

2 Shoulder & Arm

Bones of the Upper Limb

Fig. 2.1 Bones of the upper limb

Right limb. The upper limb is subdivided into three regions: arm, forearm, and hand. The shoulder girdle (clavicle and scapula) joins the upper limb to the thorax at the sternoclavicular joint.

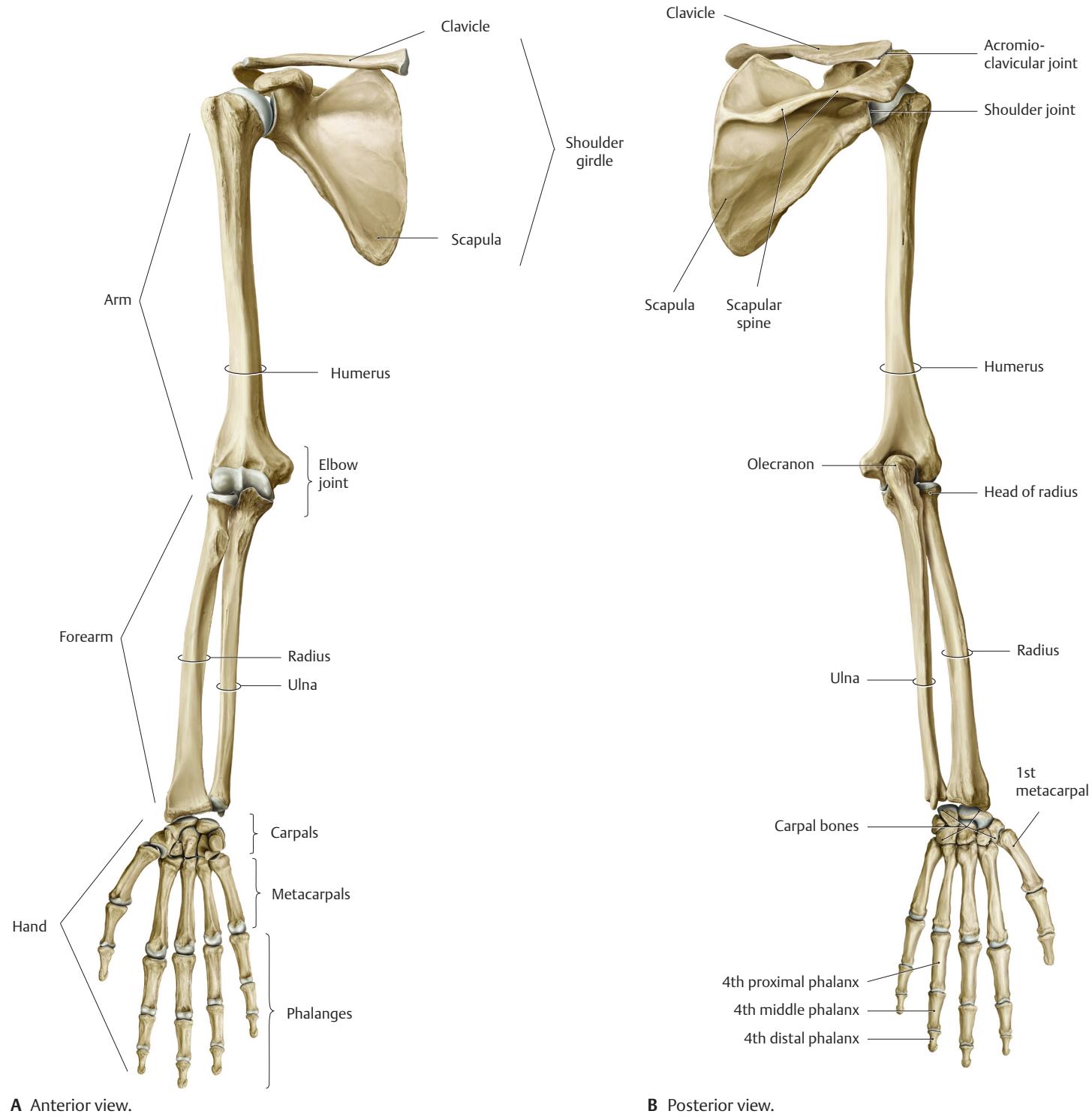
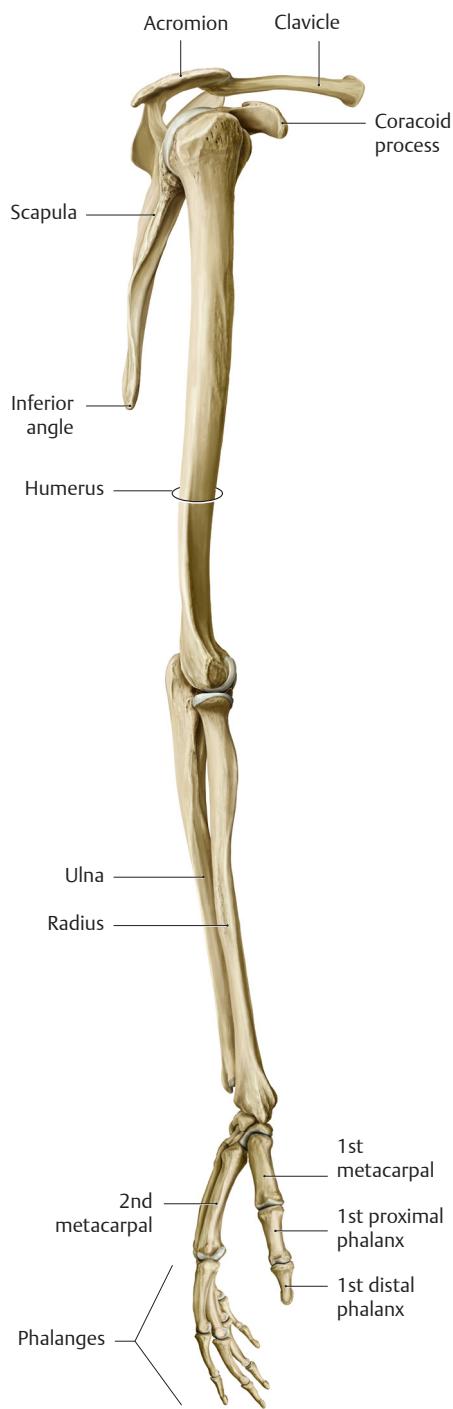
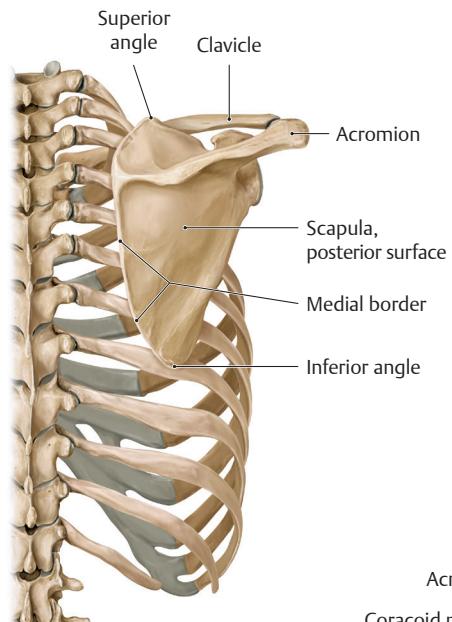


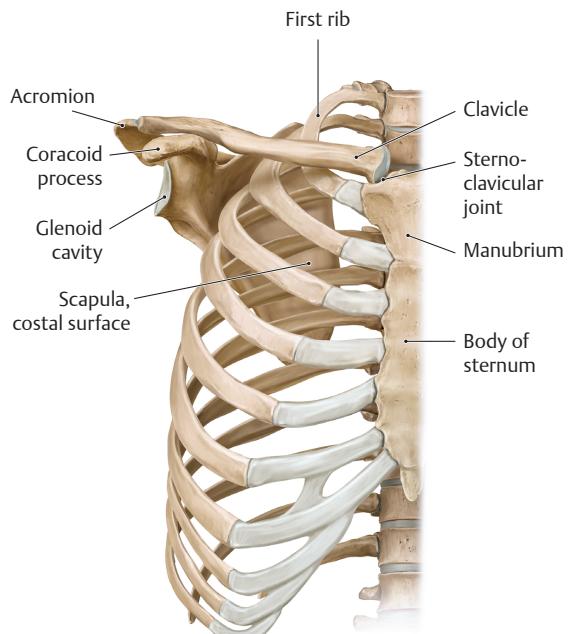
Fig. 2.2 Bones of the shoulder girdle in normal relation to those of the trunk



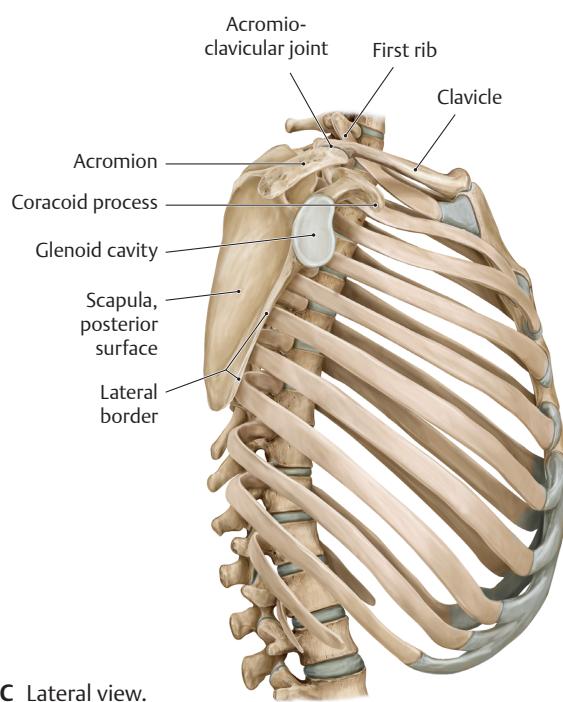
C Lateral view.



B Posterior view.



A Anterior view.



C Lateral view.

Clavicle & Scapula

The shoulder girdle (clavicle and scapula) connects the bones of the upper limb to the thoracic cage. Whereas the pelvic girdle (paired hip bones) is firmly integrated into the axial skeleton (see p. 558), the shoulder girdle is extremely mobile.

Fig. 2.3 Shoulder girdle in situ

Right shoulder, superior view.

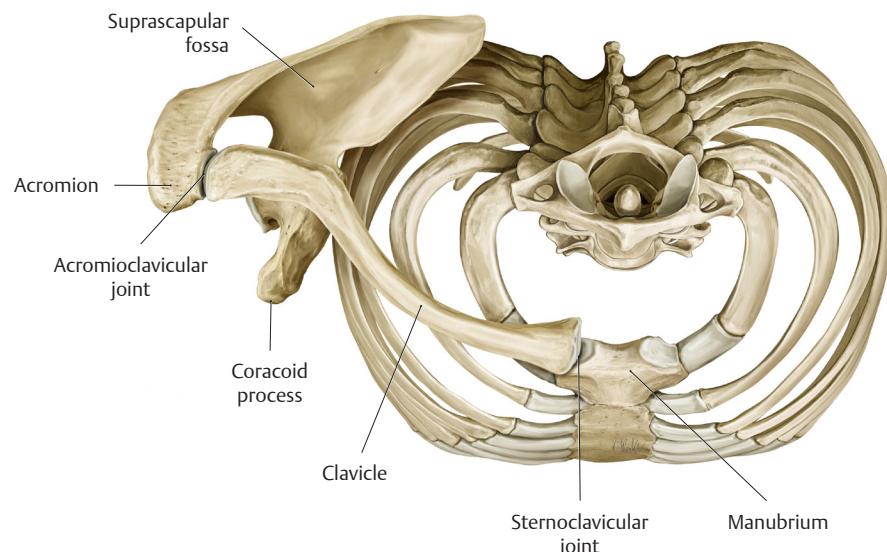
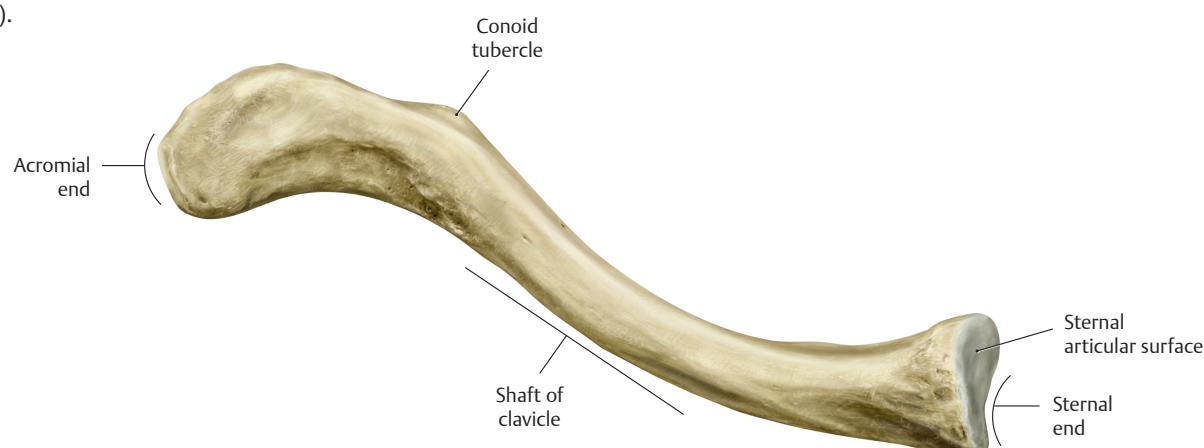
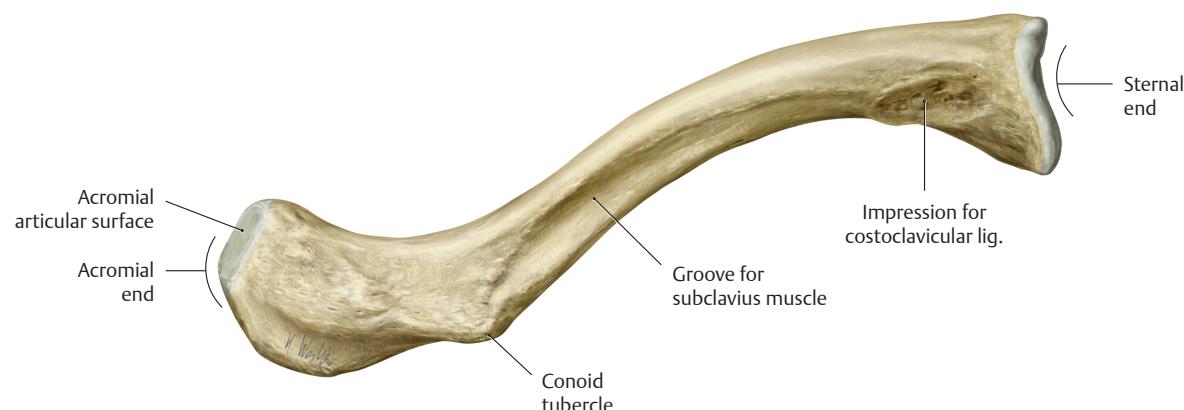


Fig. 2.4 Clavicle

Right clavicle. The S-shaped clavicle is visible and palpable along its entire length (generally 12 to 15 cm). Its medial end articulates with the sternum at the sternoclavicular joint. Its lateral end articulates with the scapula at the acromioclavicular joint (see Fig. 2.3).



A Superior view.



B Inferior view.

