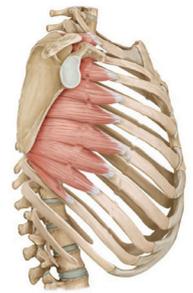


CHAPTER 2



Pectoral Region and Axilla

Learning Objectives

At the end of the dissection of the pectoral region and axilla, students should be able to identify the following:

- **Nerves:** Supraclavicular nerves, medial and lateral pectoral nerves, long thoracic nerve and branches of the intercostal nerves.
- **Vessels:** Branches of the internal thoracic artery, *thoracoacromial artery and its branches*, *superior thoracic artery* and *cephalic vein*.
- **Muscles:** Pectoralis major, pectoralis minor, subclavius and serratus anterior.
- The anatomical basis of the clinical signs and conditions (e.g., Peau d'orange skin in carcinoma of the breast and policeman's tip position of the upper limb in Erb's palsy).

Introduction

The upper limb is adapted to great freedom of movement in order to perform skillful/prehensile acts. Its importance is duly reflected by the sizeable area of representation it occupies in the cerebral cortex. The upper limb for the purpose of dissection is divisible into the following:

Shoulder region: It includes the axilla or armpit, scapular region and pectoral region.

Arm (*brachium*): The part between the shoulder and elbow, with humerus as its bone.

Forearm (*antebrachium*): It extends from the elbow to the wrist. It has two bones, the radius and ulna. Distally, they articulate with the carpal bones to form the wrist joint. The forearm bones articulate at the superior, middle and inferior radioulnar joints. The movements of pronation and supination occur at these joints.

Hand (*manus*): It consists of the wrist/carpus, metacarpus and digits (fingers and thumbs). The forearm bones, radius and ulna, articulate with the carpal bones. The carpals distally articulate with the metacarpals and the metacarpals articulate with the phalanges. The hand presents ball of the thumb, thenar eminence and ball of the little finger, that is, the hypothenar eminence.

The upper limb is attached to the thorax by muscles which form the *anterior* and *posterior axillary folds*. When the upper limb is moved away, the axilla (pyramidal shape) or armpit becomes evident.

The pectoral region covers the anterior thoracic wall presenting mammary glands. In females, breasts or mammary glands are well developed, while in males, they are rudimentary.

Surface Landmarks

1. **Clavicle:** It is the collar bone. It is subcutaneous and palpable throughout its length. It is concave along the lateral one-third and convex along the medial two-thirds for vessels and nerves to pass between the axilla and root of neck. It articulates with the manubrium at the sternoclavicular joint and laterally with the acromion of the scapula at the acromioclavicular joint (**Fig. 2.1**).
2. **Acromion** (Acron: summit; omos: shoulder): It can be felt as a flat subcutaneous bone on the top of the shoulder.
3. **Acromioclavicular joint:** A plane synovial joint is felt as a slight depression between the lateral end of the clavicle and acromion.
4. **Jugular notch:** It lies between the medial ends of the clavicle along the superior margin of the manubrium.
5. **Sternal angle:** It can be felt as a transverse ridge at the junction of the manubrium with the body of the sternum. It lies at the level of the second costal cartilage. Other ribs are counted downwards from the second.

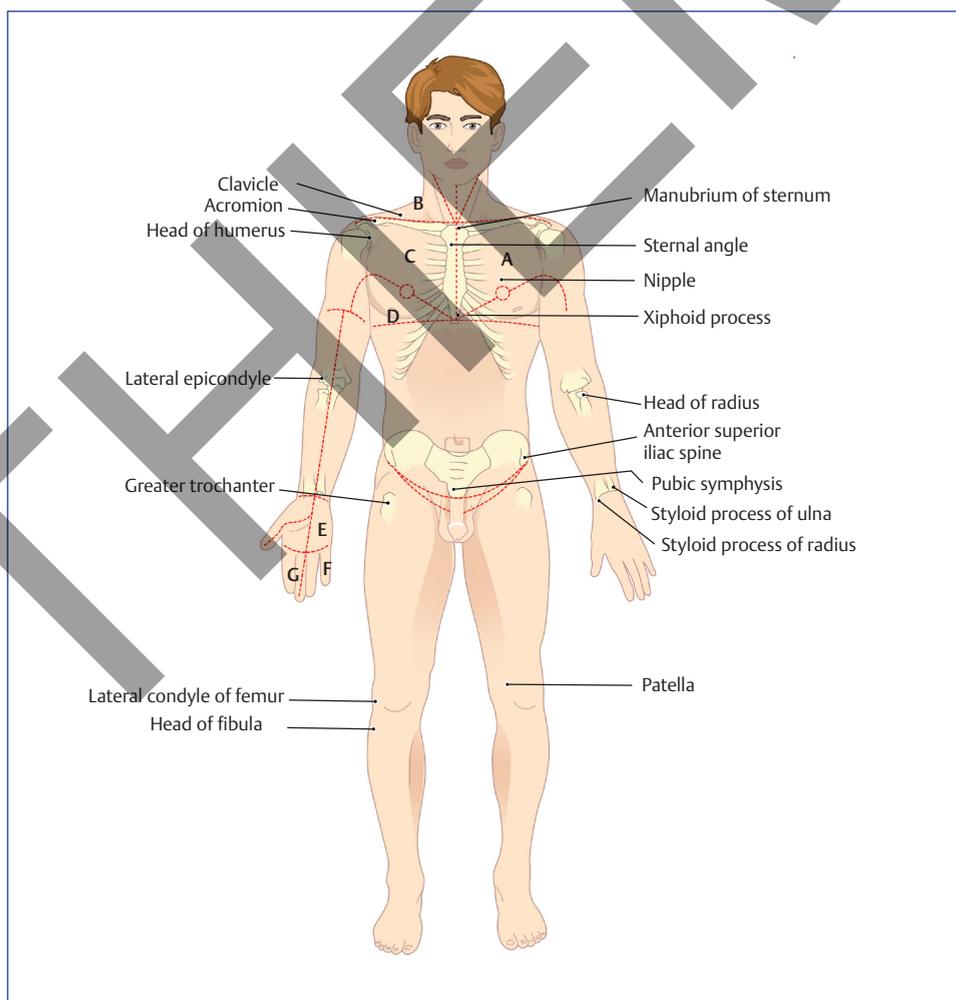


Fig. 2.1 Surface landmarks and incisions.

6. *Xiphoid process*: It is the lower part of the sternum lying in the epigastric fossa between the cartilages of the seventh ribs.
7. *Nipple*: It is variable in position, usually at the fourth intercostal space slightly medial to the mid-clavicular line.
8. *Infraclavicular fossa*: It is a depression inferior to the junction of the middle with lateral one-third of the clavicle.
9. *Coracoid process of the scapula*: It can be felt 2 cm below the clavicle just lateral to the infraclavicular fossa, under the muscle fibres of the deltoid.
10. *Axilla* (armpit): It is a hollow pyramidal space between the abducted upper limb and side of the thorax.
11. *Anterior axillary fold*: It is formed by the pectoralis major muscle.
12. *Posterior axillary fold*: It is formed by the latissimus dorsi and teres major muscles.

