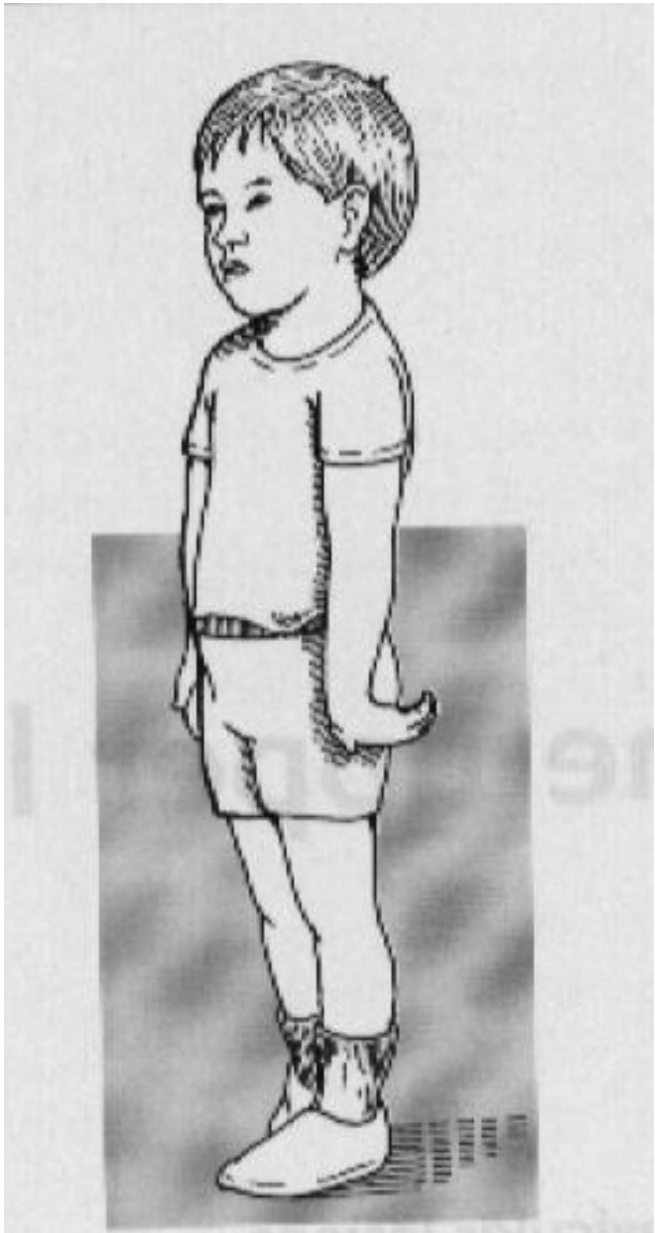
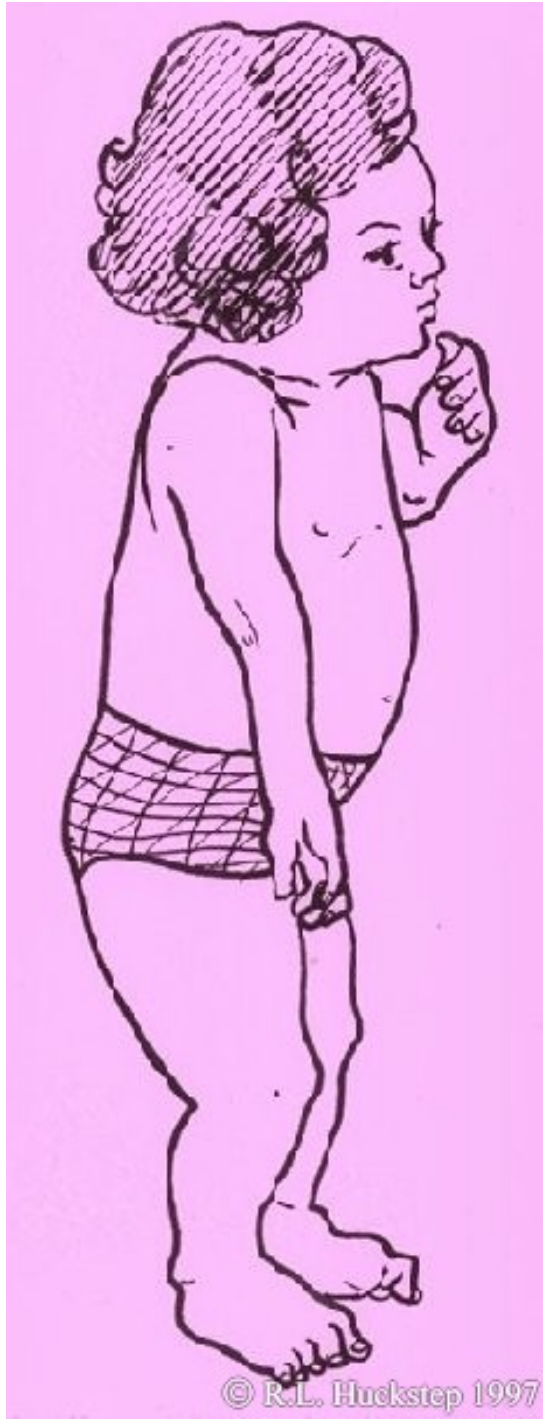


Fig. 12.2 The position of the hand in Erb’s palsy.