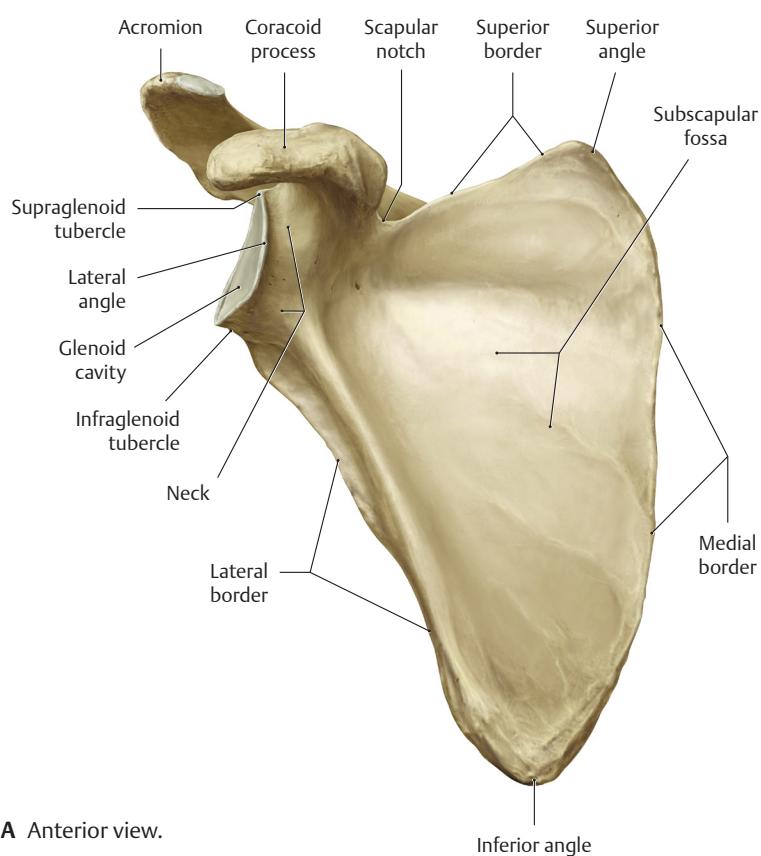
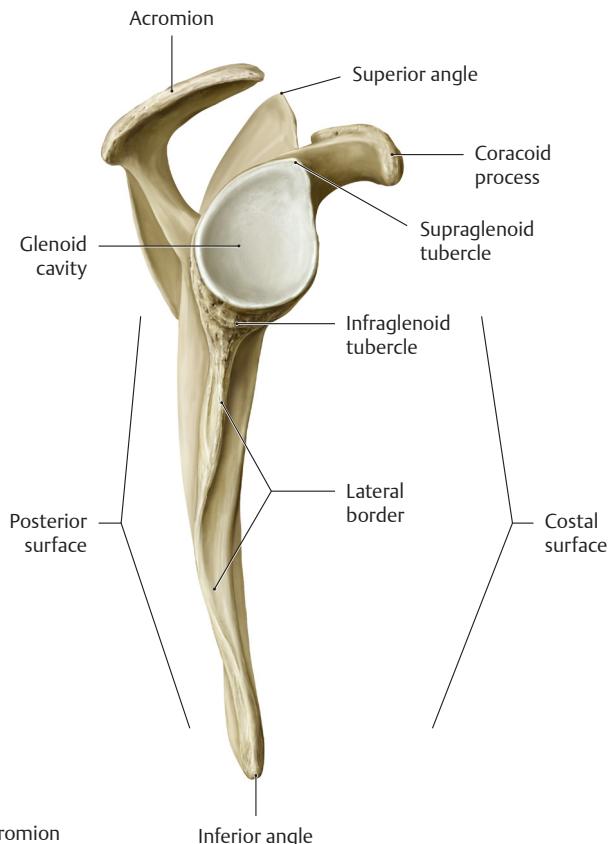
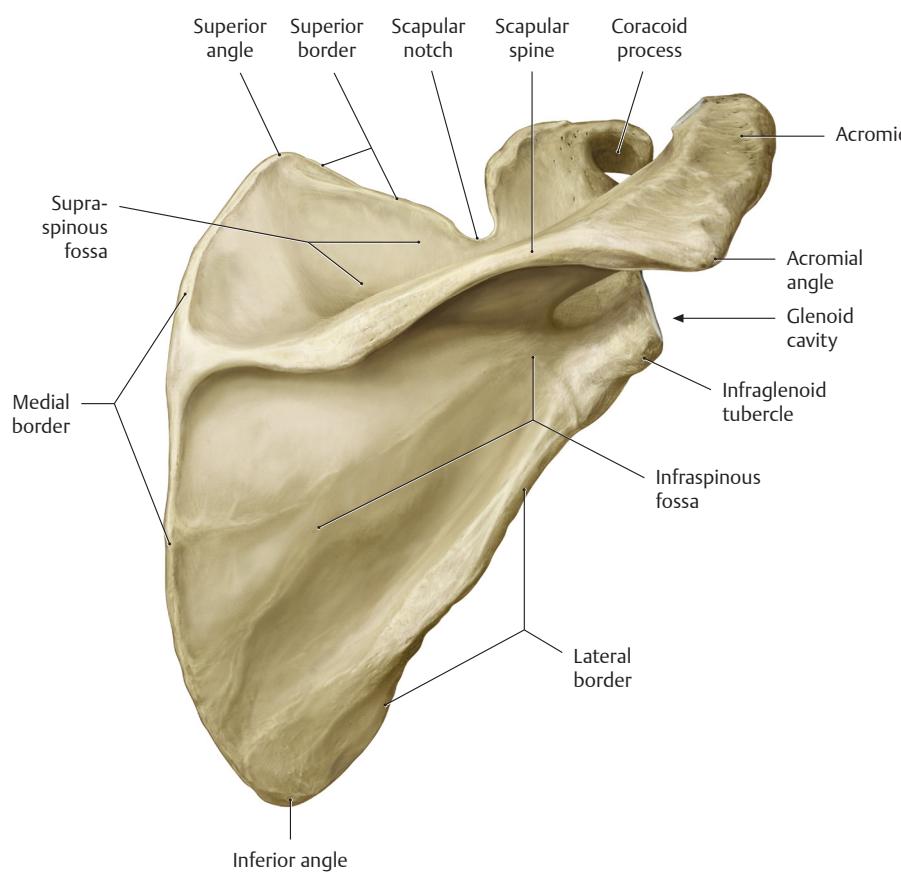
**A** Anterior view.

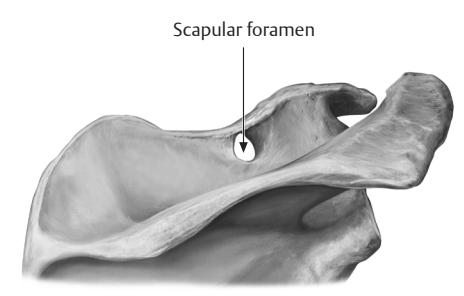
Fig. 2.5 Scapula
Right scapula. In its normal anatomical position, the scapula extends from the 2nd to the 7th rib.

**B** Right lateral view.**C** Posterior view.

Clinical box 2.1

Scapular foramen

The superior transverse ligament of the scapula (see Fig. 2.14) may become ossified, transforming the scapular notch into an anomalous bony canal, the scapular foramen. This can lead to compression of the suprascapular nerve as it passes through the canal (see p. 89).

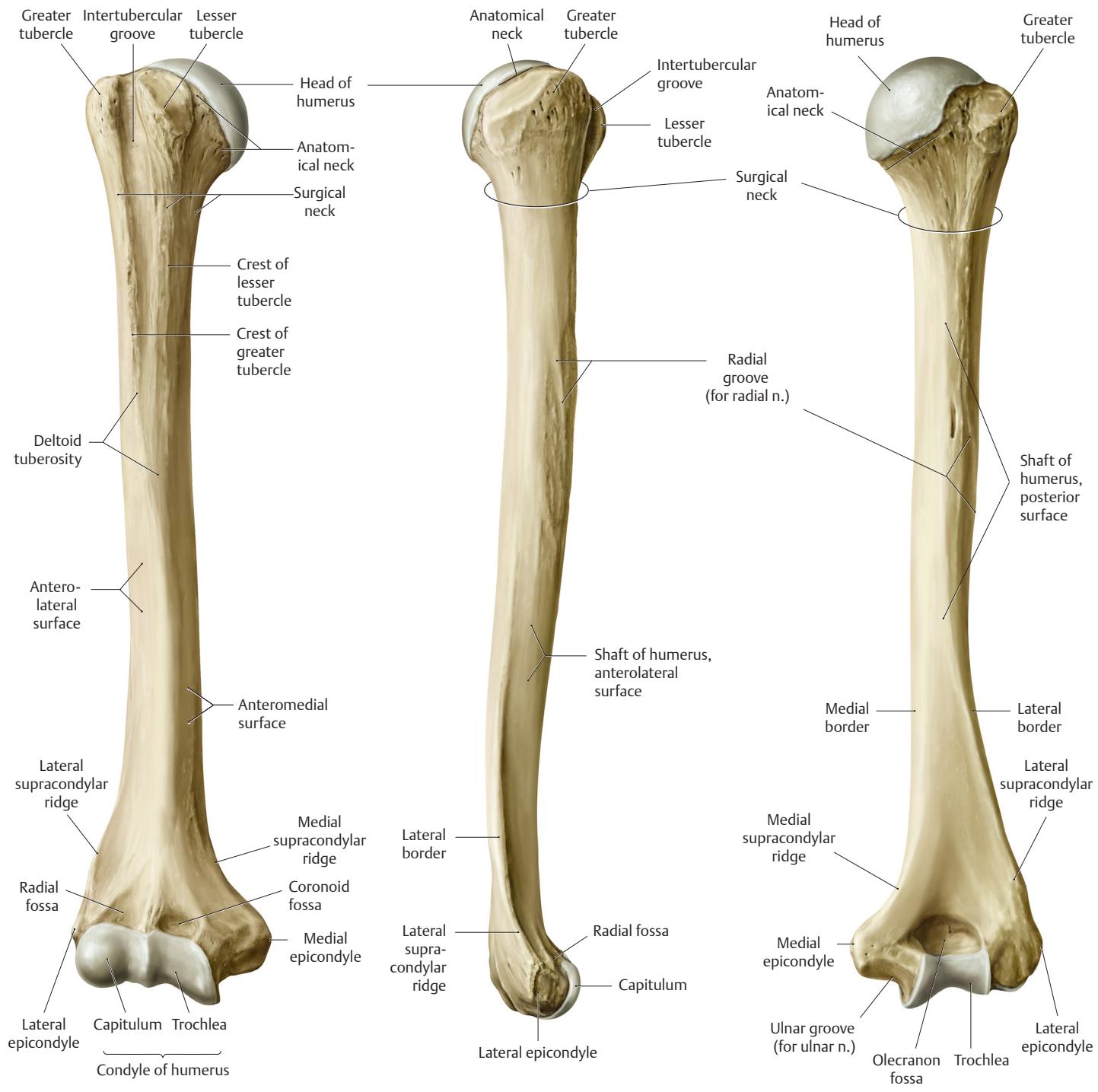


Humerus

Fig. 2.6 Humerus

Right humerus. The head of the humerus articulates with the scapula at the glenohumeral joint (see p. 10). The capitulum and trochlea of the

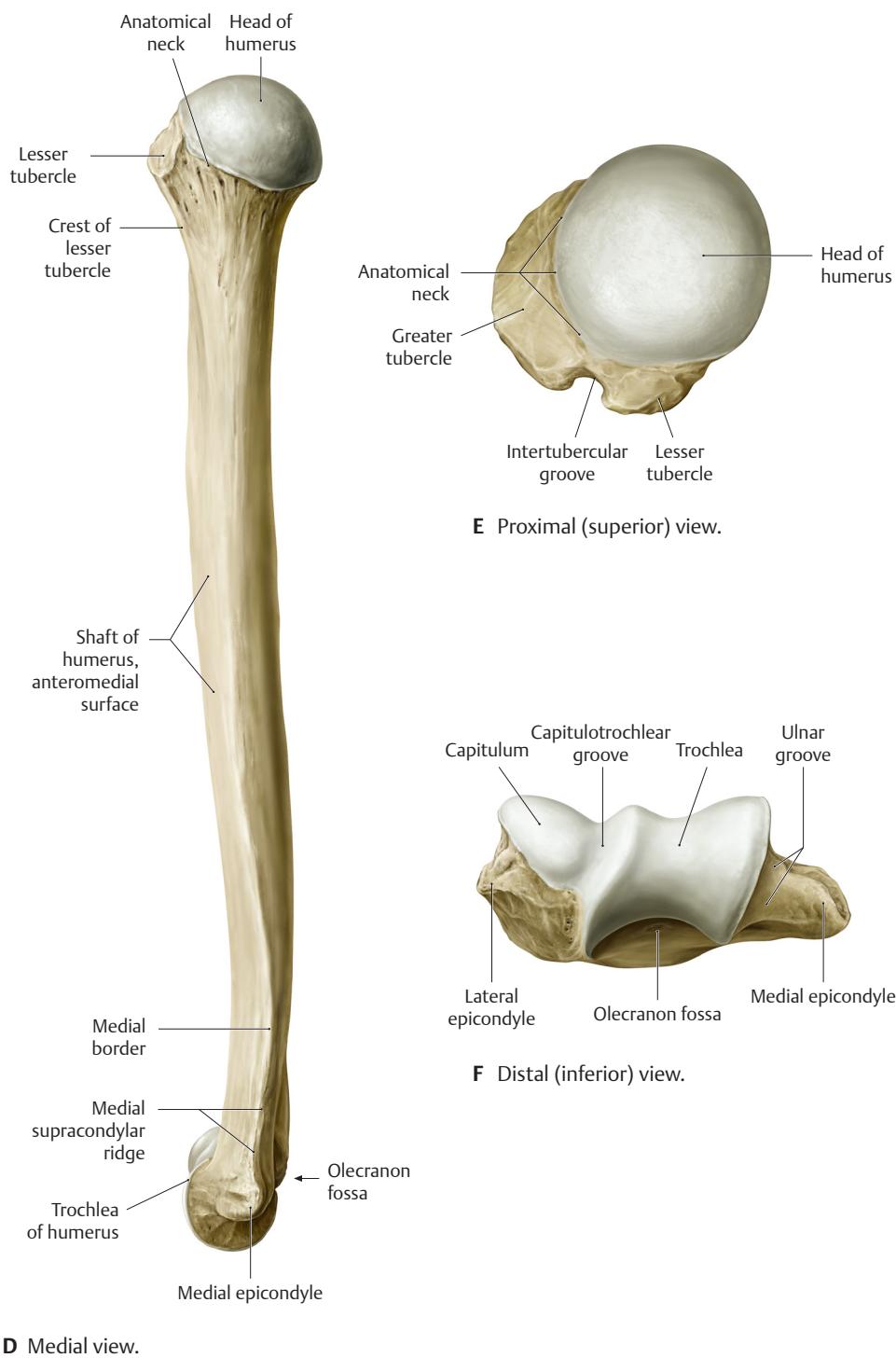
humerus articulate with the radius and ulna, respectively, at the elbow (cubital) joint (see p. 34).



A Anterior view.

B Lateral view.

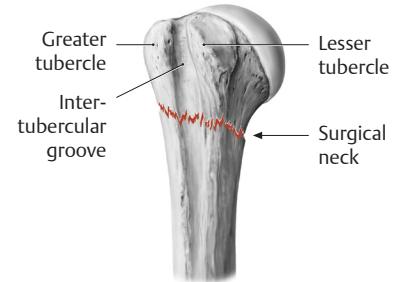
C Posterior view.



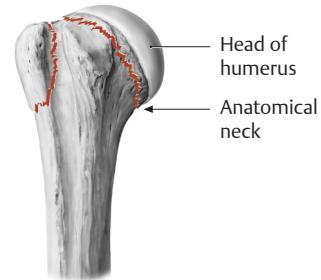
Clinical box 2.2

Fractures of the humerus

Anterior view. Fractures of the proximal humerus are very common and occur predominantly in older patients who sustain a fall onto the outstretched arm or directly onto the shoulder. Three main types are distinguished.



A Extra-articular fracture.



B Intra-articular fracture.



C Comminuted fracture.

Extra-articular fractures and intra-articular fractures are often accompanied by injuries of the blood vessels that supply the humeral head (anterior and posterior circumflex humeral arteries), with an associated risk of post-traumatic avascular necrosis.

Fractures of the surgical neck can damage the axillary nerve and fractures of the humeral shaft and distal humerus are frequently associated with damage to the radial nerve.

Joints of the Shoulder

Fig. 2.7 Joints of the shoulder: Overview

Right shoulder, anterior view.

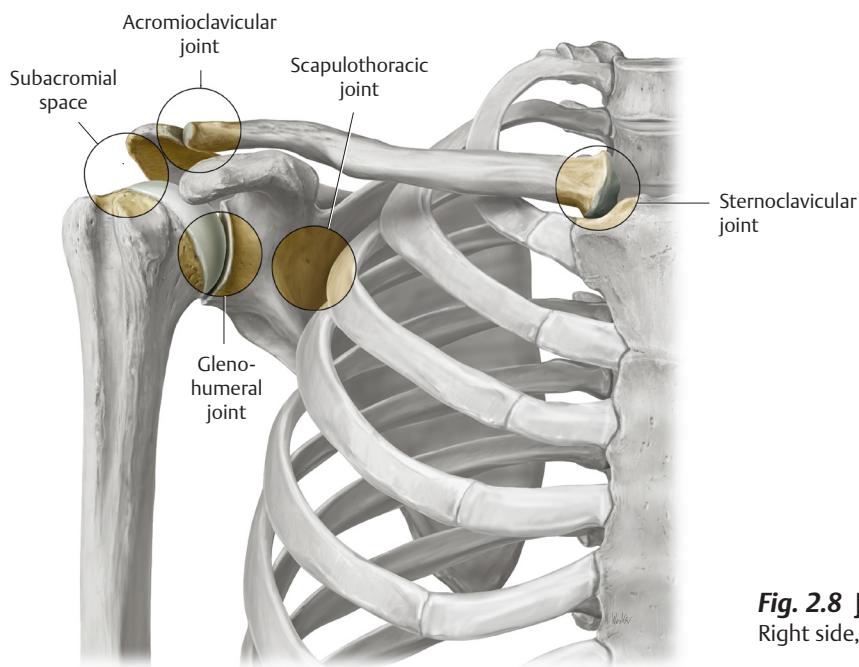


Fig. 2.8 Joints of the shoulder girdle

Right side, superior view.

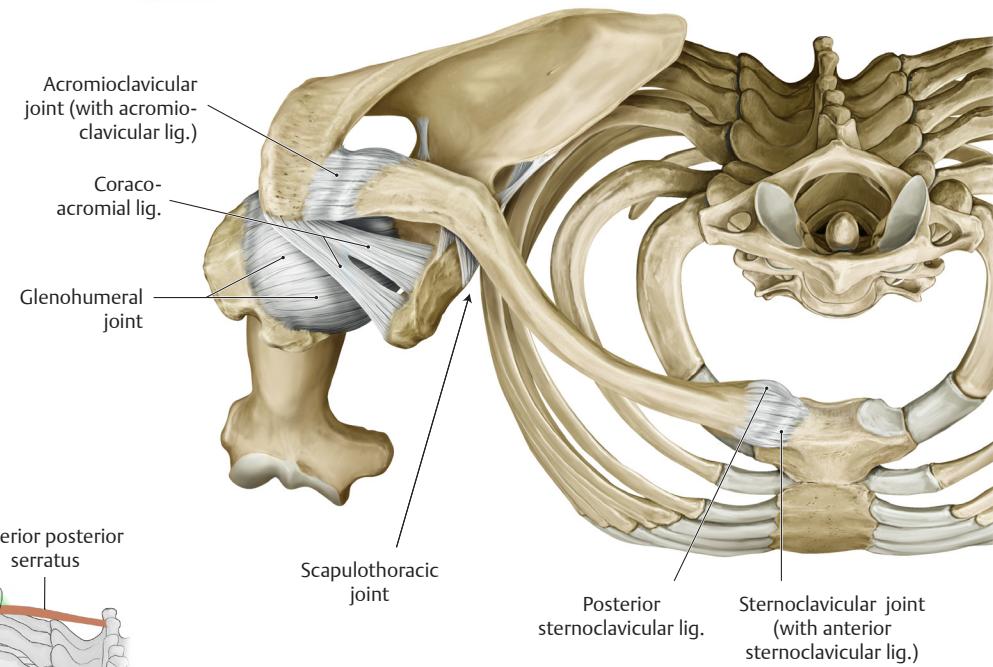


Fig. 2.9 Scapulothoracic joint

Right side, superior view. In all movements of the shoulder girdle, the scapula glides on a curved surface of loose connective tissue between the serratus anterior and the subscapularis muscles. This surface can be considered a scapulothoracic joint.