Dissection and Identification

In the supine position of the cadaver, as shown in **Fig. 2.1**, give the following *skin incisions*:

<https://www.winkingskull.com/dissector/V1/video.aspx?vid=73>

1. *Incision A*: Along the midline from the jugular notch to the xiphisternum.
2. *Incision B*: From the jugular notch along the clavicle to the acromion; in this, avoid (refrain) cutting through the platysma muscle and supraclavicular nerves.
3. The *platysma* is a thin sheet of muscle present in the superficial fascia of the neck region and helps in facial expressions. The muscle may extend below the clavicle into the superficial fascia of the upper part of the thorax and will be studied in detail with the head and neck regions.
4. *Incision C*: From the xiphisternal junction encircling the nipple and then along the anterior axillary fold to the arm.
5. *Incision D*: Horizontal incision from the xiphisternal junction to the posterior axillary fold.
6. Reflect the skin flaps and the superficial fascia laterally by blunt dissection.
7. While separating the skin flap along the clavicle (*incision B*), identify the *supraclavicular nerves* by doing blunt dissection through the superficial fascia.
8. While reflecting the skin flap at *incision C*, close to the anterior axillary fold, identify the *lateral cutaneous branches of the intercostal nerves* emerging serially in a vertical line. Trace their branches anteriorly and posteriorly.
9. The *nipple* and surrounding skin should be left as a landmark.
10. In female cadavers, an attempt can be made to dissect the mammary gland.

Mammary Gland

The mammary gland is a *modified sweat gland* extending vertically between the second and the sixth rib in the midclavicular line and sideways from the lateral border of the sternum to the midaxillary line. It lies within the superficial fascia anterior to the pectoralis major muscle. The pectoral fascia covers the anterior surface of the pectoralis major and is connected to the overlying skin by the *suspensory ligaments of the breast (ligaments of Cooper)*, which pass between the lobes of the mammary gland (**Fig. 2.2**).

The mammary gland consists of 15 to 20 lobes; each lobe has a *lactiferous duct* which is dilated to form the *lactiferous sinus* at the base of the nipple and opens separately at the apex. *Axillary tail (tail of Spence)* of the gland passes superolaterally into the axilla to the level of the third rib. The gland is surmounted by the *nipple* lying at the level of the fourth intercostal space. It is surrounded by the *areola*, which is pink in colour at young age. In the early stages of pregnancy and shortly thereafter owing to pigmentation, both nipple and areola become dark permanently (**Fig. 2.3**).

Blood Supply

Blood supply to this region occurs by the perforating branches of the *intercostal* and *internal thoracic arteries* medially and the *lateral thoracic artery* laterally (**Fig. 2.4**).

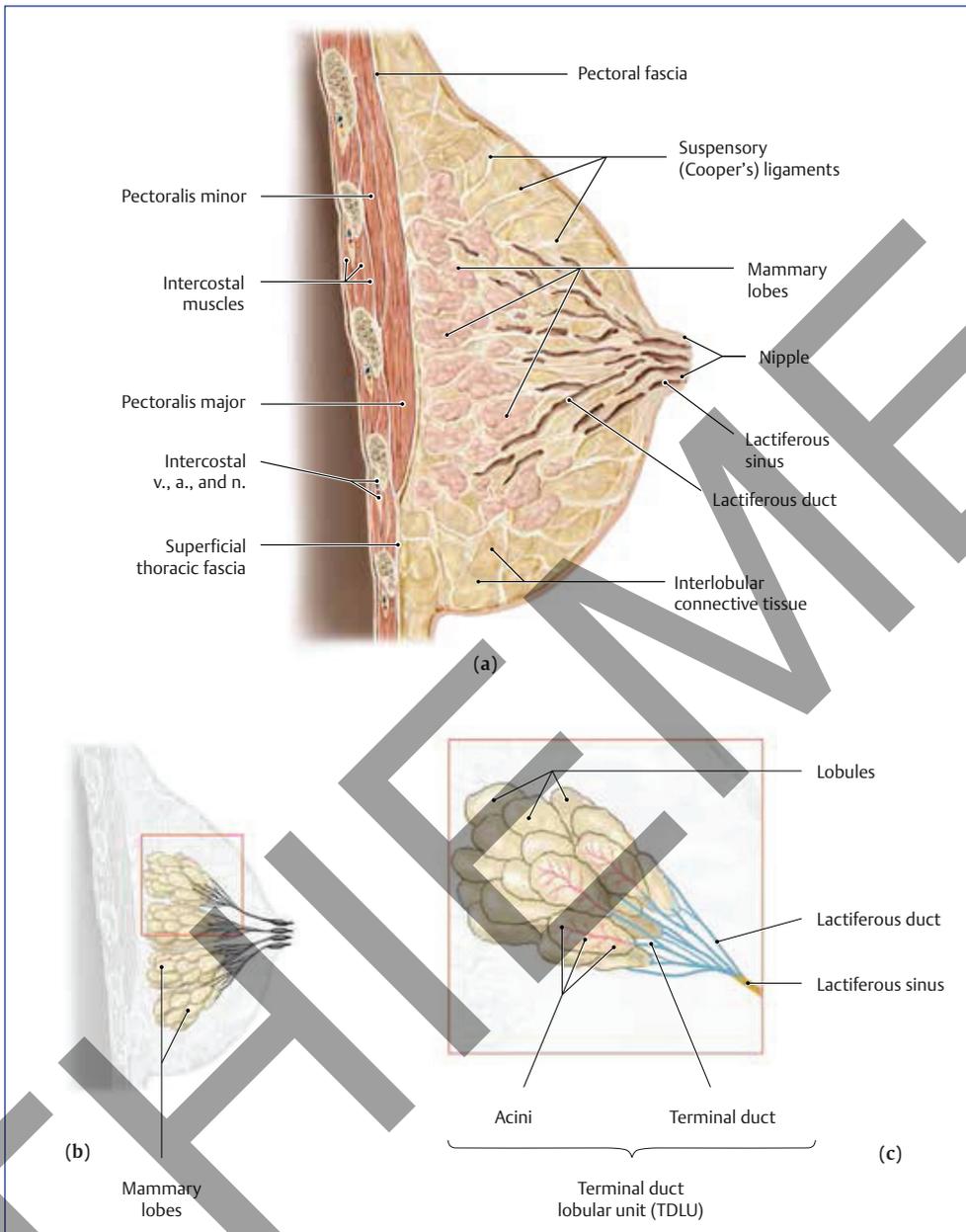


Fig. 2.2 (a, b, c) Structures of the mammary gland (breast).

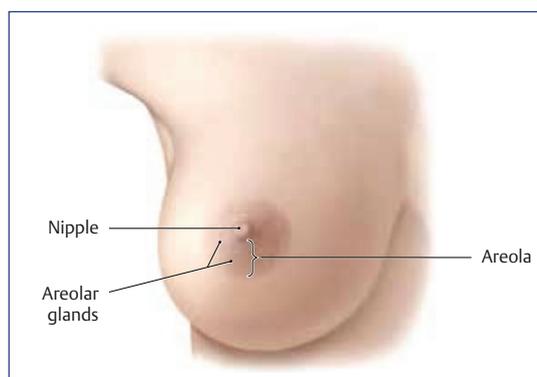


Fig. 2.3 External features of the right breast.

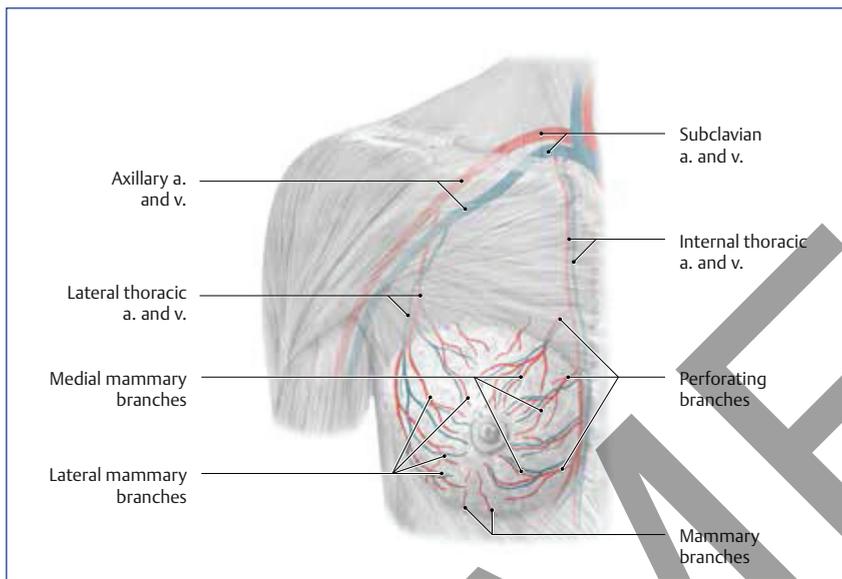


Fig. 2.4 Blood supply of the breast.