Erb’s palsy



Infraclavicular lesions

Trauma:

Mechanism of injury:

- When the arm is violently abducted
- Anterior dislocation of the shoulder

injury to the lower part of the brachial plexus

Infraclavicular lesions

Birth injury:

- Damage to the lower cords (C7, C8, T1): *Klumpke's palsy* (weakness of finger flexors and intrinsics)

Erb’s palsy:

C5/6 paralysis (particularly following a breech delivery)

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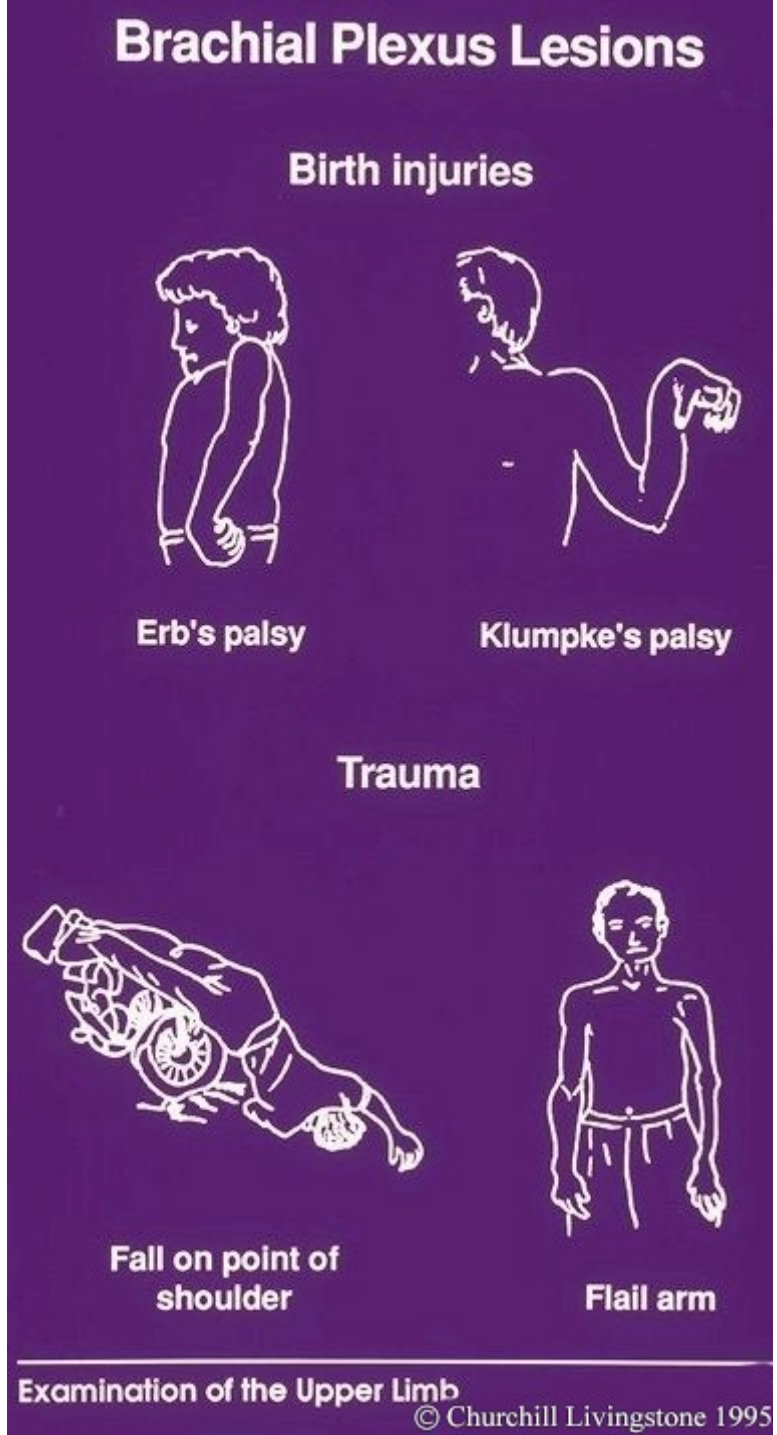
paralysis of the deltoid, external rotators of the shoulder, & biceps

↓

the baby's arm is held in adduction, internal rotation and with the elbow extended (waiter's tip position)



Klumpke's palsy:

C7, C8 and T1 palsy

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flexed elbow & paralyzed hand