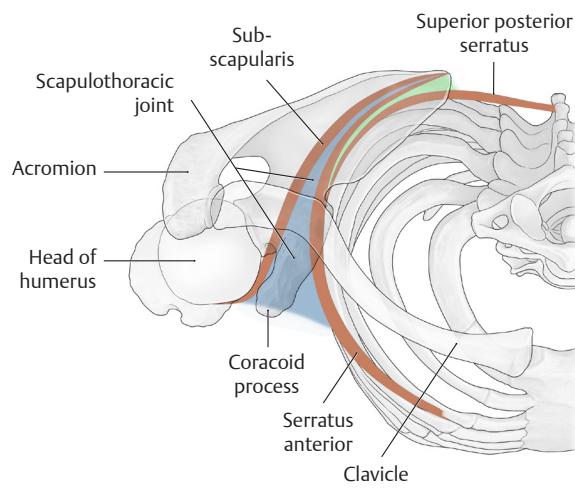
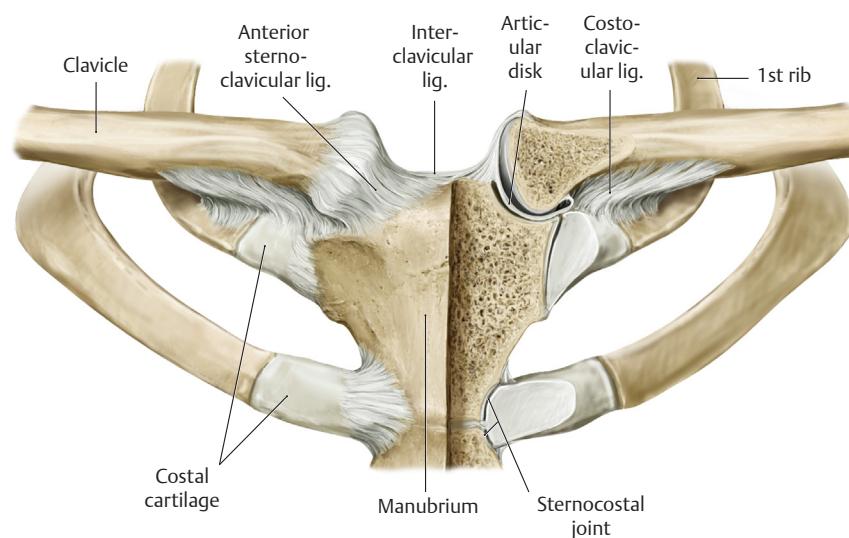
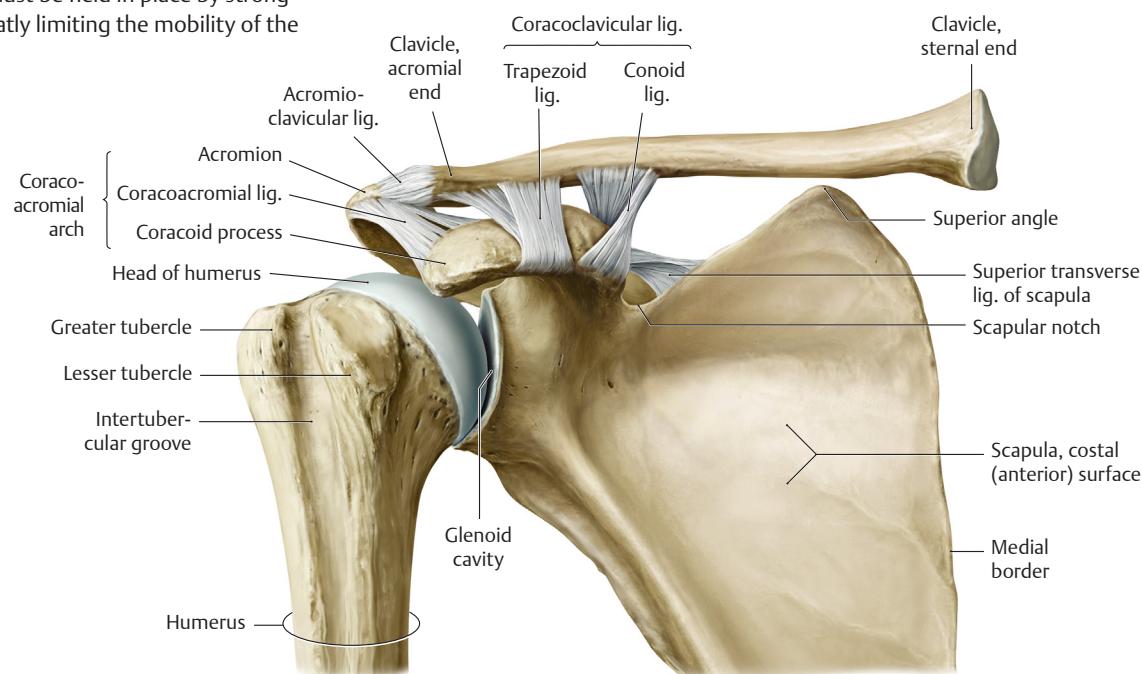


Fig. 2.10 Sternoclavicular joint

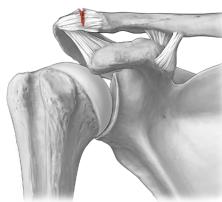
Anterior view with sternum coronally sectioned (left). Note: A fibrocartilaginous articular disk compensates for the mismatch of surfaces between the two saddle-shaped articular facets of the clavicle and the manubrium.

**Fig. 2.11 Acromioclavicular joint**

Anterior view. The acromioclavicular joint is a plane joint. Because the articulating surfaces are flat, they must be held in place by strong ligaments, greatly limiting the mobility of the joint.

**Clinical box 2.3****Injuries of the acromioclavicular joint**

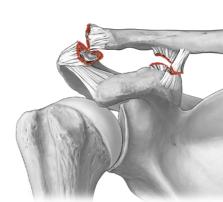
A fall onto the outstretched arm or shoulder frequently causes dislocation of the acromioclavicular joint (often known as a “shoulder separation”) and damage to the coracoclavicular ligaments.



A Stretching of acromioclavicular ligaments.



B Rupture of acromioclavicular ligament.

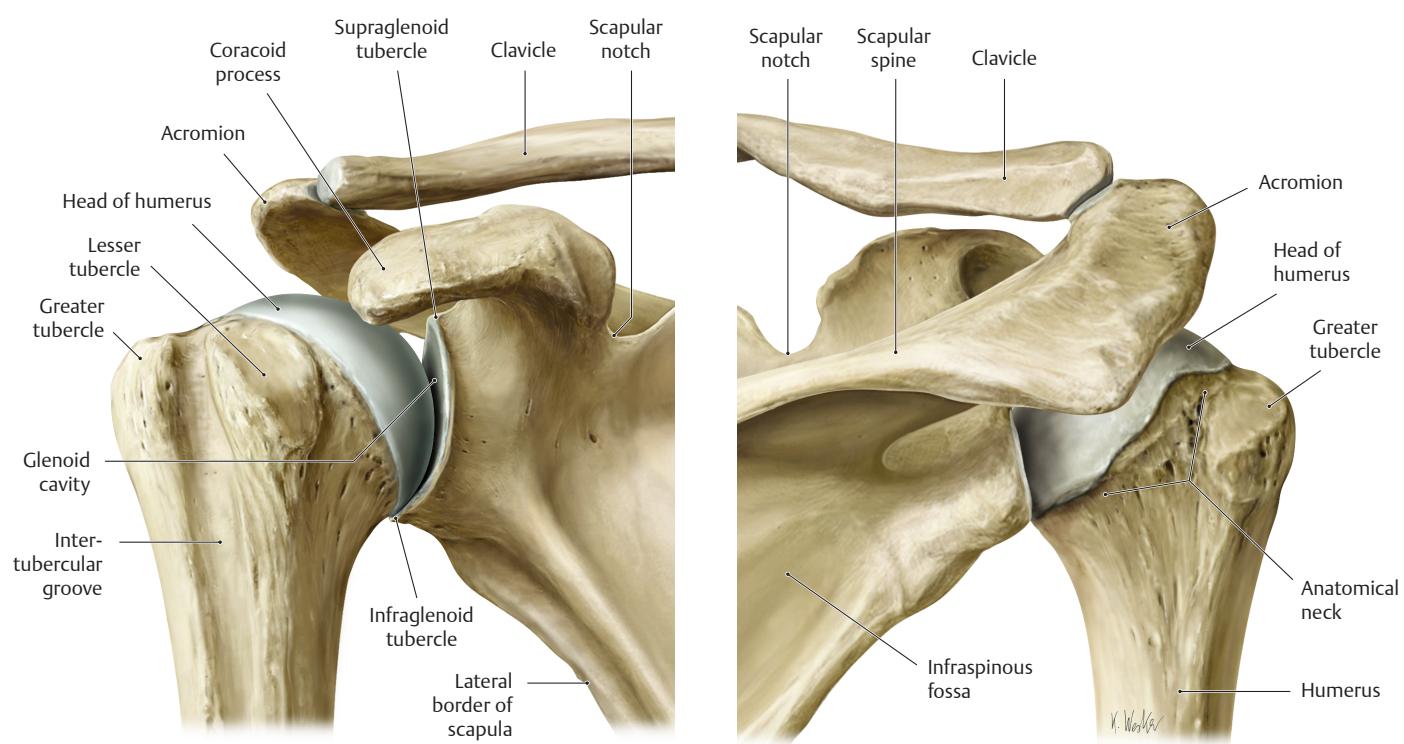


C Complete dislocation of acromioclavicular joint. Note rupture of acromioclavicular and coracoclavicular ligaments.

Joints of the Shoulder: Glenohumeral Joint

Fig. 2.12 Glenohumeral joint: Bony elements

Right shoulder.



A Anterior view.

B Posterior view.

Fig. 2.13 Glenohumeral joint cavity



C Lateral view.

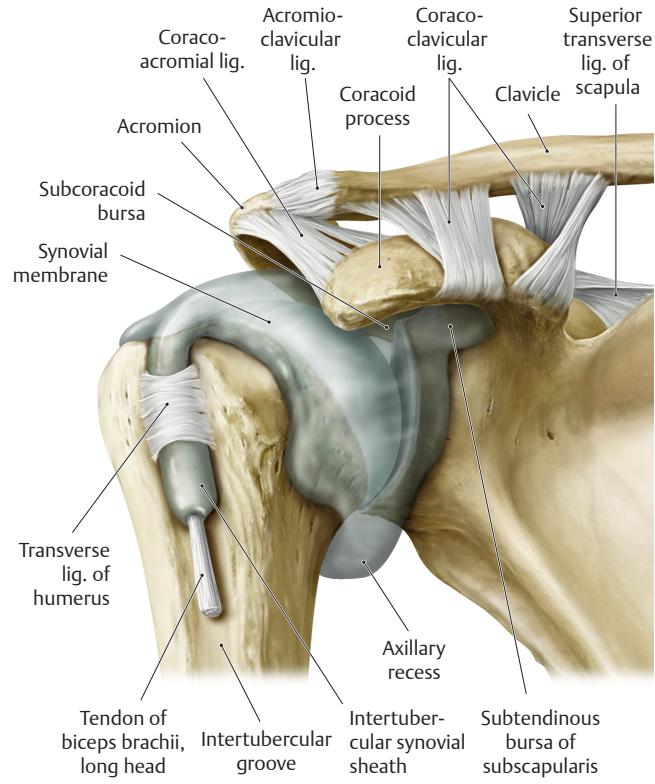
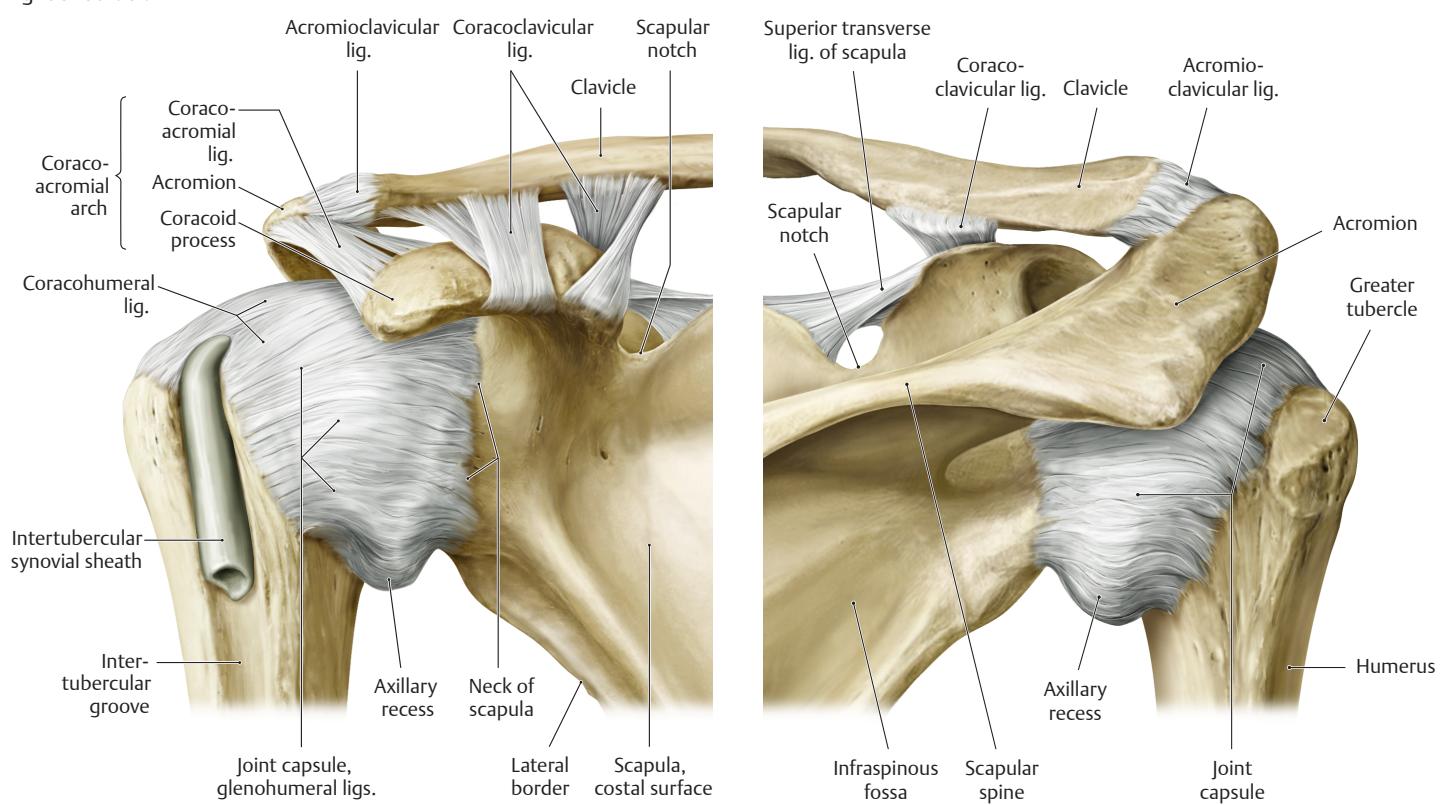
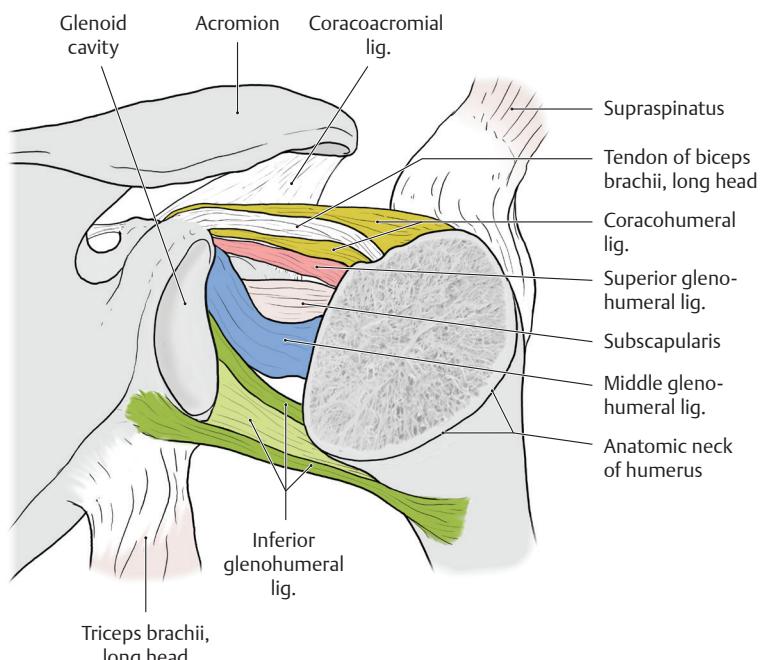
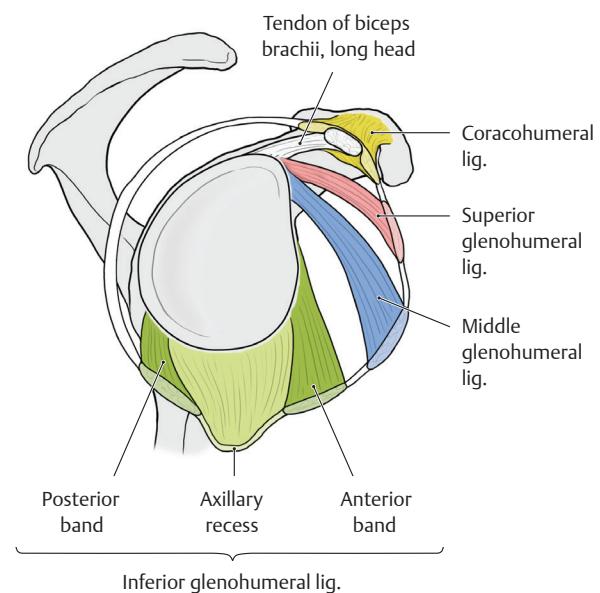


Fig. 2.14 Glenohumeral joint: Capsule and ligaments

Right shoulder.