Lymphatic Drainage of the Breast

Considering the frequency of occurrence of the carcinoma of the breast in females and its spread through the lymphatics, it is necessary to study the lymphatic drainage of the breast (**Fig. 2.5**).

From the superficial part of the gland, the lymphatics drain into the *subareolar plexus of Sappo*. From the deep part of carcinoma involving the *inferomedial quadrant of the breast*, the malignant cells may pass through the rectus sheath to the umbilicus, then along the ligamentum teres hepatis to the liver and from there the cells fall on the ovary, forming a secondary tumour called the *Krukenberg's tumour*. Lymphatics from the mammary gland pass to the *pectoral lymph nodes* along the axillary tail through the pectoralis major to the apical axillary nodes via *infraclavicular nodes* and to the *parasternal nodes* along the internal thoracic artery of the same as well as the opposite side.

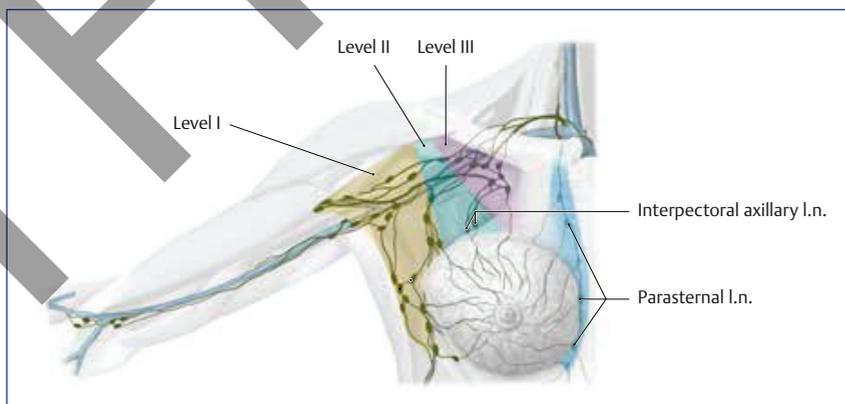


Fig. 2.5 Lymphatic drainage of the breast.

Dissection and Identification

1. Identify the *nipple and areola*.
2. Scoop the fat out by blunt dissection between the *suspensory ligaments of the breast*, where lobes of the functional glandular tissue existed earlier.

3. About 15 to 20 *lactiferous ducts*, each arising from a lobe of the gland, converge on the nipple and expand into the *lactiferous sinus* deep to the nipple.
4. Attempt to pass a bristle through one of the ducts of the nipple and try to identify a lobe of the gland. The attempt may not be very successful in elderly females.
5. At the anterior ends of the intercostal spaces deep to the breast, small *neurovascular bundles* exist. Trace the branches of these nerves medially and laterally.

At this stage, it would be pertinent to have short descriptions of the cutaneous nerves, vessels and deep fascia in the region before we explore the deeper structures.

Cutaneous Nerves

Table 2.1 provides an account of the cutaneous nerves, their origin and distribution (**Fig. 2.6**).

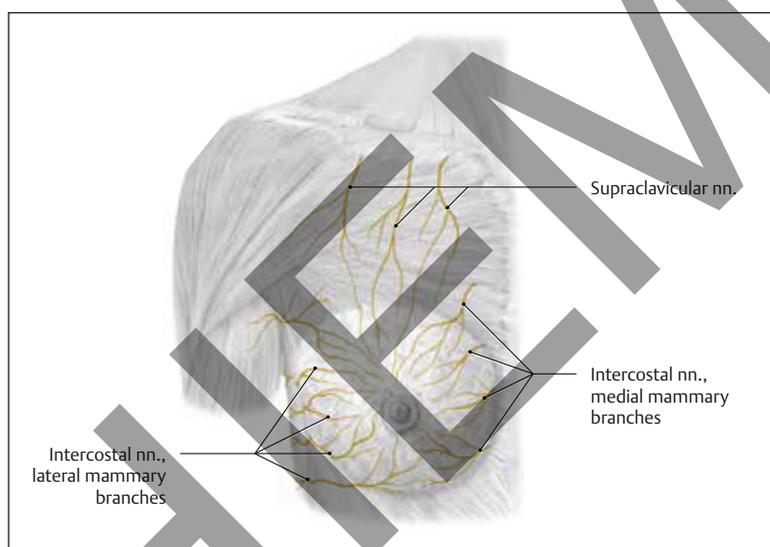


Fig. 2.6 Cutaneous innervation of the breast.

Table 2.1 Cutaneous nerves

| Name of nerve | Origin/Source | Distribution |
|---|---|--|
| Supraclavicular | Branches from the third and fourth cervical nerves | Piercing the deep fascia in the neck, then crossing over the clavicle to supply the <i>skin in front of the chest</i> (up to the second costal cartilage) and <i>shoulder</i> They are grouped as <i>medial, intermediate</i> and <i>lateral</i> as per their placement |
| Anterior cutaneous branches of the intercostal nerves | Branches from the <i>intercostal nerves</i> emerge from the intercostal spaces (except T1 or at times T2) | Piercing the pectoralis major and deep fascia. They supply the <i>skin, from the anterior midline to the midclavicular line</i> |
| Lateral cutaneous branches of the intercostal nerves | Branches from the <i>intercostal nerves</i> | They pierce the deep fascia in a vertical line little behind the anterior axillary fold, supplying the overlying strip of the skin |

Deep Fascia

The deep fascia covering the pectoralis major (pectoral fascia) blends with the periosteum of the clavicle and sternum, and then passes over the deltopectoral groove to be continuous with the fascia over the deltoid. At the lower border of the pectoralis major, it is continuous along the axillary floor as *axillary fascia*.

Clavipectoral Fascia

It is a strong sheet of fascia, lying deep to the pectoralis major muscle (**Fig. 2.7**). It is attached to the clavicle above and splits to enclose the subclavius and pectoralis minor muscles. Lower down, it continues as a suspensory ligament of the axilla which blends with the *axillary fascia*. Between the subclavius and pectoralis minor, it is pierced by the following structures:

1. Lateral pectoral nerve
2. Thoracoacromial trunk/artery
3. Cephalic vein
4. Lymphatics from the deep part of the breast

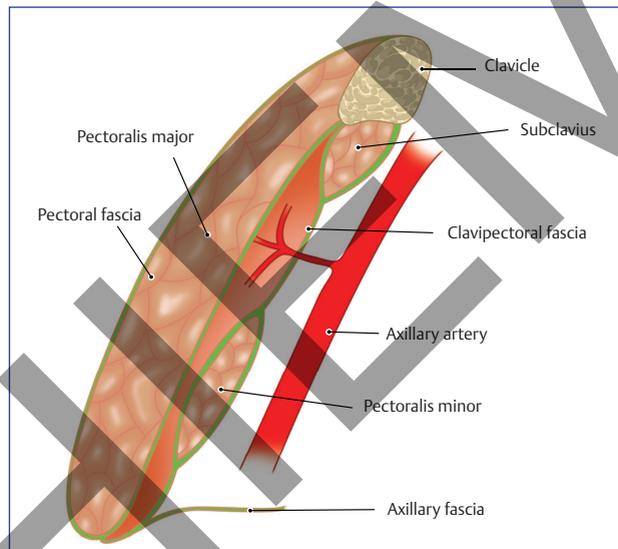


Fig. 2.7 Clavipectoral fascia as seen in oblique section parallel to the axillary artery.