**A** Anterior view.**B** Posterior view.**Fig. 2.15 Ligaments reinforcing capsule**

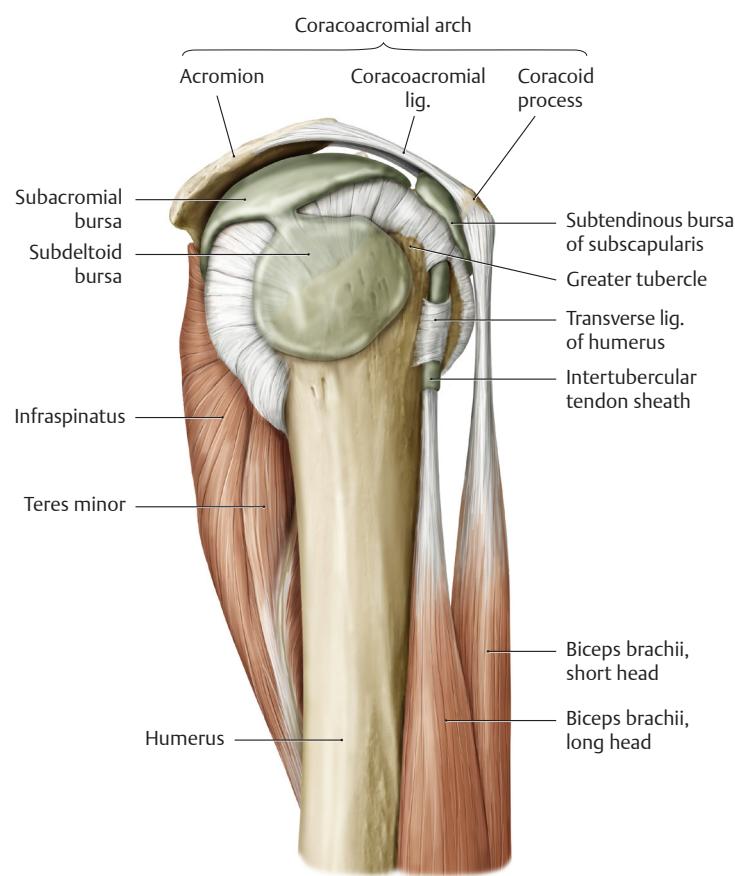
Schematic representation of the ligaments reinforcing the capsule after removal of the humeral head.
Right shoulder.

**A** Lateral view.**B** Posterior view.

Subacromial Space & Bursae

Fig. 2.16 Subacromial space

Right shoulder.



A Lateral view.

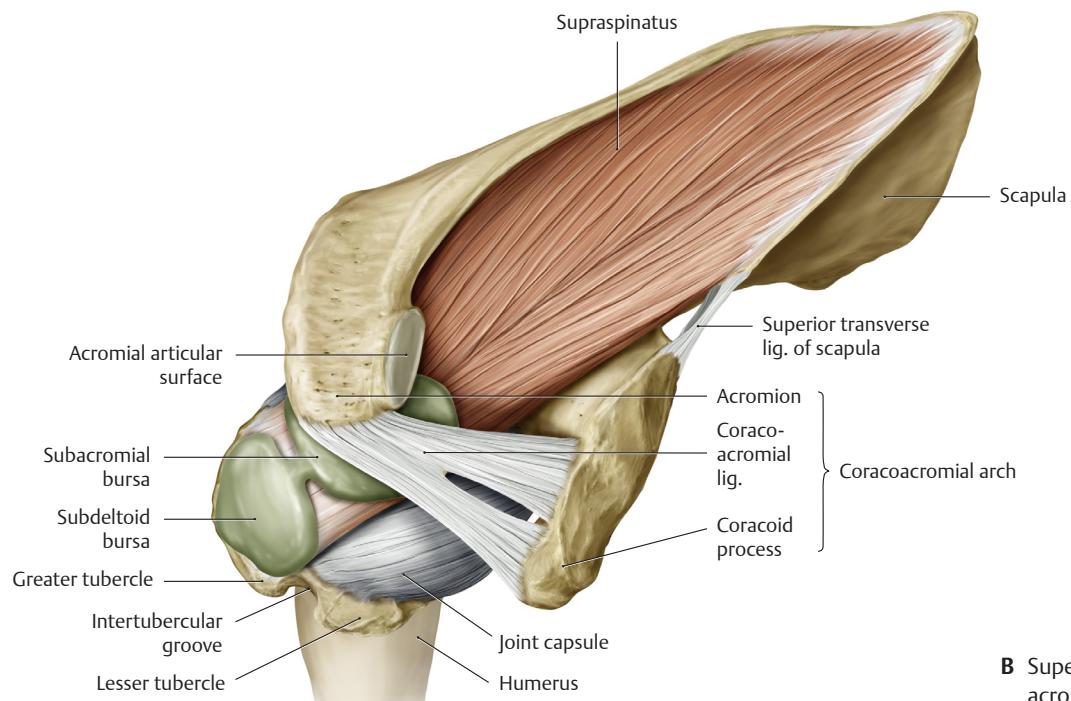
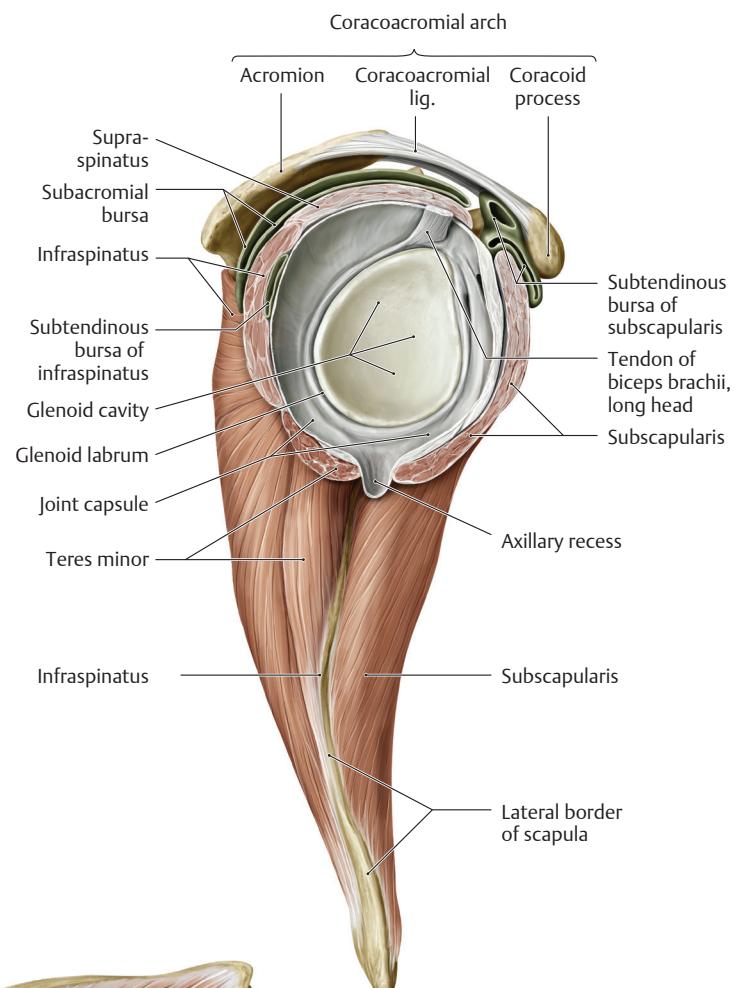


Fig. 2.17 Subacromial bursa and glenoid cavity

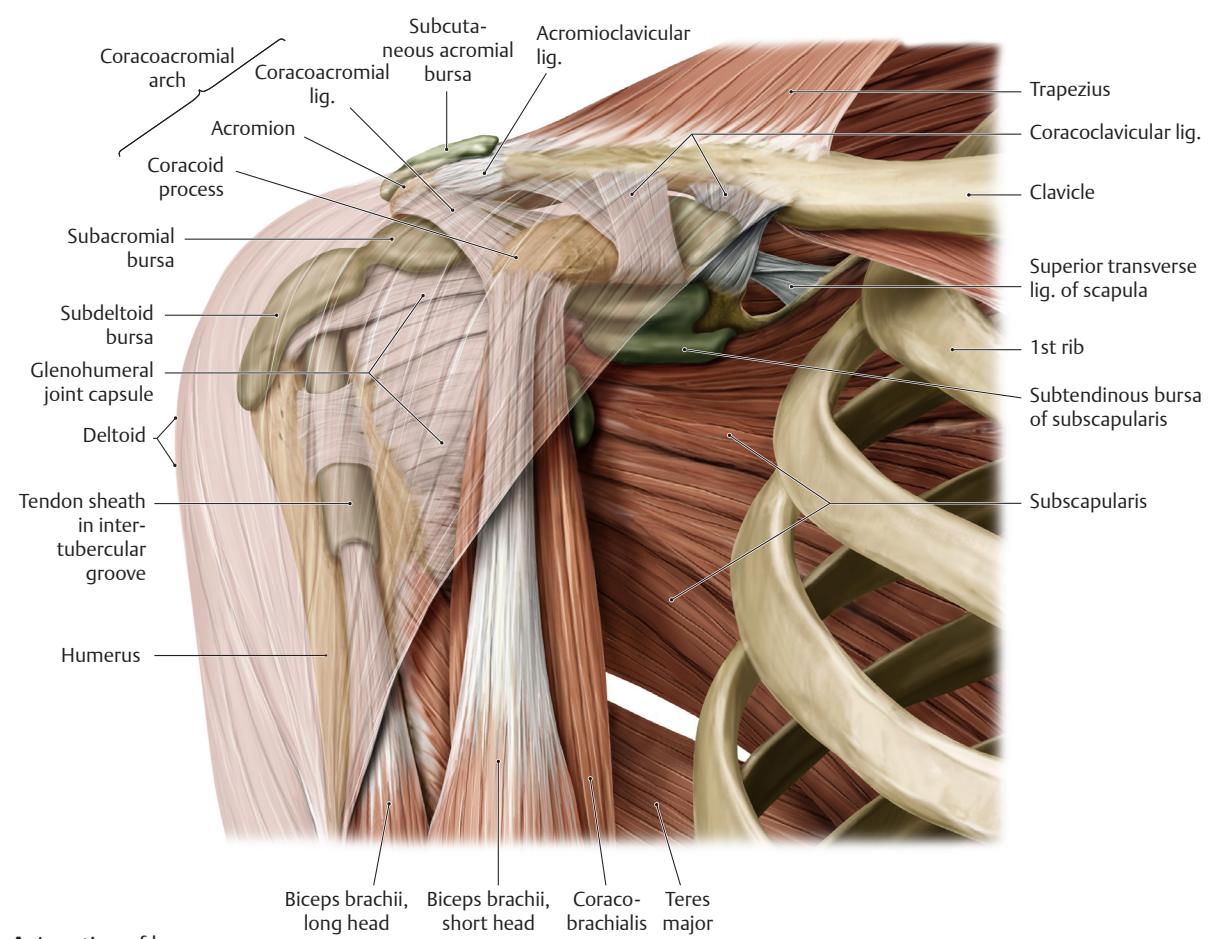
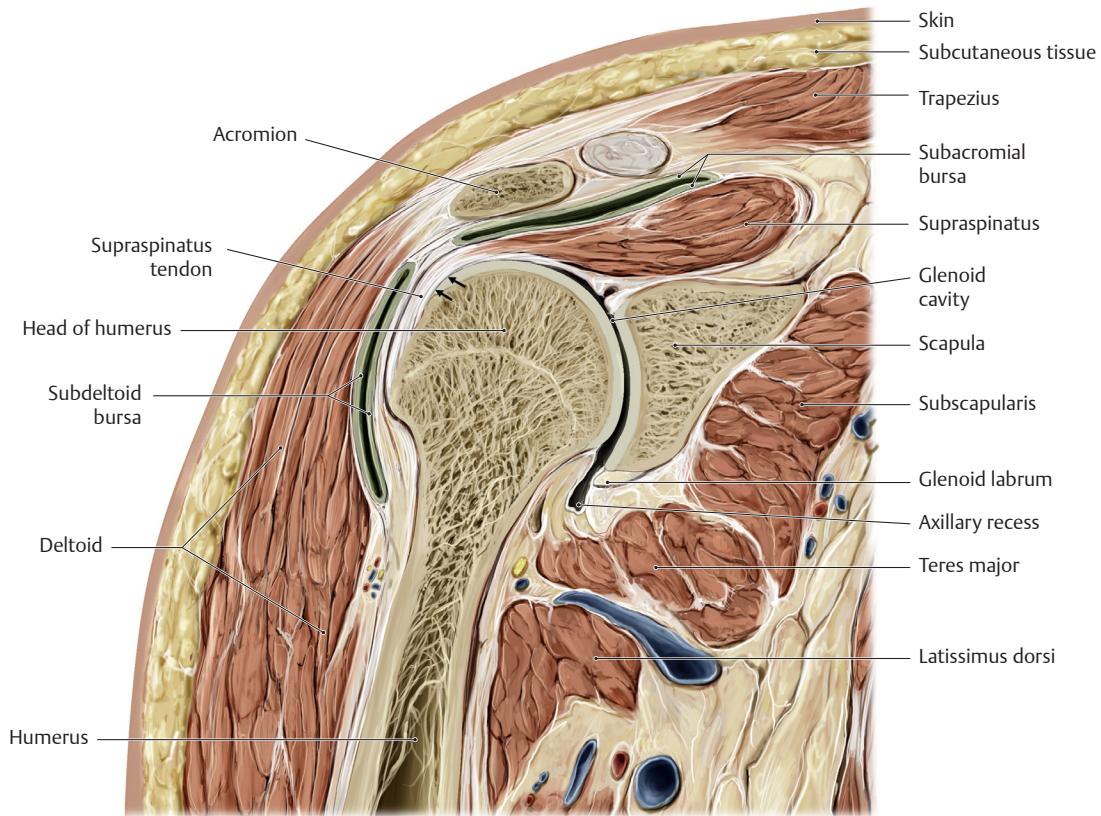
Right shoulder, lateral view of sagittal section with humerus removed.



B Superior view. Note the position of the sub-acromial bursa between the supraspinatus muscle and the coracoacromial arch.

Fig. 2.18 Subacromial and subdeltoid bursae

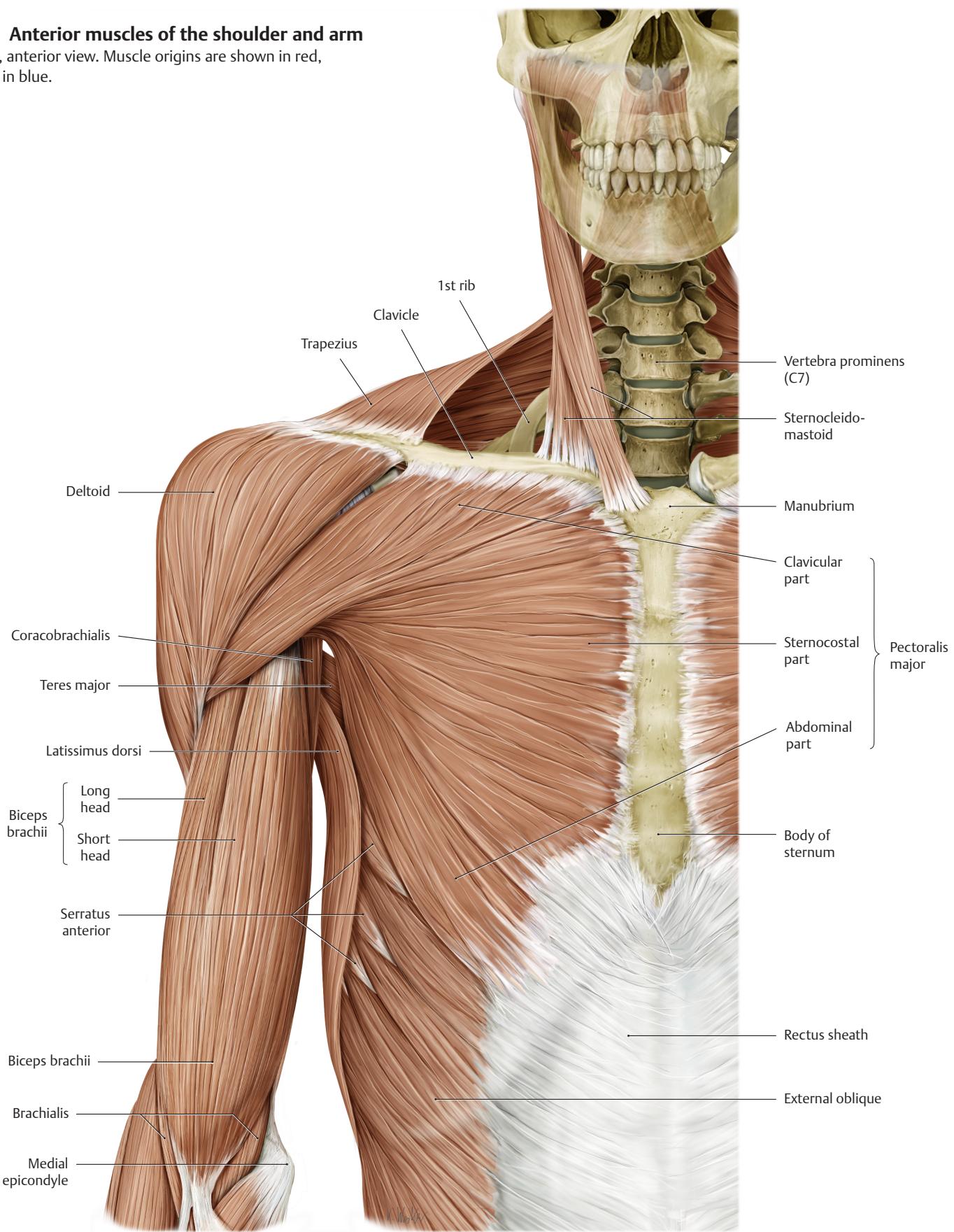
Right shoulder, anterior view.