Muscles of the Pectoral Region

Muscles of the pectoral region (**Fig. 2.8**) are described in **Table 2.2**.

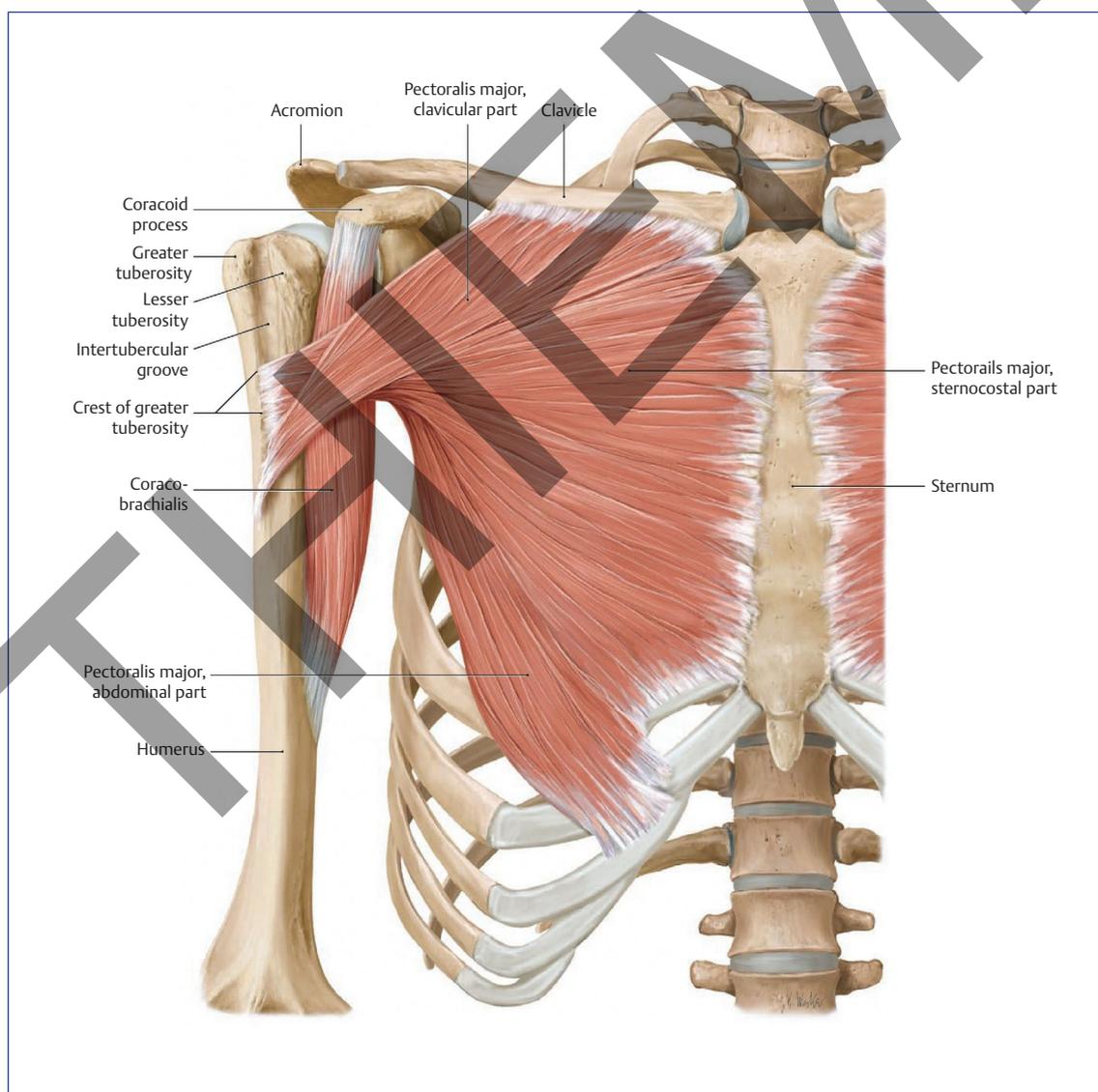
Table 2.2 Muscles of the pectoral region

| Name of muscle | Origin | Insertion | Nerve supply | Action/Function |
|--------------------------------------|---|--|---|--|
| Pectoralis major (Fig. 2.8) | <i>Clavicular head:</i> Anterior surface of the medial half of the clavicle <i>Sternocostal head:</i> Anterior surface of the sternum, upper six costal cartilages, aponeurosis of the external oblique muscle | Lateral lip of the intertubercular sulcus of the humerus | Lateral and medial pectoral nerves, clavicular head (C5, C6), sternocostal head (C7, C8 and T1) | 1. <i>Adducts and medially rotates</i> the humerus; draws the scapula anteriorly and inferiorly 2. Acting alone, the clavicular head <i>flexes the humerus</i> and the sternocostal head <i>extends it</i> from the flexed position |

(continued)

Table 2.2 (continued) Muscles of the pectoral region

| Name of muscle | Origin | Insertion | Nerve supply | Action/Function |
|-------------------------------|--|---|----------------------------------|--|
| Pectoralis minor (Fig. 2.9) | Third to fifth ribs near their costal cartilages | Medial border and superior surface of the coracoid process of the scapula | Medial pectoral nerve (C8, T1) | Stabilizes the scapula by drawing it inferiorly and anteriorly against the thoracic wall |
| Subclavius (Fig. 2.9) | Junction of the first rib and its costal cartilage | Inferior surface of the middle third of the clavicle | Nerve to the subclavius (C5, C6) | Anchors and depresses the clavicle |
| Serratus anterior (Fig. 2.10) | External surface of the upper eight ribs | Anterior surface of the medial border of the scapula | Long thoracic nerve (C5, C6, C7) | Protracts the scapula and holds it against the thoracic wall; rotates the scapula |

**Fig. 2.8** Pectoralis major.

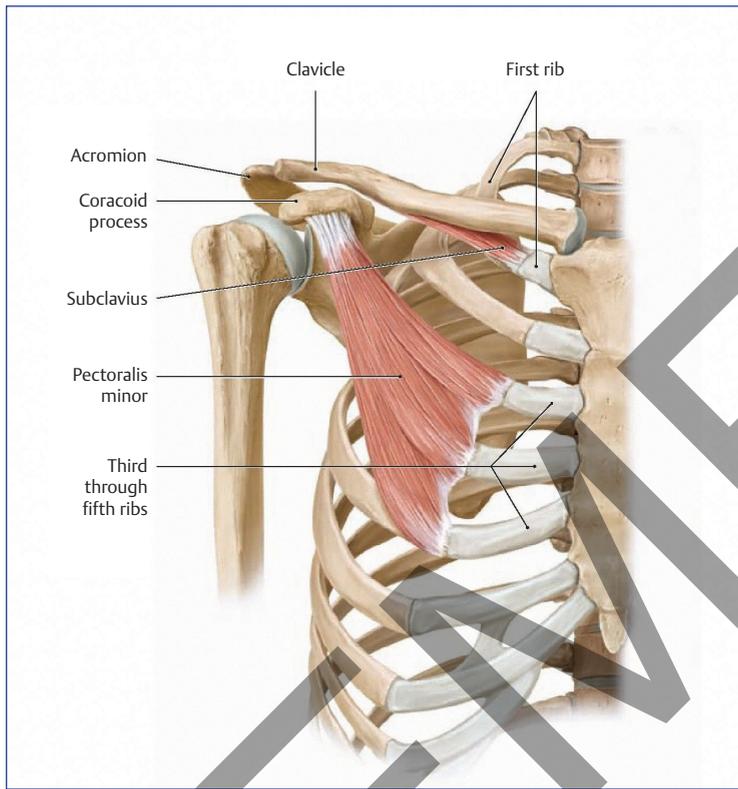


Fig. 2.9 Pectoralis minor and subclavius.