**A** Location of bursae.**B** Coronal section. The arrows are pointing at the supraspinatus tendon, which is frequently injured in a "rotator cuff tear" (for rotator cuff, see p. 25).

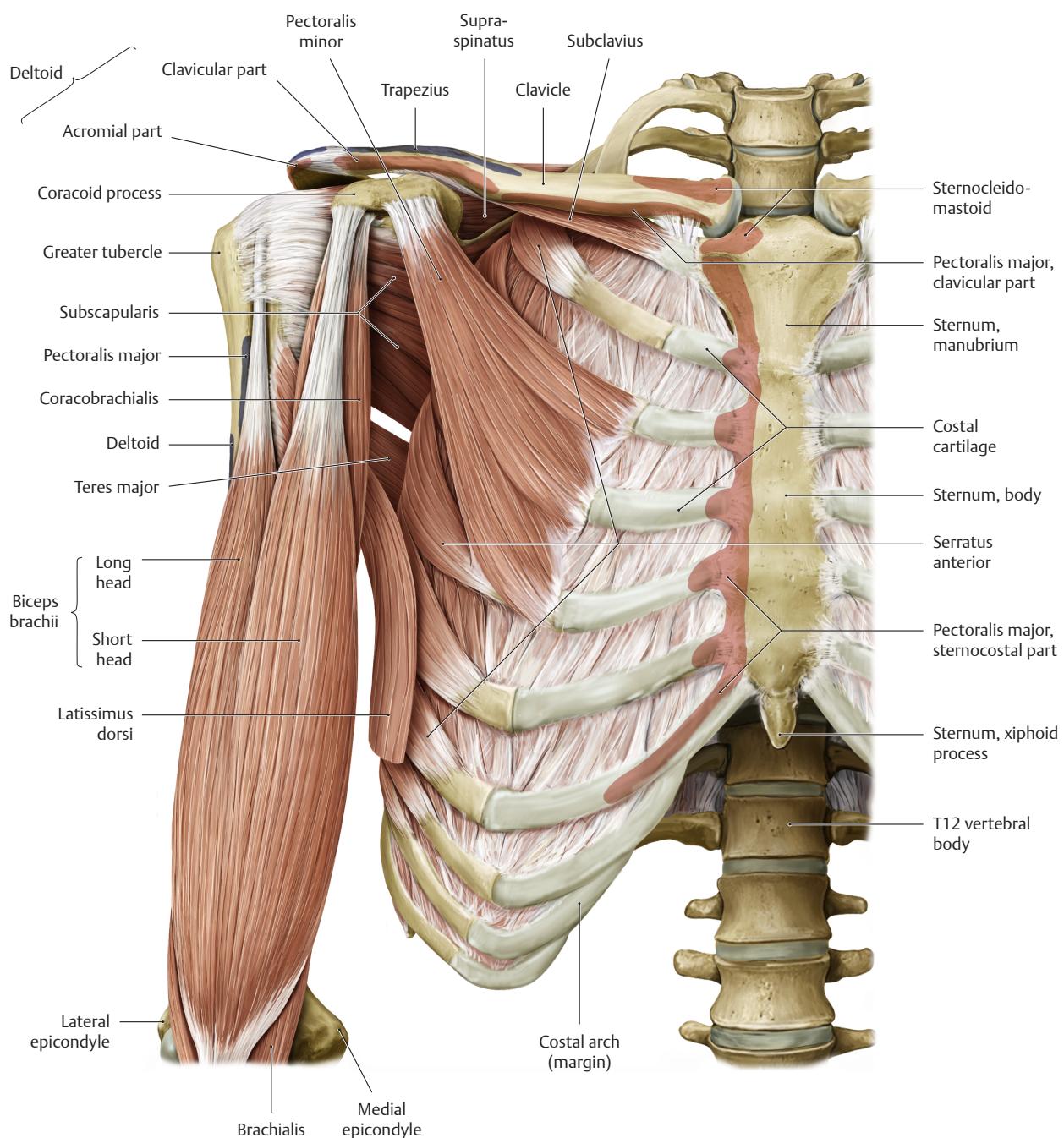
Anterior Muscles of the Shoulder & Arm (I)

Fig. 2.19 Anterior muscles of the shoulder and arm

Right side, anterior view. Muscle origins are shown in red, insertions in blue.



A Superficial dissection.

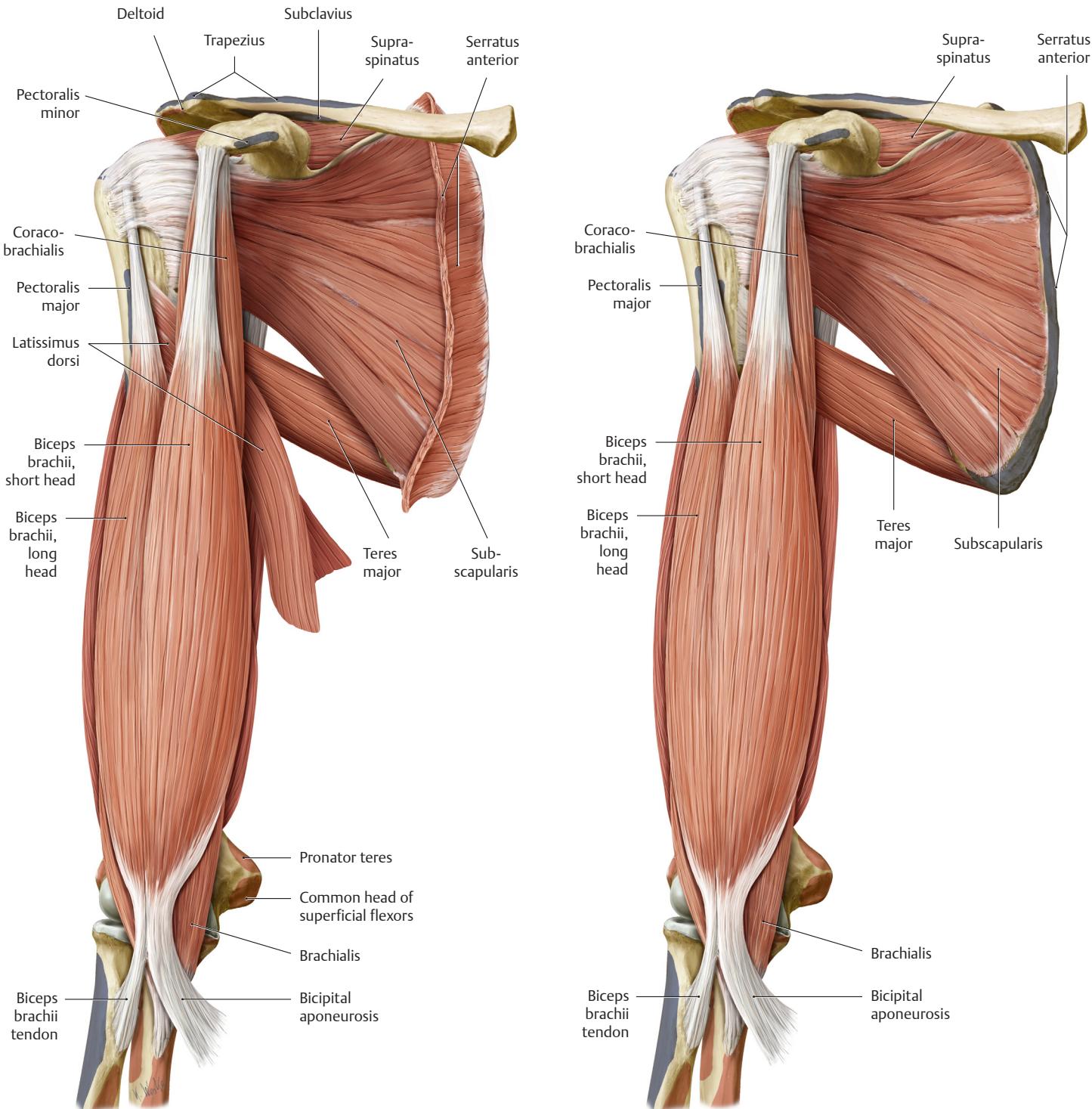


B Deep dissection. Removed: Sternocleidomastoid, trapezius, pectoralis major, deltoid, and external oblique muscles.

Anterior Muscles of the Shoulder & Arm (II)

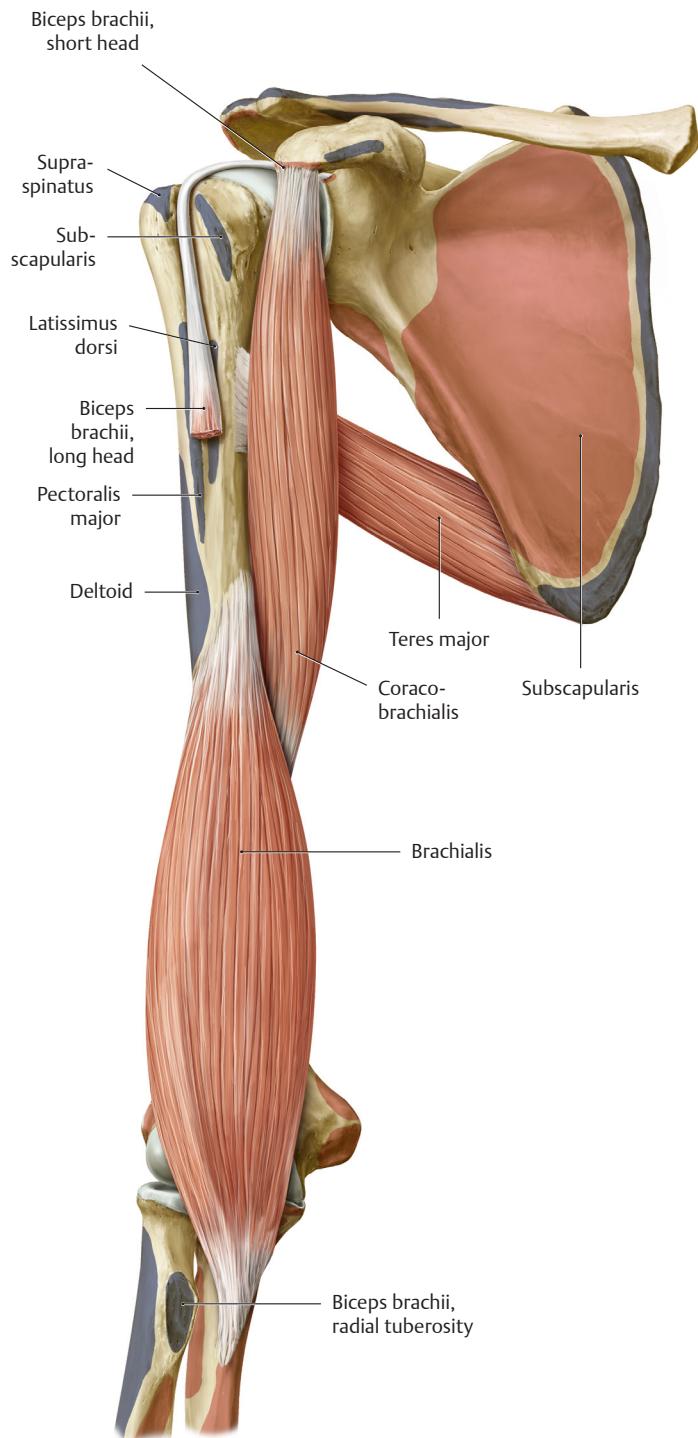
Fig. 2.20 Anterior muscles of the shoulder and arm:
Dissection

Right arm, anterior view. Muscle origins are shown in red, insertions in blue.

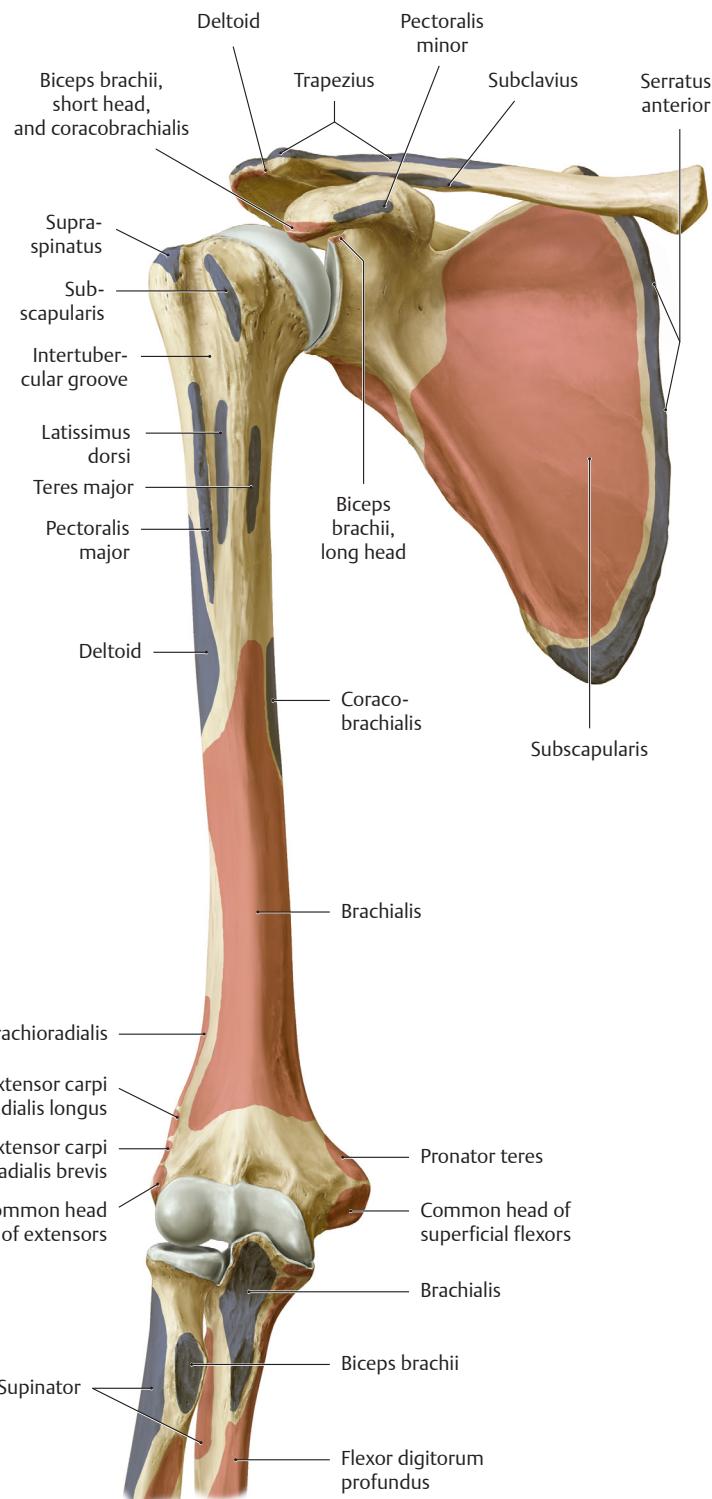


A Removed: Thoracic skeleton. Partially removed: Latissimus dorsi and serratus anterior.

B Removed: Latissimus dorsi and serratus anterior.



C Removed: Subscapularis and supraspinatus. Partially removed: Biceps brachii.

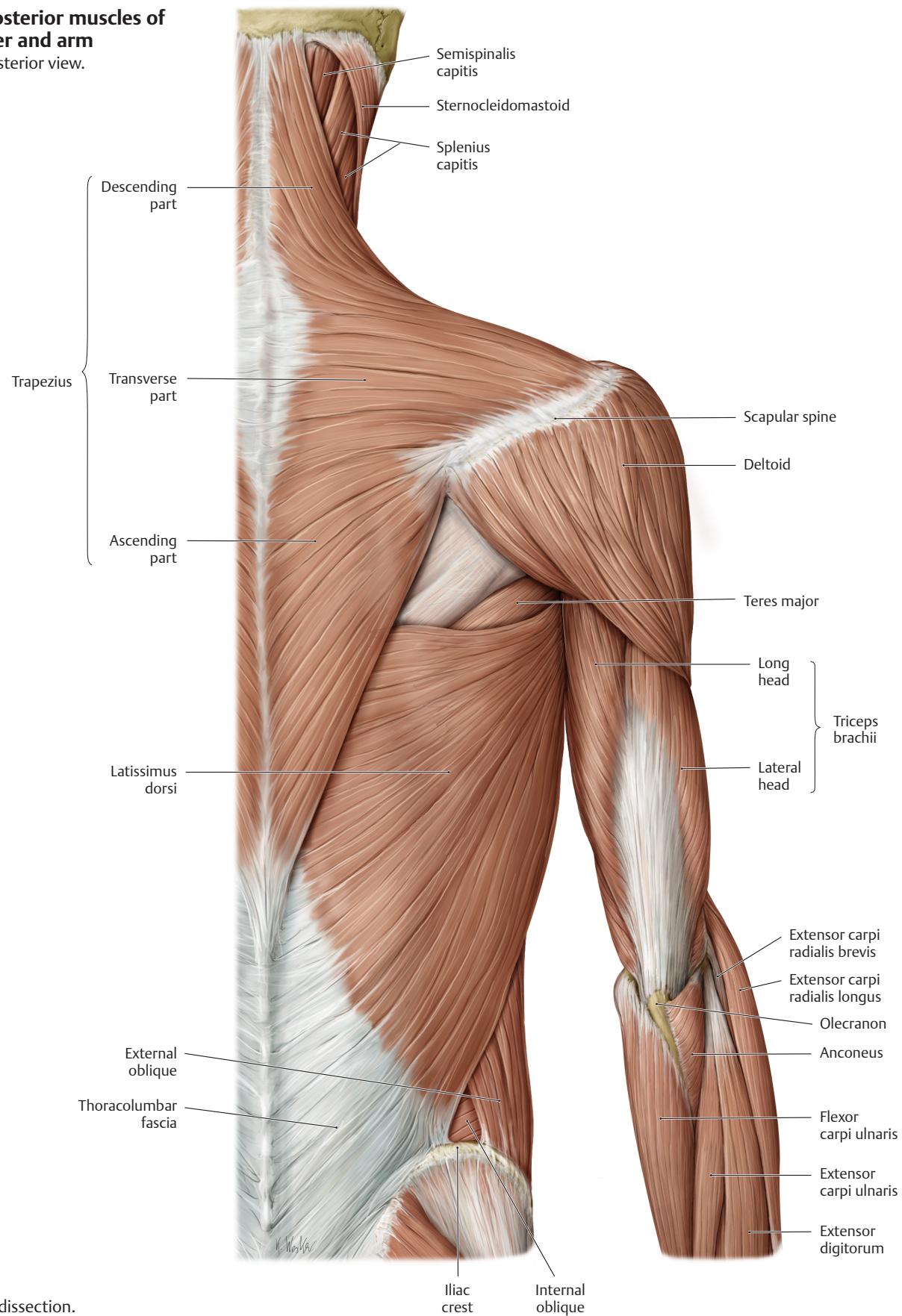


D Removed: Biceps brachii, coracobrachialis, and teres major.