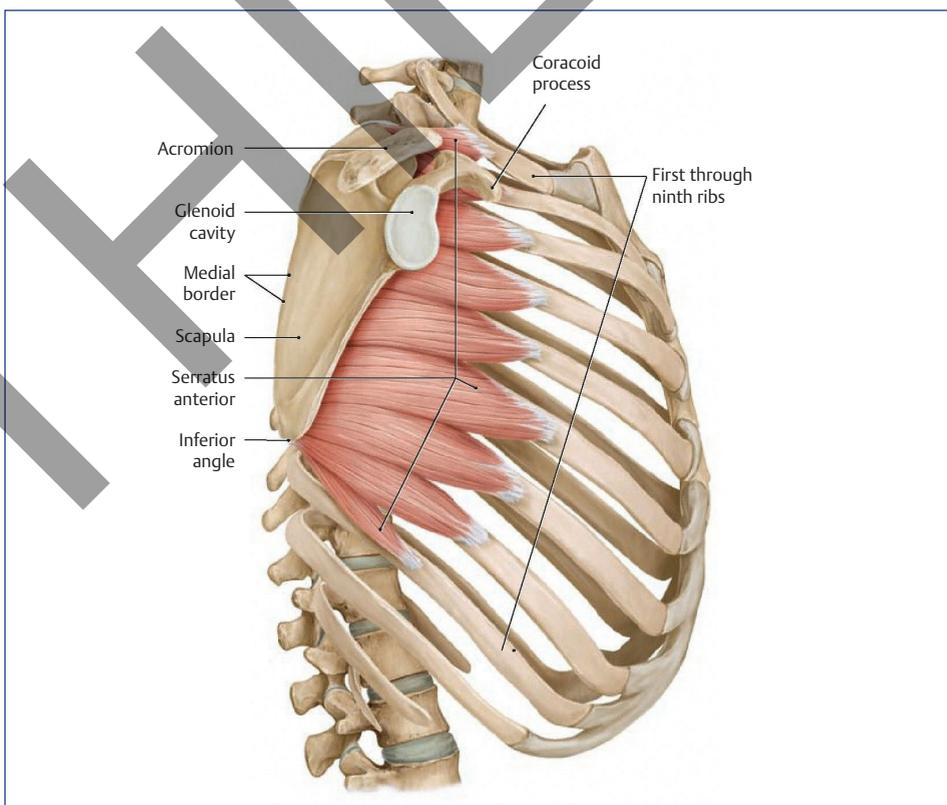


Fig. 2.10 Serratus anterior muscle.

Dissection and Identification

1. Remove the fascia from the anterior surfaces of the pectoralis major and deltoid to define their attachments.
2. Identify the clavicular and sternocostal head of the pectoralis major and trace the muscle up to its insertion on the humerus.
3. Divide the deep fascia by blunt dissection along the *deltopectoral groove* to reveal the *cephalic vein* (Fig. 2.11).
4. Identify the *deltopectoral triangle* (Fig. 2.11) bounded by the deltoid, pectoralis major and clavicle.

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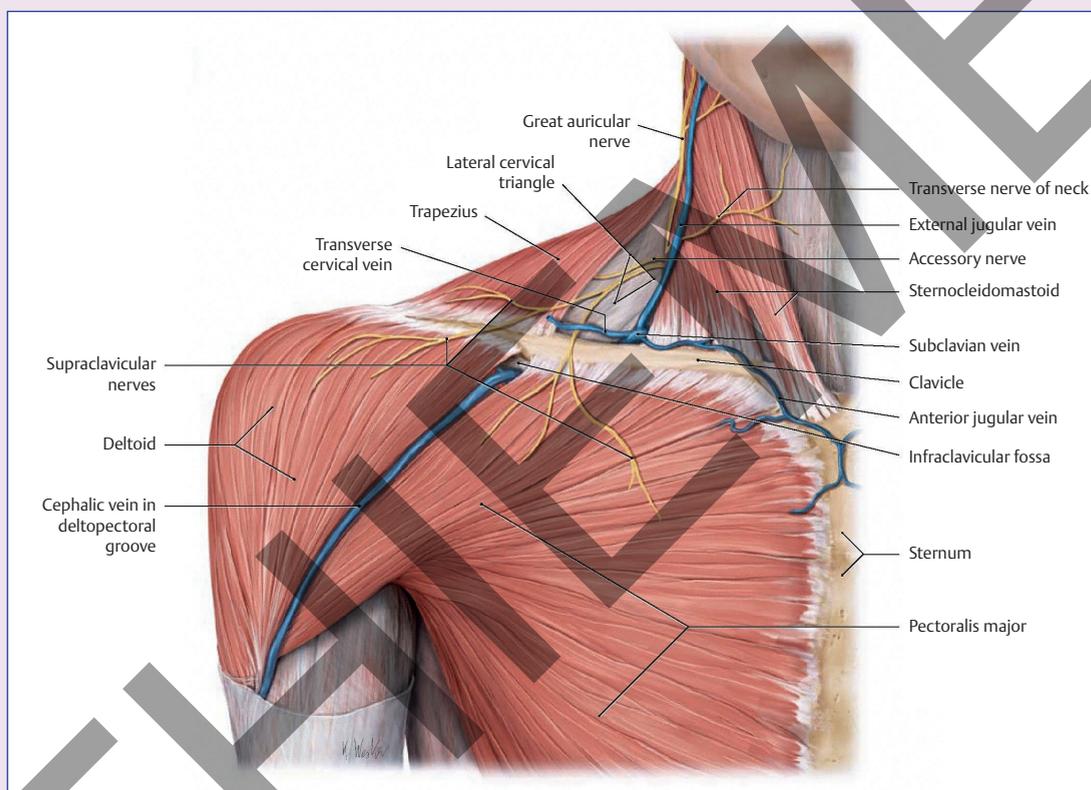


Fig. 2.11 Superficial veins and nerves of the right shoulder region.

5. Cut through the clavicular head of the pectoralis major (Fig. 2.12) just below the clavicle and lift it laterally. This exposes the *lateral pectoral nerve* and *thoracoacromial artery* piercing the clavipectoral fascia.

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6. Cut through the sternocostal head of the pectoralis major (Fig. 2.12) and lift it carefully so that the underlying structures are not damaged. Reflect the cut parts to expose the medial pectoral nerve that pierces the pectoralis minor and then the pectoralis major thus innervating both muscles.
7. Find under the reflected pectoralis major muscle the *clavipectoral fascia*, *pectoralis minor muscle* and *subclavius muscle*.
8. Trace the *cephalic vein* and *lateral pectoral nerve* through the clavipectoral fascia. Trace the cephalic vein to its termination into the *axillary vein*.
9. Trace the *pectoralis minor muscle* to its attachments.
10. Before you reflect the pectoralis minor, note that it delineates the *three parts of the axillary artery*.
11. Trace the branches of the *thoracoacromial artery*.
12. First, trace the *pectoral branch* which passes downwards and medially between the pectoralis major and minor and supplies them, then trace it proximally and identify the *acromial branch*

which passes upwards and laterally deep to the deltoid, crossing the tip of coracoid process to the acromion.

13. Find out the *clavicular branch* ascending medially to supply the sternoclavicular joint and *deltoid branch* in the deltopectoral groove accompanying the cephalic vein.
14. Trace the lateral thoracic artery, a branch of the second part of the axillary artery, along the lateral border of the pectoralis minor muscle.

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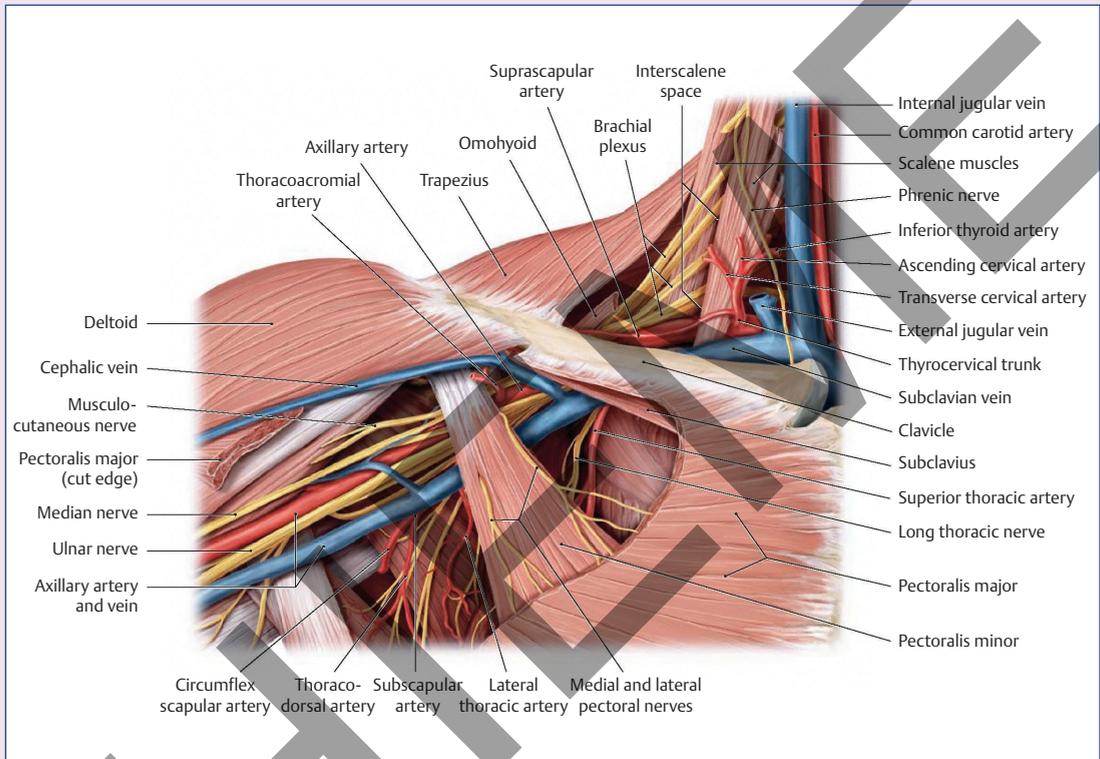


Fig. 2.12 Clavicular and sternocostal heads of pectoralis major muscle are cut to explore the underlying structures.

Axilla

The axilla (armpit) is a pyramidal-shaped space between the upper part of the arm and the lateral thoracic wall.

Boundaries and Contents

Anterior wall: Pectoralis major, pectoralis minor and subclavius with enclosing investing fascia.

Posterior wall: Subscapularis, teres major and latissimus dorsi (below).

Medial wall: Serratus anterior.

Lateral wall: Anterior and posterior walls approximate at the bicipital groove of the humerus.

Apex of the axilla: It is bounded by the clavicle, first rib and superior border of the scapula and is continuous with the root of the neck through which pass the axillary vessels and nerves of the brachial plexus. The contents of axilla include axillary vessels, axillary lymph nodes, nerves of brachial plexus and loose connective tissue (**Fig. 2.13**).

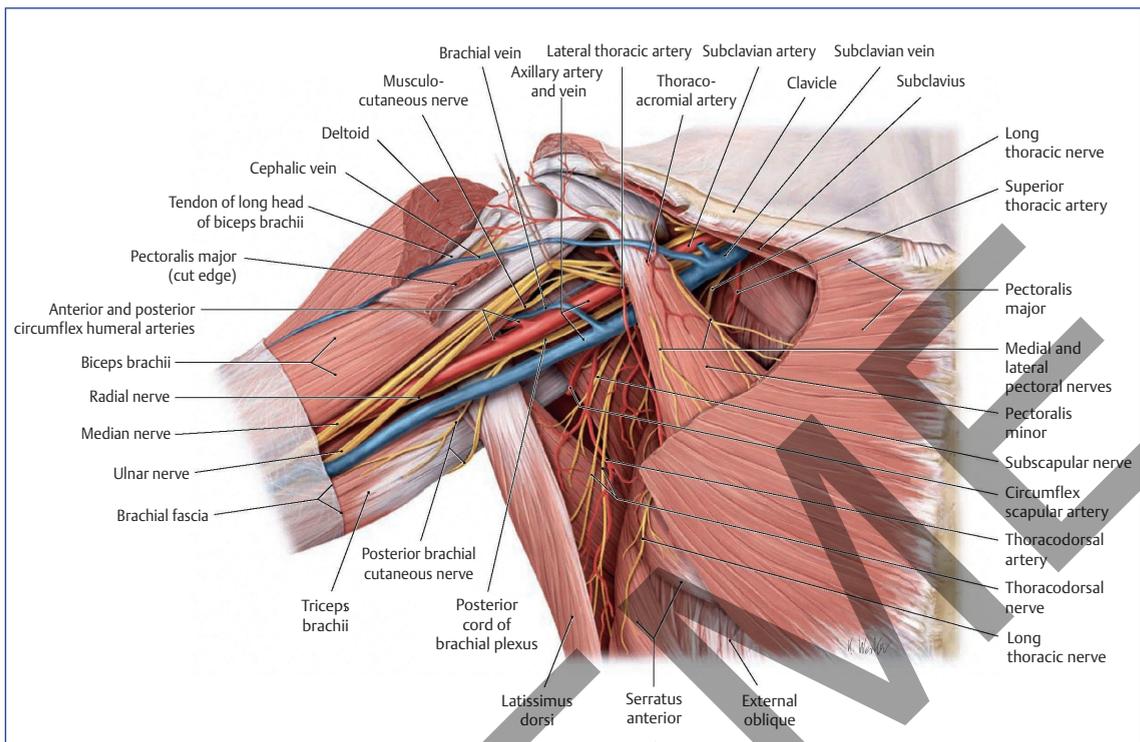


Fig. 2.13 Boundaries and contents of the axilla.

Dissection and Identification

1. Re-identify the previously dissected *pectoralis major*, *pectoralis minor*, *clavipectoral fascia*, the *medial and lateral pectoral nerves* and *thoracoacromial artery*.
<https://www.winkingskull.com/dissector/V1/video.aspx?vid=247>
2. With the help of fingers, separate the *pectoralis minor* from the underlying thoracic wall.
3. Cut its medial attachments to the thoracic wall; reflect the muscle laterally retaining its attachment to the coracoid process and this exposes the contents of the axilla.
4. *Abduct the arm* to gain better access to the axilla and to appreciate the linear pathway of the brachial plexus into the upper limb.
5. Remove the fat from the axilla to expose the *axillary sheath*.
6. Subsequently, expose the vessels and nerves in the axilla, superior to the *pectoralis minor* (**Fig. 2.14**).
7. Cut through the anterior layer of the *clavipectoral fascia* just inferior to the clavicle to expose the *subclavius muscle*.
8. Expose the contents of the axilla by removing the loose connective tissue, fat and lymph nodes.
9. The lymph nodes cannot be seen unless enlarged by disease.
10. Identify the extensive *axillary venous plexus*.
11. Remove the smaller tributaries of the vein in order to get better visualization of the brachial plexus and the axillary artery with its branches.