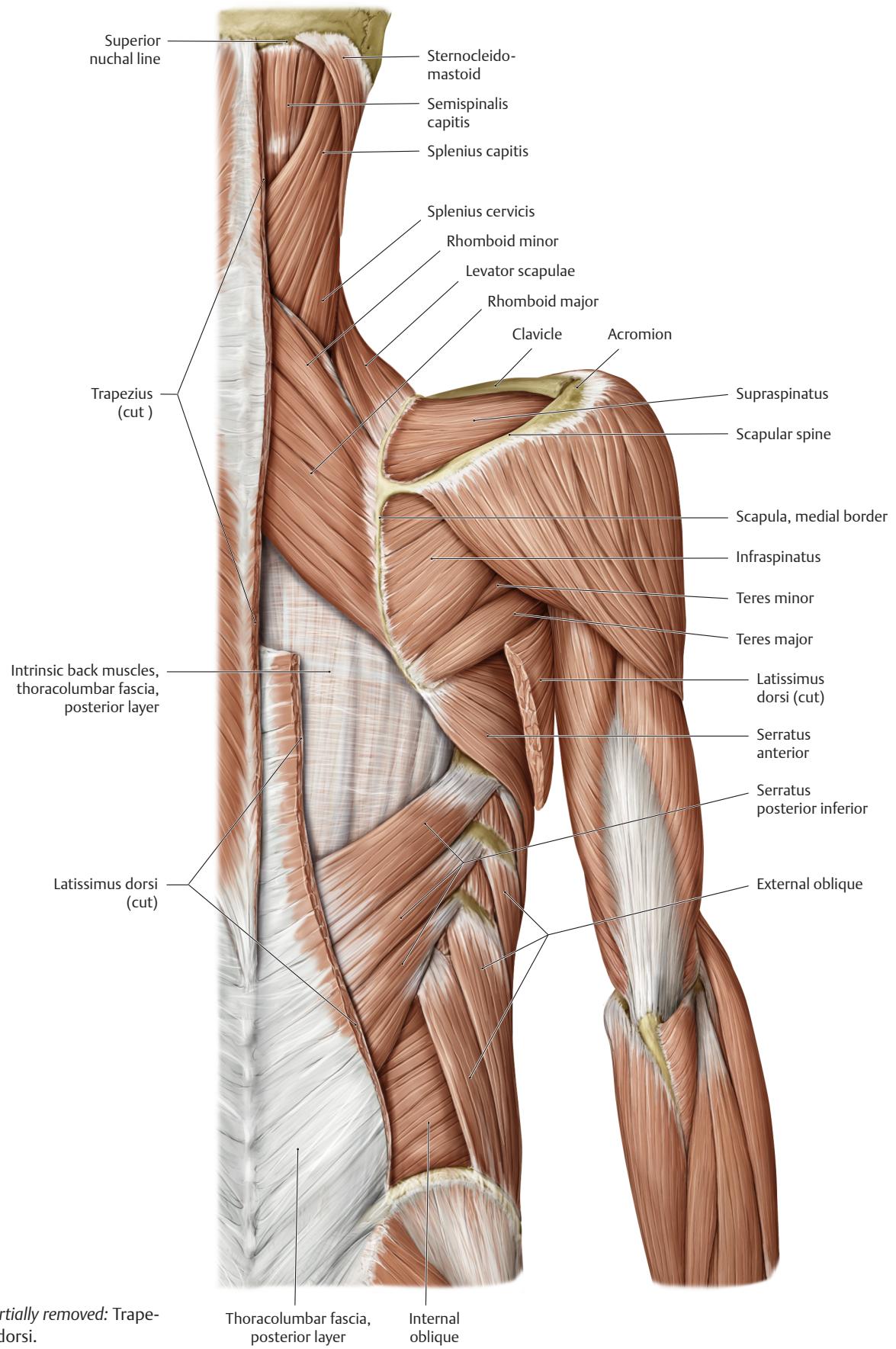
Posterior Muscles of the Shoulder & Arm (I)

Fig. 2.21 Posterior muscles of the shoulder and arm

Right side, posterior view.



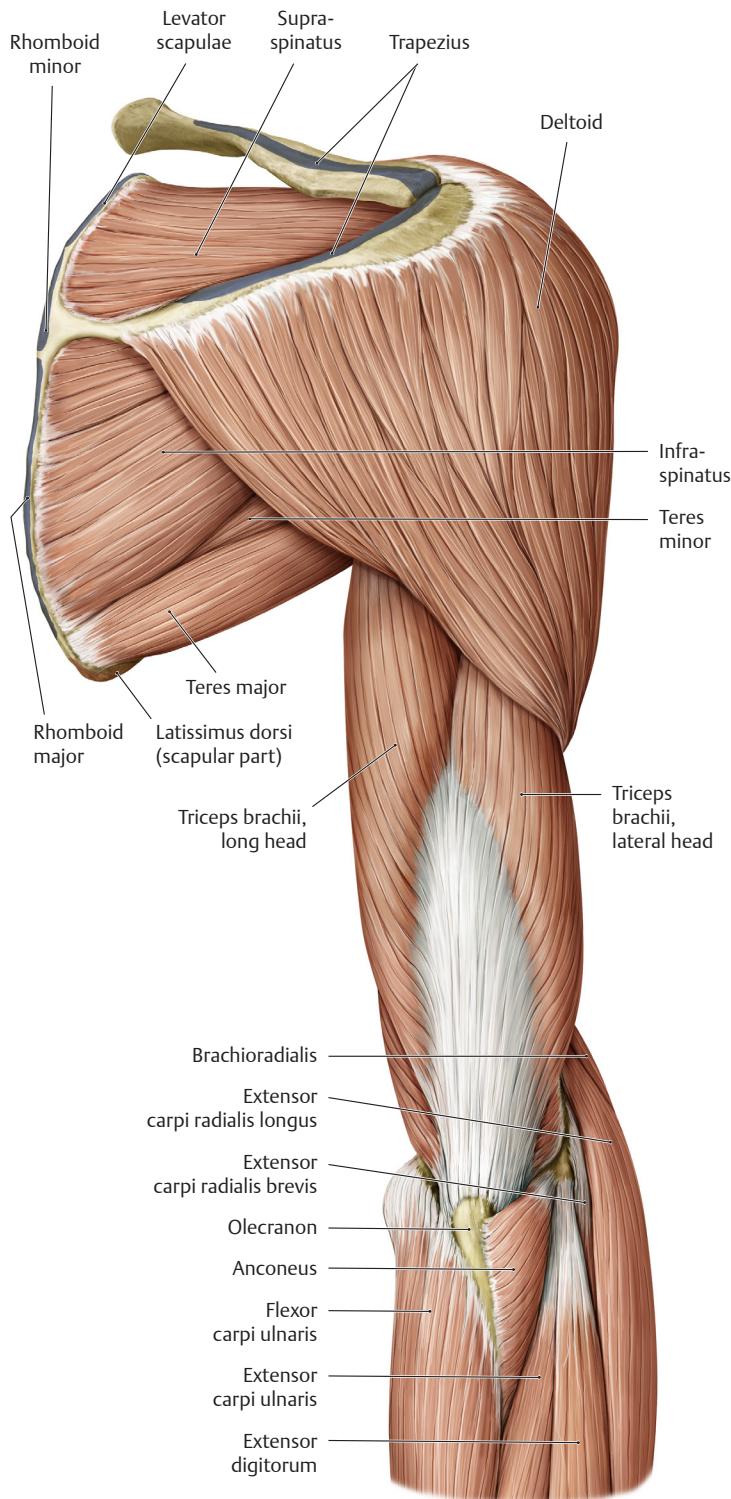
A Superficial dissection.



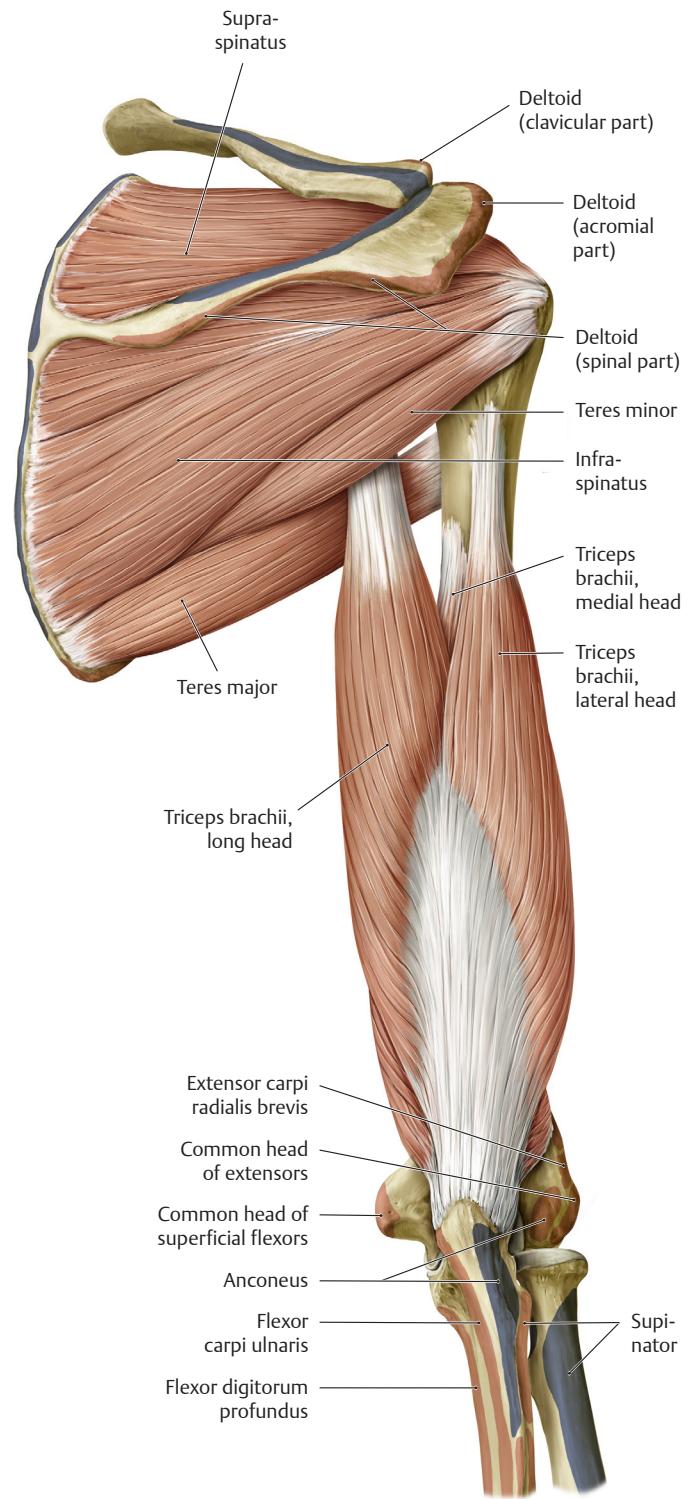
Posterior Muscles of the Shoulder & Arm (II)

Fig. 2.22 Posterior muscles of the shoulder and arm: Dissection

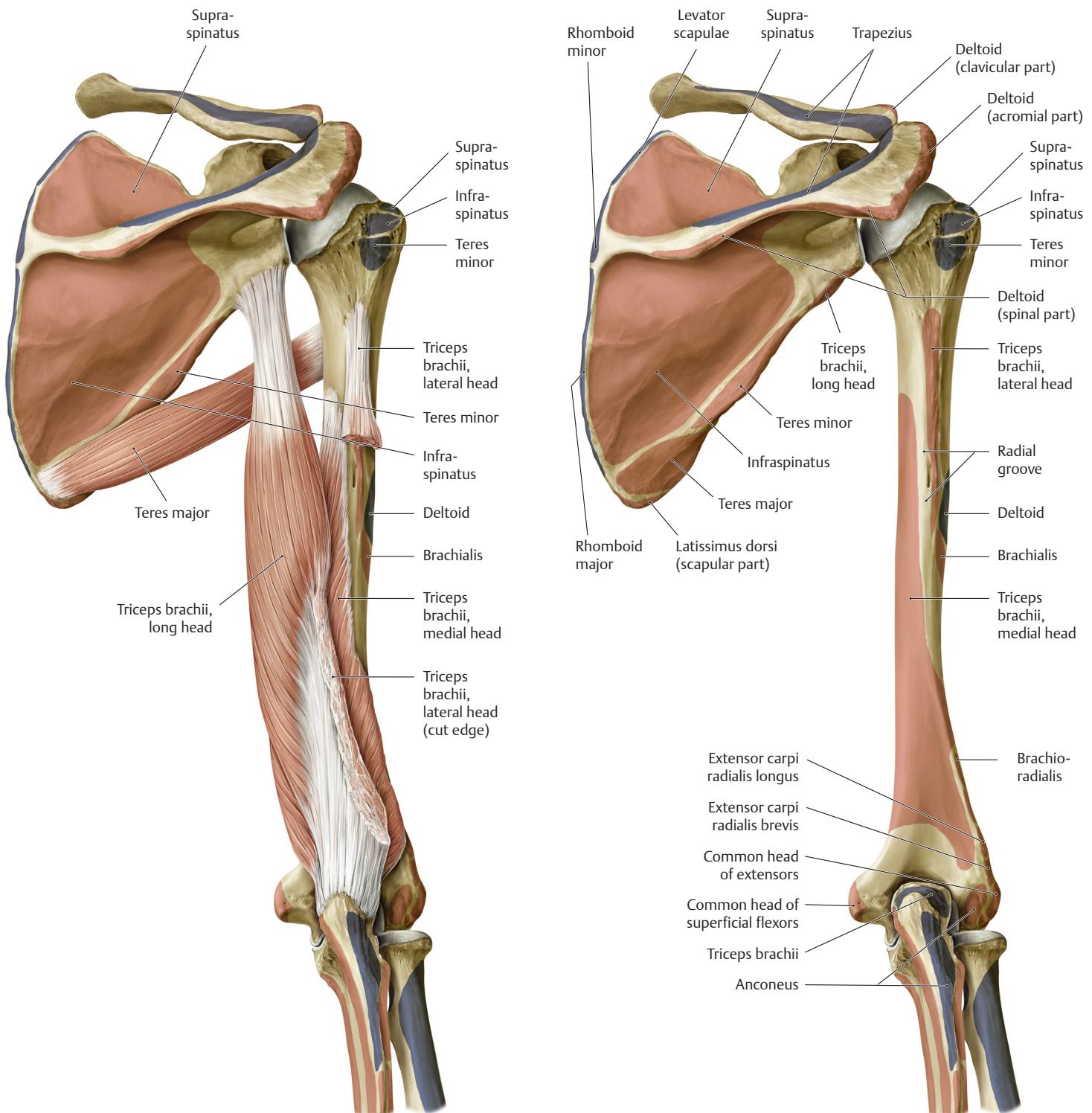
Right arm, posterior view. Muscle origins are shown in red, insertions in blue.



A Removed: Rhomboids major and minor, serratus anterior, and levator scapulae.



B Removed: Deltoid and forearm muscles.



C Removed: Supraspinatus, infraspinatus, and teres minor. Partially removed: Triceps brachii.

D Removed: Triceps brachii and teres major.

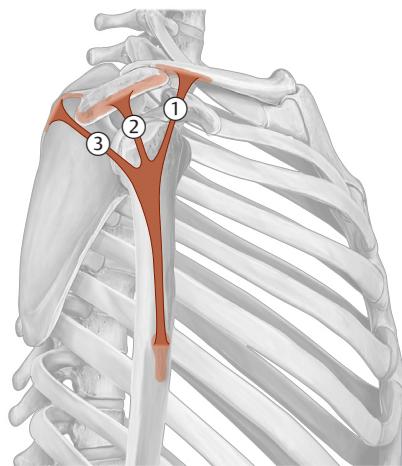
Muscle Facts (I)

The actions of the three parts of the deltoid muscle depend on their relationship to the position of the humerus and its axis of motion. At less than 60 degrees, the muscles act as adductors, but at greater than

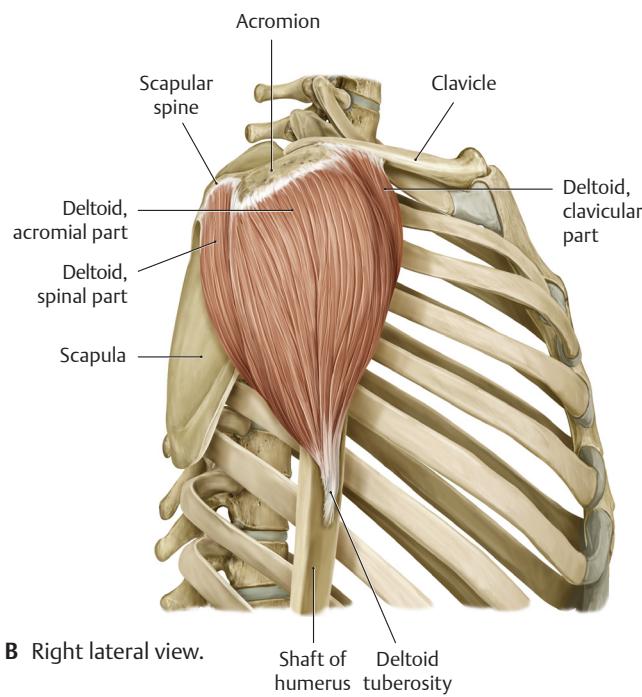
60 degrees, they act as abductors. As a result, the parts of the deltoid can act antagonistically as well as synergistically.