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12. Trace the branches of all three parts of the axillary artery.

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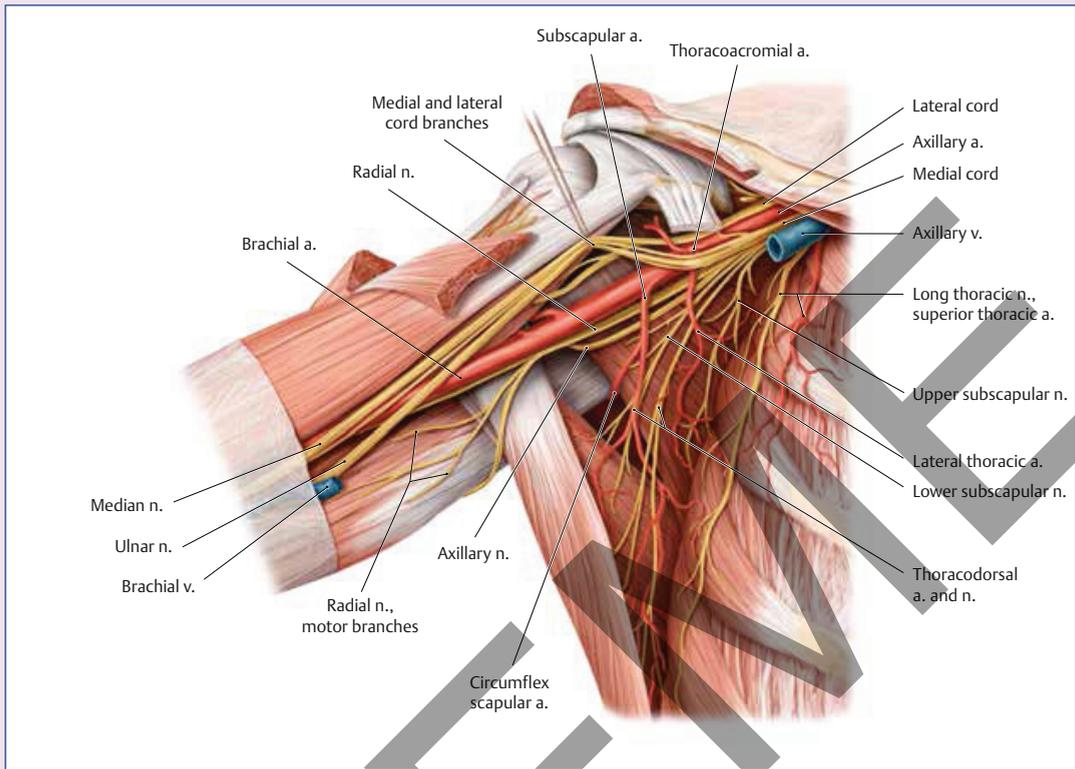


Fig. 2.14 *Removed:* Anterior wall (pectoral major and minor, and clavipectoral fascia). *Retracted:* Medial and lateral cords of the brachial plexus.

Axillary Artery

The *axillary artery* begins as a continuation of the third part of the *subclavian artery* at the outer border of the first rib and ends at the lower border of the teres major to continue as the *brachial artery* (Fig 2.15).

The proximal part of the axillary artery, axillary vein and brachial plexus and their branches are enclosed in the axillary sheath, derived from the prevertebral layer of the deep cervical fascia.

The axillary artery is surrounded by the brachial plexus and inferomedially it is related with the axillary vein throughout its course.

The axillary artery is divided into three parts by the pectoralis minor muscle.

First part of the axillary artery: It lies proximal to the pectoralis minor muscle and extends from the outer border of the first rib to the medial border of the pectoralis minor muscle.

Branches from the first part: The superior thoracic artery is the only branch given by the first part of the axillary artery. It arises near the apex of the axilla and supplies blood to the first and second intercostal spaces.

Second part of the axillary artery: It lies behind the pectoralis minor muscle. It gives two branches, the thoracoacromial artery and lateral thoracic artery. The thoracoacromial artery is divided into four branches:

1. Pectoral branch
2. Acromial branch
3. Deltoid branch
4. Clavicular branch

The lateral thoracic artery arises at the lateral border of the pectoralis minor muscle and descends along the lateral border of the pectoralis minor, and provides, in females, large lateral mammary branches to supply the breast.

Table 2.3 Brachial plexus

| Name of nerve | Source with root value | Course | Distribution |
|---------------------------------------|--|--|---|
| Lateral pectoral | <i>Lateral cord</i> , C5, C6 and C7 | Pierces the clavipectoral fascia to reach the deep surface of the pectoralis major | Pectoralis major |
| Musculocutaneous | Terminal branch of the <i>lateral cord</i> (C5–C7) | Exits the axilla by piercing the coracobrachialis; descending between the biceps and brachialis, it continues as the lateral cutaneous nerve of the forearm | Coracobrachialis, biceps brachii and brachialis muscle and lateral forearm skin |
| Median | Lateral root of the median nerve from the <i>lateral cord</i> (C5–C7) and medial root from <i>medial cord</i> (C8, T1) | Lateral and medial roots unite to form the median nerve lateral to the axillary artery, then descends through the arm adjacent to the brachial artery | Muscles of the flexor compartment of the forearm (except for the flexor carpi ulnaris, medial half of the flexor digitorum profundus), intrinsic muscles of the thenar part and palmar skin |
| Medial pectoral | <i>Medial cord</i> (C8, T1) | Passes between the axillary artery and vein, pierces the pectoralis minor and then pierces the deep surface of the pectoralis major muscle | Pectoralis major (sternocostal part) and pectoralis minor |
| Medial cutaneous nerve of the arm | | Runs by the medial side of the axillary and brachial veins and communicates with the intercostobrachial nerve | Skin of the medial side of the arm up to the medial epicondyle of the humerus and olecranon process of the ulna |
| Medial cutaneous nerve of the forearm | | In close relation with the ulnar nerve, pierces the deep fascia along with the basilic vein and then divides into anterior and posterior branches | Skin of the medial side of the forearm up to the wrist |
| Ulnar | <i>Medial cord</i> (C7, C8 and T1) | Terminal branch of the medial cord of the brachial plexus descends on the medial side of the arm; running behind the medial epicondyle of the humerus, it supplies the medial aspect of the forearm and hand | Flexor carpi ulnaris and medial half of the flexor digitorum profundus, intrinsic muscles of the hand, medial half of the skin of the hand |
| Upper subscapular | <i>Posterior cord</i> (C5) | Passes posteriorly and enters the subscapularis muscle directly | Upper part of the subscapularis muscle |
| Lower subscapular | <i>Posterior cord</i> (C6) | Runs inferolaterally, deep to the subscapular artery and vein | Lower part of the subscapularis and teres major muscles |
| Thoracodorsal | <i>Posterior cord</i> (C6, C7 and C8) | Arises between the upper and lower subscapular nerves, passes along the posterior axillary wall to the latissimus dorsi muscle | Latissimus dorsi muscle |
| Axillary | Terminal branch of the <i>posterior cord</i> (C5, C6) | Exits the axilla through the quadrangular space. Winds around the surgical neck of the humerus | Shoulder joint, deltoid, teres minor muscles and skin overlying the inferior part of the deltoid |
| Radial | Terminal branch of the <i>posterior cord</i> (C5–T1) | Exits the axilla lying posterior to the axillary artery, passes into the radial groove, perforates the lateral intermuscular septum and enters the cubital fossa | All the muscles of the <i>extensor compartment of the forearm</i> , skin of the posterior and inferolateral arm |