Fig. 2.23 Deltoid

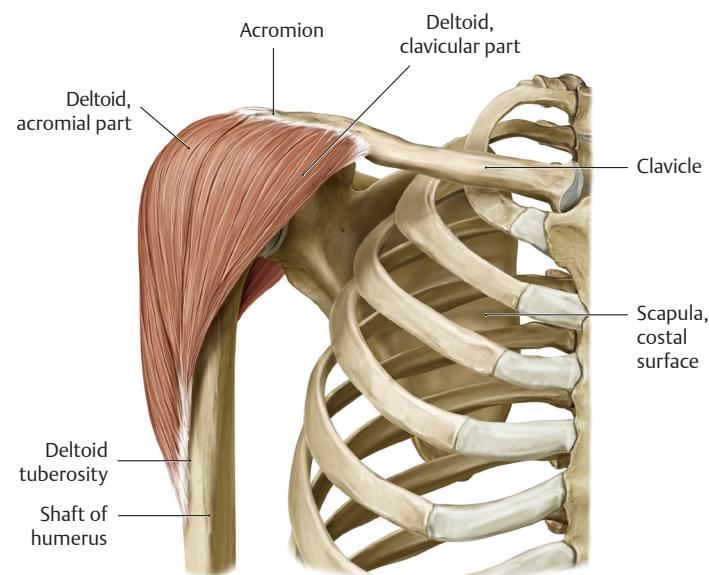
Right shoulder.



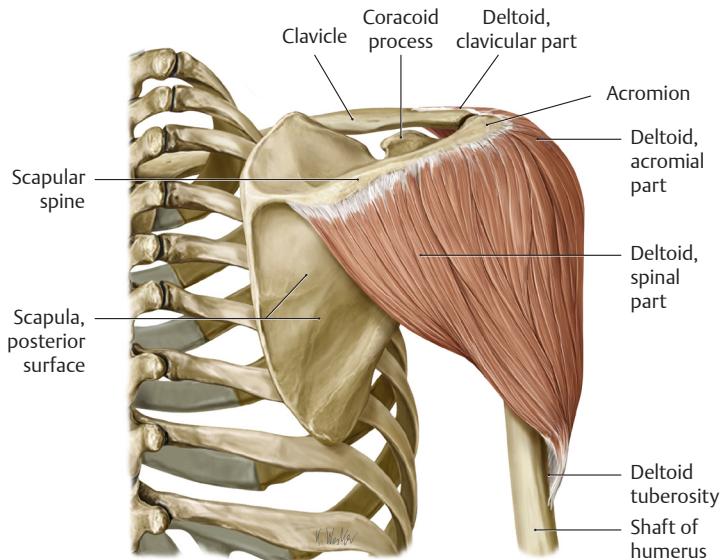
A Parts of the deltoid, right lateral view, schematic.



B Right lateral view.



C Anterior view.

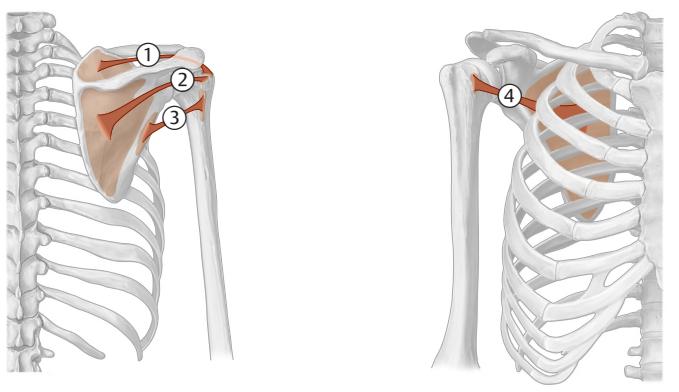


D Posterior view.

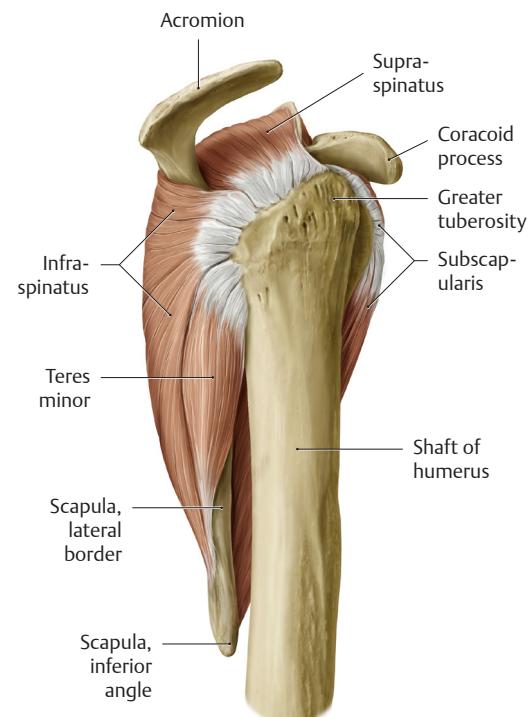
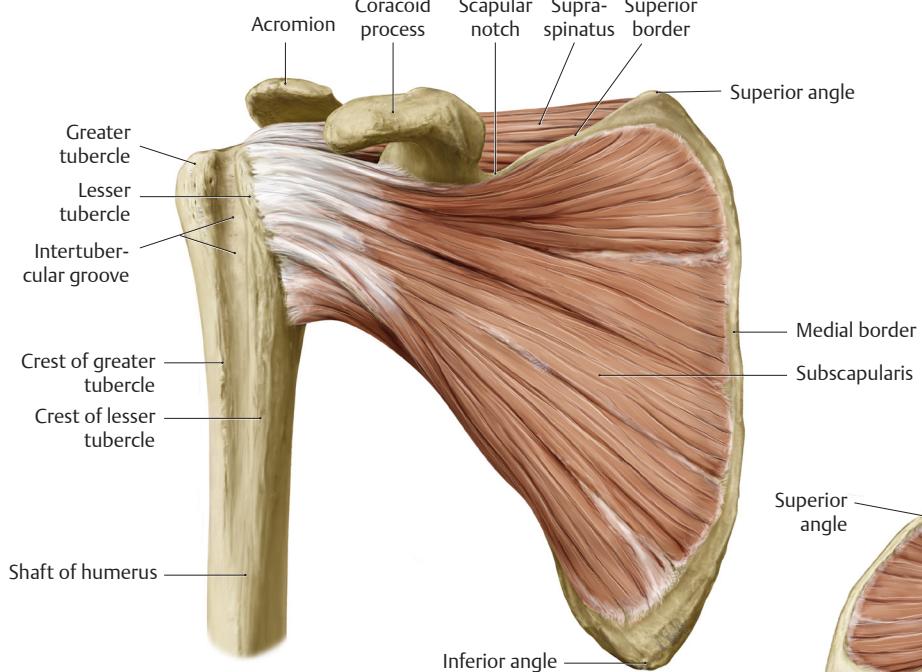
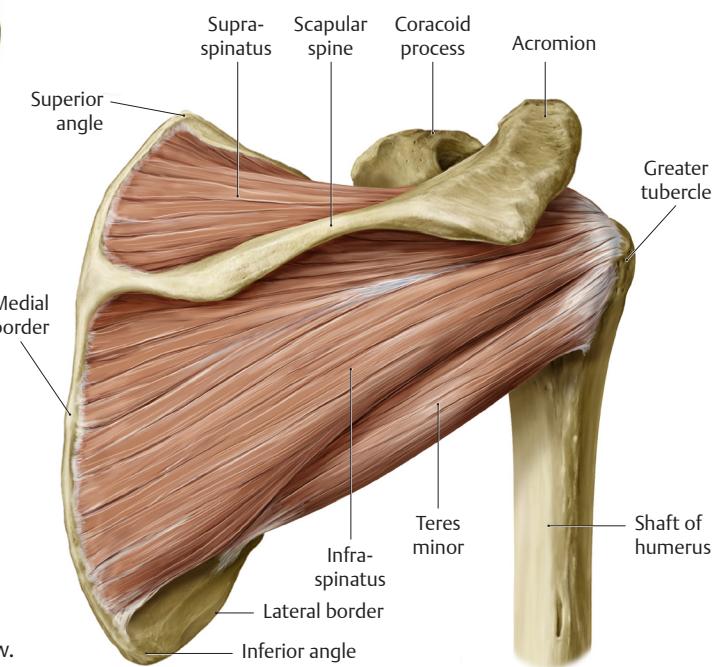
Table 2.1 Parts of the deltoid

Muscle	Origin	Insertion	Innervation	Action*
Deltoid	① Clavicular (anterior) part ② Acromial (lateral) part ③ Spinal (posterior) part	Lateral one third of clavicle Acromion Scapular spine	Humerus (deltoid tuberosity) Axillary n. (C5, C6)	Flexion, internal rotation, adduction Abduction Extension, external rotation, adduction

* Between 60 and 90 degrees of abduction, the clavicular and spinal parts assist the acromial part with abduction.

**Fig. 2.24 Rotator cuff**

Right shoulder. The rotator cuff consists of four muscles: supraspinatus, infraspinatus, teres minor, and subscapularis.

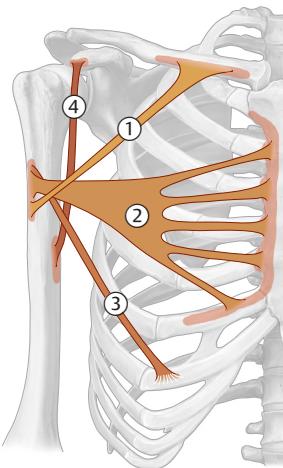
**D Lateral view.****C Anterior view.****E Posterior view.****Table 2.2****Muscles of the rotator cuff**

Muscle	Origin	Insertion		Innervation	Action
① Supraspinatus	Scapula	Supraspinous fossa	Humerus	Humerus (greater tubercle)	Initiates abduction
② Infraspinatus		Infraspinous fossa			External rotation
③ Teres minor		Lateral border		Axillary n. (C5, C6)	External rotation, weak adduction
④ Subscapularis		Subscapular fossa		Humerus (lesser tubercle)	Upper and lower subscapular nn. (C5, C6)
					Internal rotation

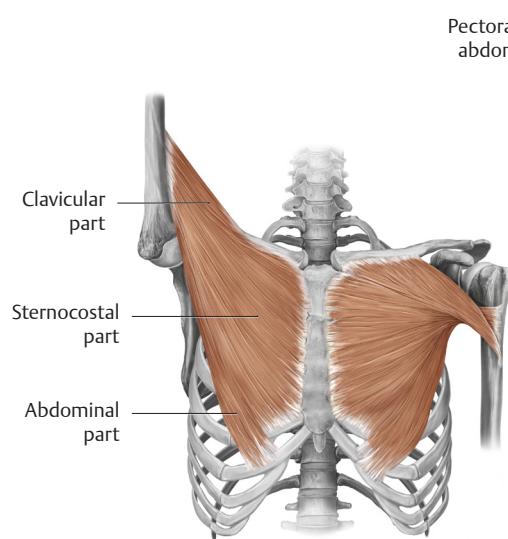
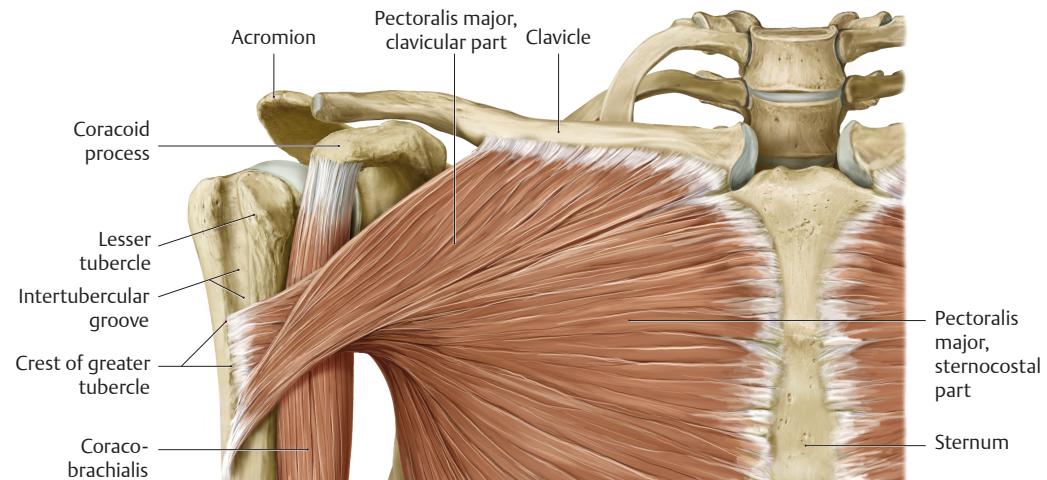
Muscle Facts (II)

Fig. 2.25 Pectoralis major and coracobrachialis

Anterior view.



A Schematic.



B Pectoralis major in neutral position (left) and elevation (right).

C Pectoralis major and coracobrachialis.

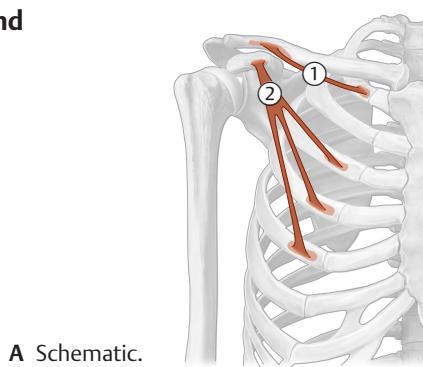
Table 2.3

Pectoralis major and coracobrachialis

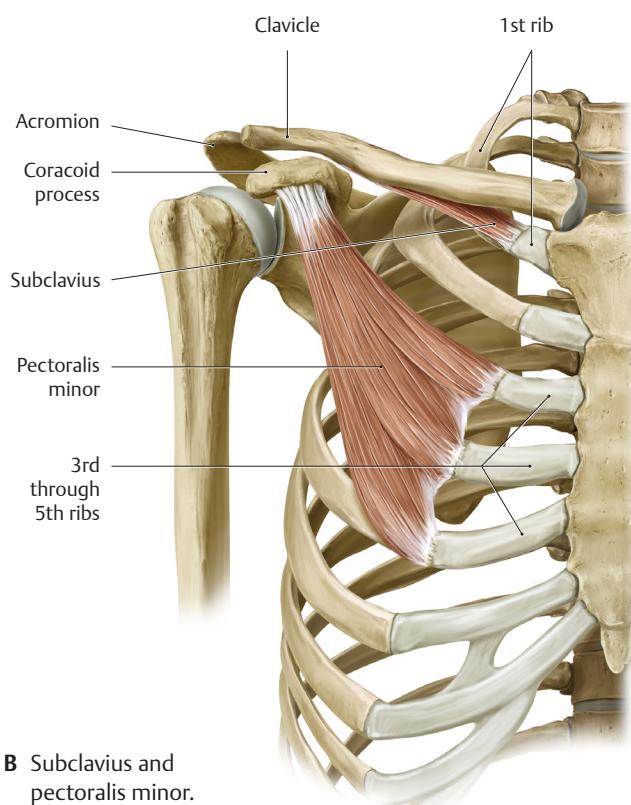
Muscle	Origin	Insertion	Innervation	Action
Pectoralis major	① Clavicular part	Clavicle (medial half)	Humerus (crest of greater tubercle) Medial and lateral pectoral nn. (C5-T1)	Entire muscle: adduction, internal rotation Clavicular and sternocostal parts: flexion; assist in respiration when shoulder is fixed
	② Sternocostal part	Sternum and costal cartilages 1–6		
	③ Abdominal part	Rectus sheath (anterior layer)		
④ Coracobrachialis	Scapula (coracoid process)	Humerus (in line with crest of lesser tubercle)	Musculocutaneous n. (C5–C7)	Flexion, adduction, internal rotation

Fig. 2.26 Subclavius and pectoralis minor

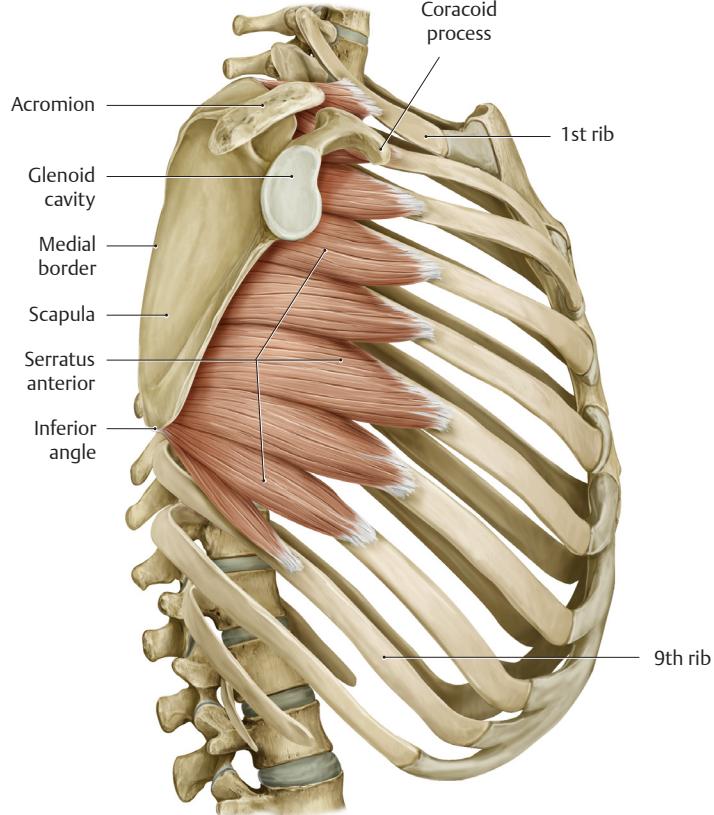
Right side, anterior view.