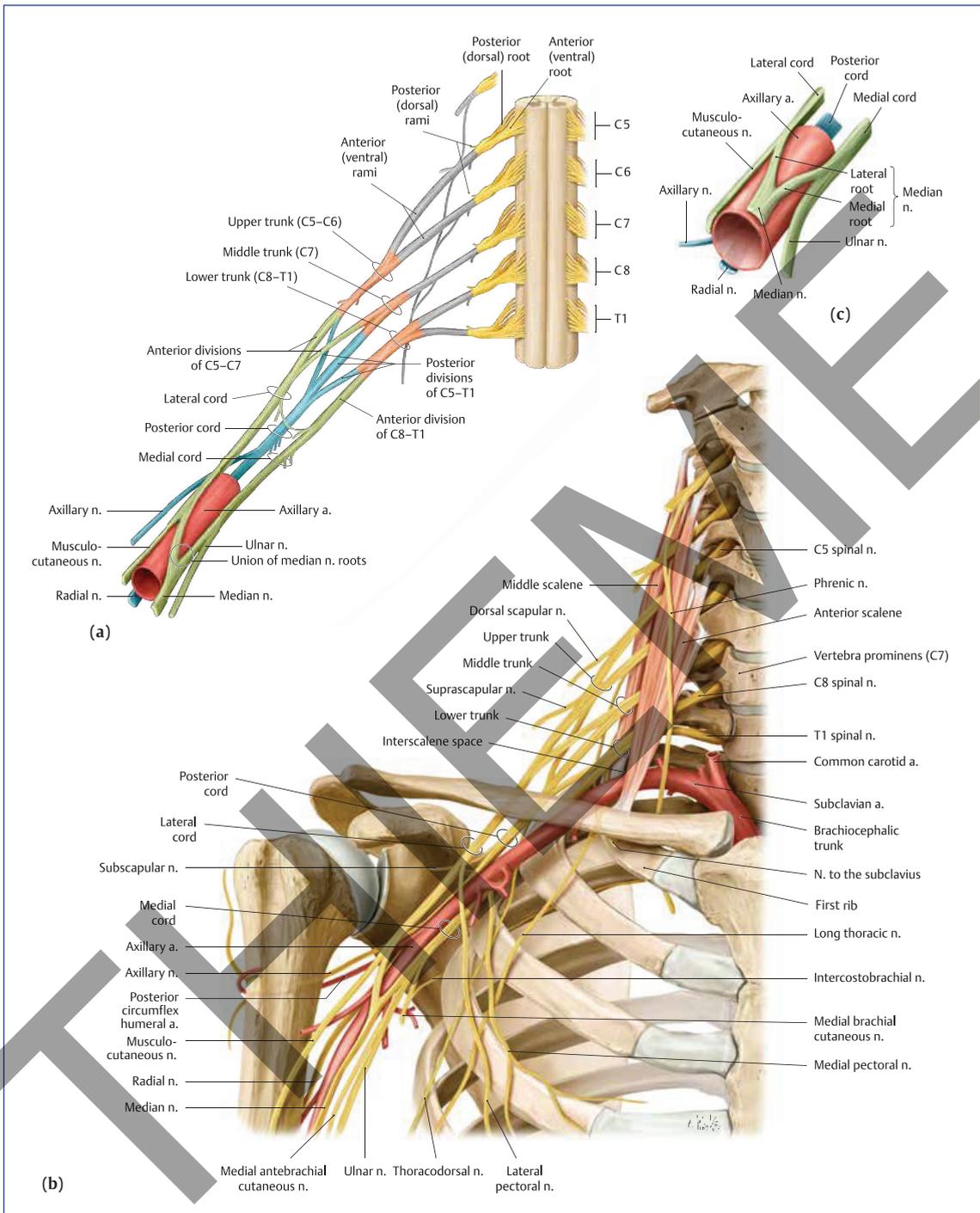


Fig. 2.16 Brachial plexus. **(a and b)** Formation and structure. **(c)** Course in relation to axillary artery stretched for clarity.

Dissection and Identification

Let us now trace the branches of the brachial plexus.

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Lateral cord of the brachial plexus:

1. Trace the *coracobrachialis* and *short head of the biceps* springing from the tip of the coracoid process.

2. Find the *musculocutaneous nerve* entering the coracobrachialis, and trace this nerve upwards to find the lateral cord of the brachial plexus.
3. *Lateral root of the median nerve* also arises from the lateral cord of the brachial plexus. To find out the median nerve, trace the lateral root distally.
4. Find the *axillary artery* and *median nerve* medial to the coracobrachialis muscle.

Medial cord of the brachial plexus:

1. Trace the *medial root of the median nerve* proximally to find out the medial cord of the brachial plexus.
2. Identify the *ulnar nerve* from the medial cord of the brachial plexus.
3. Trace the previously identified medial and lateral pectoral nerves to the medial and lateral cords of the brachial plexus, respectively.
4. Identify the *medial cutaneous nerve of the forearm*, *medial cutaneous nerve of the arm* and branches from the medial cord of the brachial plexus by tracing them to a short distance into the arm.

Posterior cord of the brachial plexus:

1. To get a better view of the posterior cord of the brachial plexus, retract the axillary artery, the medial and lateral cords of the brachial plexus superiorly.
2. With the help of blunt dissection, clean the *axillary nerve* passing posterior to the humerus accompanied by the posterior circumflex humeral artery.
3. Identify the *radial nerve*, which passes behind the humerus but anterior to the latissimus dorsi and teres major muscles.
4. Identify the *subscapular nerves* arising from the posterior cord of the brachial plexus and supplying the subscapularis muscle.
5. At this stage, one can also see the teres major and latissimus dorsi along with the subscapularis, forming the post axillary wall.
6. Please note that the medial, lateral and posterior cords of the brachial plexus are disposed around the second part of the axillary artery in their respective positions behind the pectoralis minor.



Clinical Notes

1. *Carcinoma of the breast* is a common cancer in females. It can cause *dimpling of the skin* from the malignant infiltration and contraction of the suspensory ligaments of the breast (ligaments of Cooper).
2. *Peau d'orange sign*: An orange peel appearance of the skin because of cancer cells interfering with the lymph drainage leading to lymph edema with puffy skin between the dimpled pores.
3. *Radical mastectomy*: In radical mastectomy, excision of the breast tumour is done with pectoralis major and axillary node clearance. The clavicular head of the pectoralis major is usually spared for cosmetic reasons.
4. *Breast abscess* is drained by radial incisions to avoid cutting through a number of lactiferous ducts.
5. *Krukenberg's tumour* is a secondary ovarian tumour and may occur in case of carcinoma of the breast, involving the inferomedial quadrant of the breast.
6. *Erb–Duchenne palsy*: Injury to the upper part of the brachial plexus (C5, C6) results in the paralysis of the shoulder and arm muscles. The upper limb is adducted in the shoulder, arm is medially rotated and the elbow extended (Porter's tip hand/Police man's tip hand).
7. *Klumpke's paralysis*: Injury to the lower part of the brachial plexus, damaging the lower trunk (C8, T1), results in claw hand due to paralysis of the short muscles of the hand.

THEME