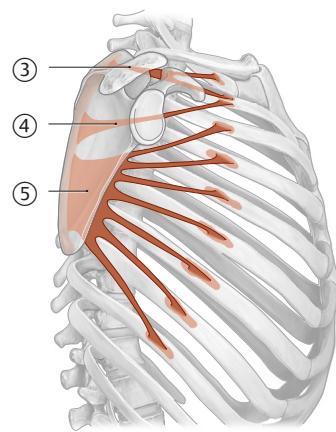
A Schematic.



B Subclavius and pectoralis minor.



A Serratus anterior.



B Schematic.

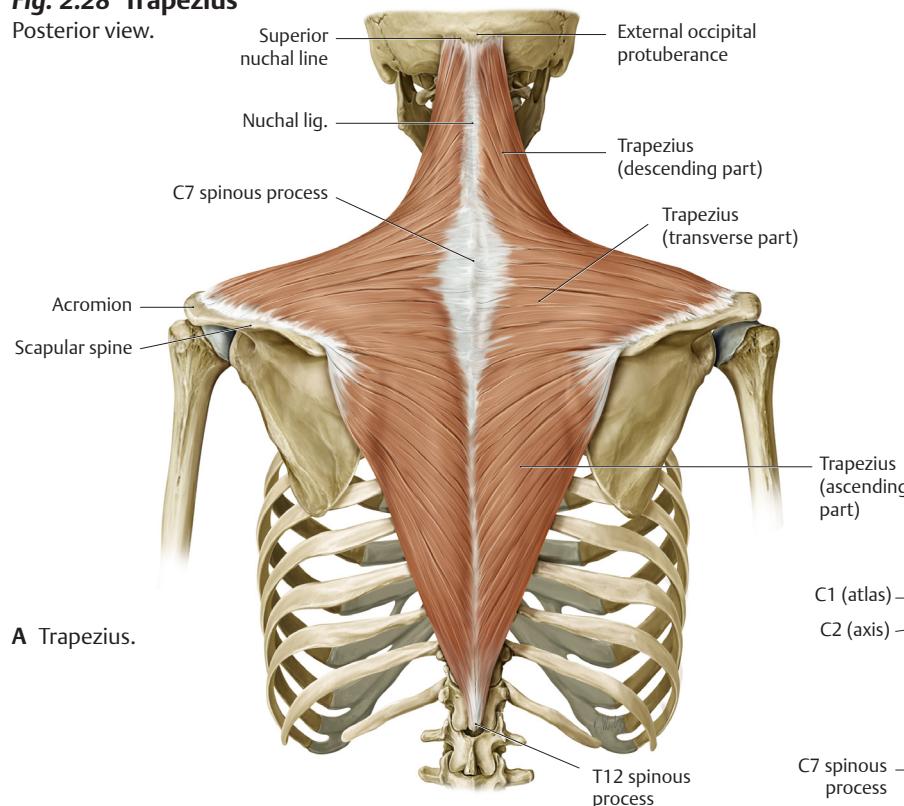
Table 2.4 Subclavius, pectoralis minor, and serratus anterior

Muscle	Origin	Insertion	Innervation	Action
① Subclavius	1st rib	Clavicle (inferior surface)	N. to subclavius (C5, C6)	Steadies the clavicle in the sternoclavicular joint
② Pectoralis minor	3rd to 5th ribs	Coracoid process	Medial pectoral n. (C8, T1)	Draws scapula downward, causing inferior angle to move posteromedially; rotates glenoid inferiorly; assists in respiration
Serratus anterior	③ Superior part	Scapula (costal and dorsal surfaces of superior angle)	Long thoracic n. (C5–C7)	Superior part: lowers the raised arm
	④ Intermediate part	Scapula (costal surface of medial border)		Entire muscle: draws scapula laterally forward; elevates ribs when shoulder is fixed
	⑤ Inferior part	Scapula (costal surface of medial border and costal and dorsal surfaces of inferior angle)		Inferior part: rotates inferior angle of scapula laterally forward (allows elevation of arm above 90°)

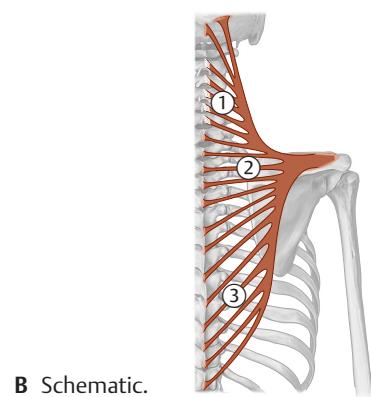
Muscle Facts (III)

Fig. 2.28 Trapezius

Posterior view.



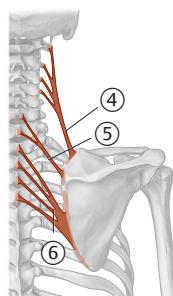
A Trapezius.



B Schematic.

Fig. 2.29 Levator scapulae with rhomboids major and minor

Right side, posterior view.



A Schematic.

B Levator scapulae with rhomboids major and minor.

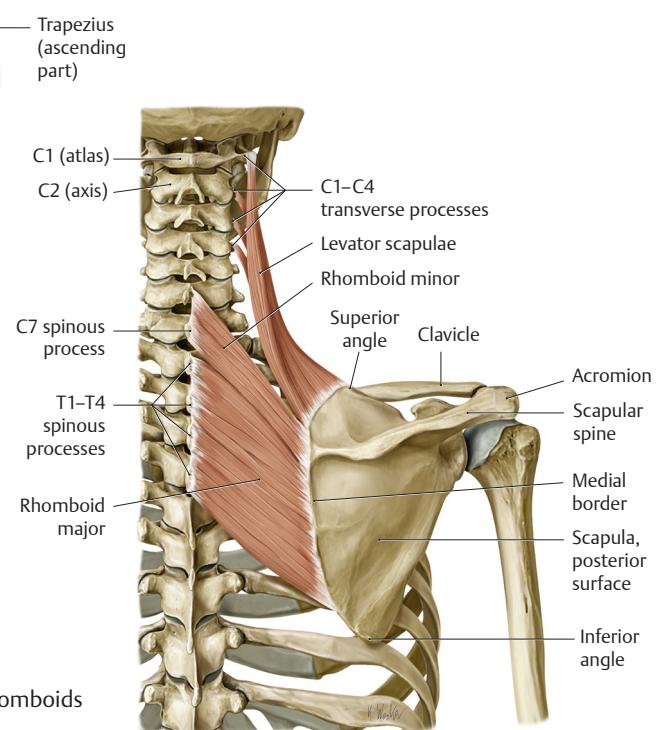


Table 2.5

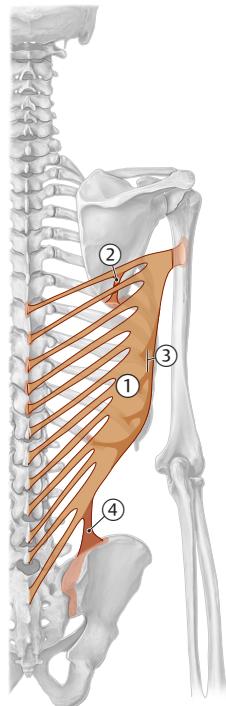
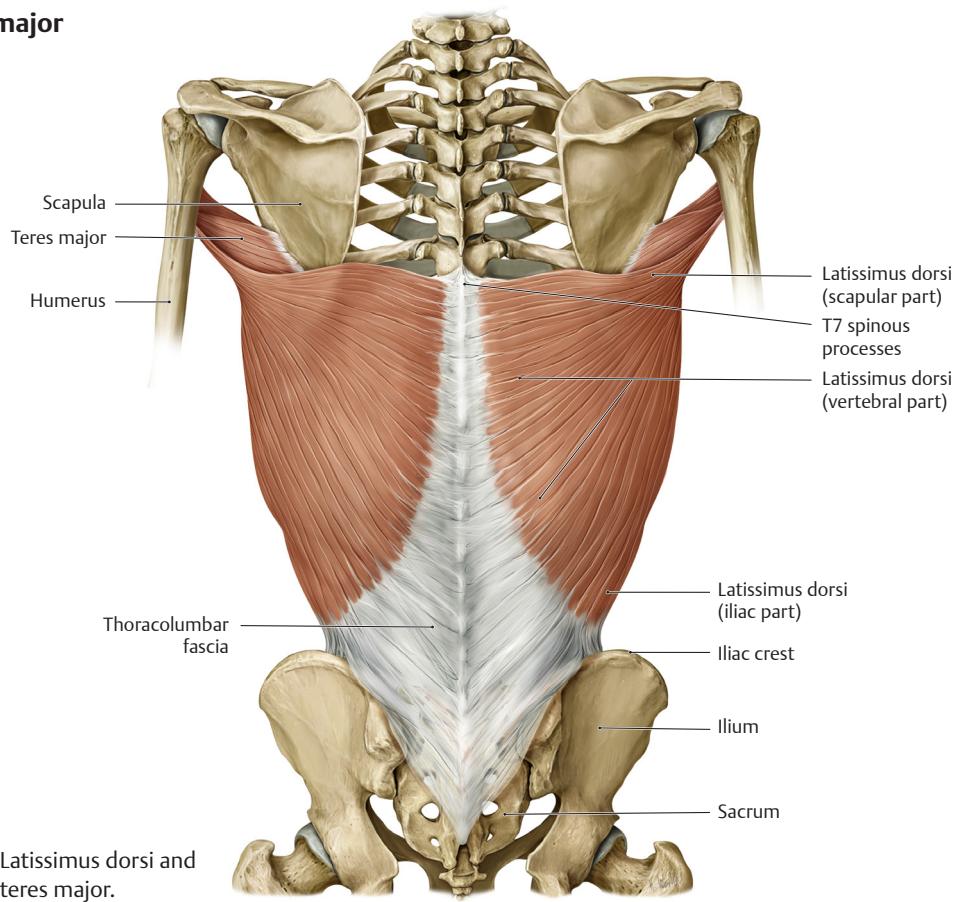
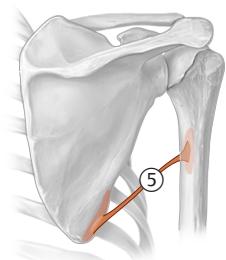
Trapezius, levator scapulae, and rhomboids major and minor

Muscle	Origin	Insertion	Innervation	Action
Trapezius	① Descending part	Occipital bone; spinous processes of C1–C7	Accessory n. (CN XI); C3–C4 of cervical plexus	Draws scapula obliquely upward; rotates glenoid cavity superiorly; tilts head to same side and rotates it to opposite
	② Transverse part	Aponeurosis at T1–T4 spinous processes		Draws scapula medially
	③ Ascending part	Spinous processes of T5–T12		Draws scapula medially downward Entire muscle: steadies scapula on thorax
④ Levator scapulae	Transverse processes of C1–C4	Scapula (superior angle)	Dorsal scapular n. and cervical spinal nn. (C3–C4)	Draws scapula medially upward while moving inferior angle medially; inclines neck to same side
⑤ Rhomboid minor	Spinous processes of C6, C7	Medial border of scapula above (minor) and below (major)	Dorsal scapular n. (C4–C5)	Steadies scapula; draws scapula medially upward
⑥ Rhomboid major	Spinous processes of T1–T4 vertebrae	Scapular spine		

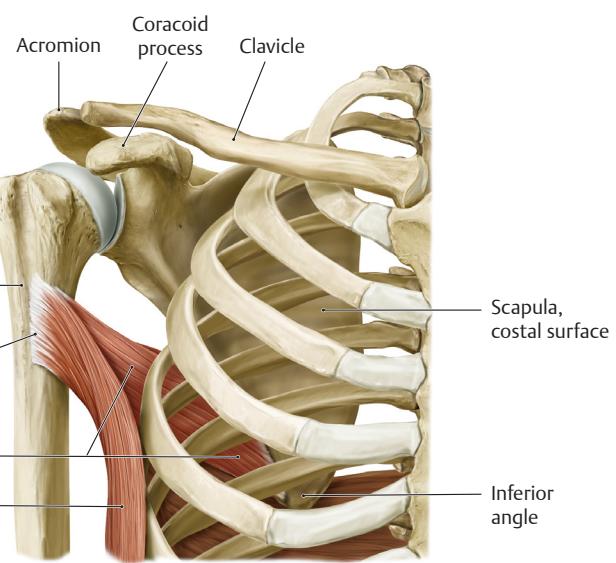
CN, cranial nerve.

Fig. 2.30 Latissimus dorsi and teres major

Posterior view.

**A** Latissimus dorsi, schematic.**B** Latissimus dorsi and teres major.**C** Teres major, schematic.

D Insertion of the latissimus dorsi on the floor of the intertubercular groove and the teres major on the crest of the lesser tubercle of the humerus.

**Table 2.6** Latissimus dorsi and teres major

Muscle	Origin	Insertion	Innervation	Action
Latissimus dorsi	① Vertebral part	Spinous processes of T7-T12 vertebrae; thoracolumbar fascia	Thoracodorsal n. (C6-C8)	Internal rotation, adduction, extension, respiration ("cough muscle")
	② Scapular part	Scapula (inferior angle)		
	③ Costal part	9th to 12th ribs		
	④ Iliac part	Iliac crest (posterior one third)		
⑤ Teres major	Scapula (inferior angle)	Crest of lesser tubercle of the humerus (anterior angle)	Lower subscapular n. (C5, C6)	Internal rotation, adduction, extension

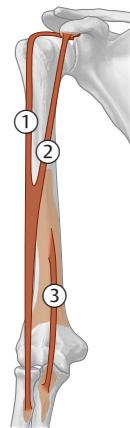
Muscle Facts (IV)

The anterior and posterior muscles of the arm may be classified respectively as flexors and extensors relative to the movement of the elbow joint. Although the coracobrachialis is topographically part of the

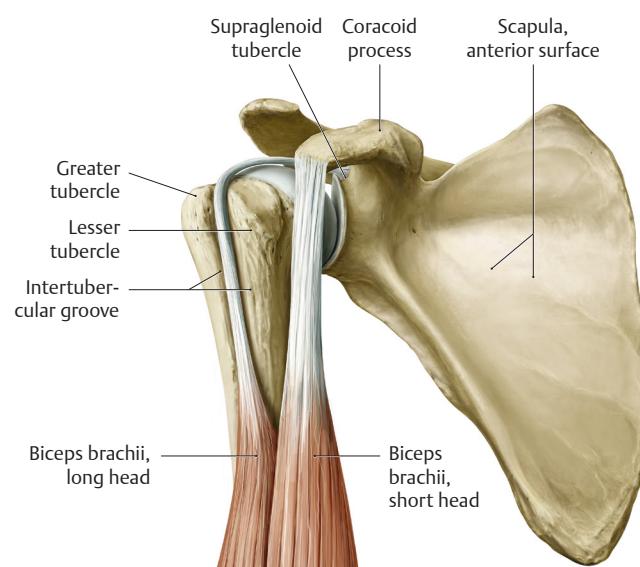
anterior compartment, it is functionally grouped with the muscles of the shoulder (see p. 26).

Fig. 2.31 Biceps brachii and brachialis

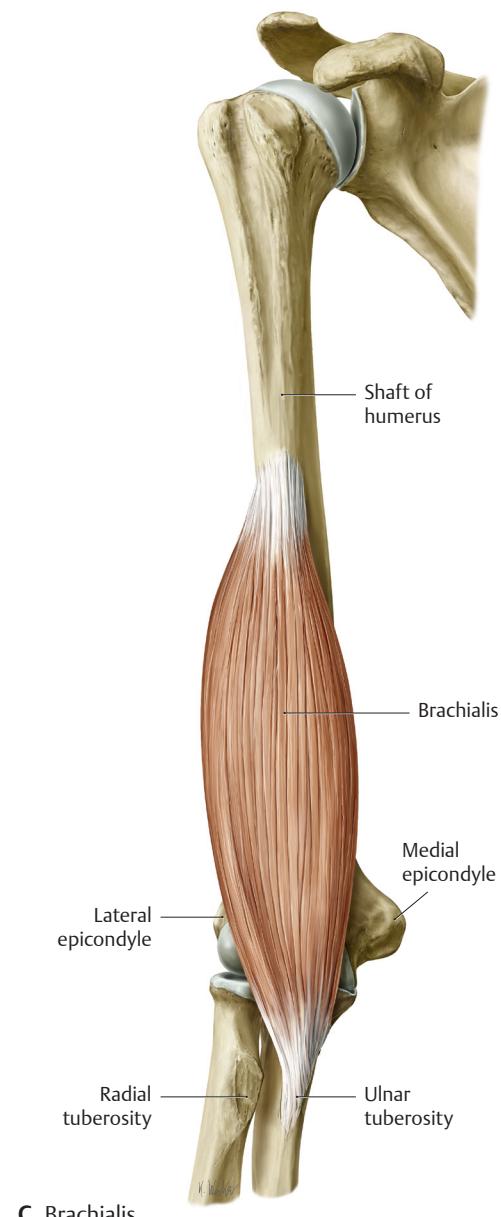
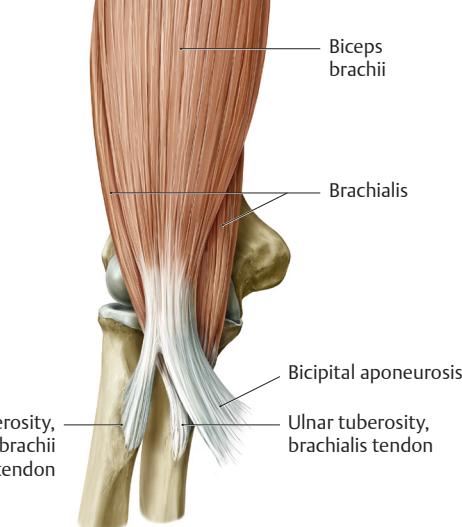
Right arm, anterior view.



A Schematic.



B Biceps brachii and brachialis.



C Brachialis.

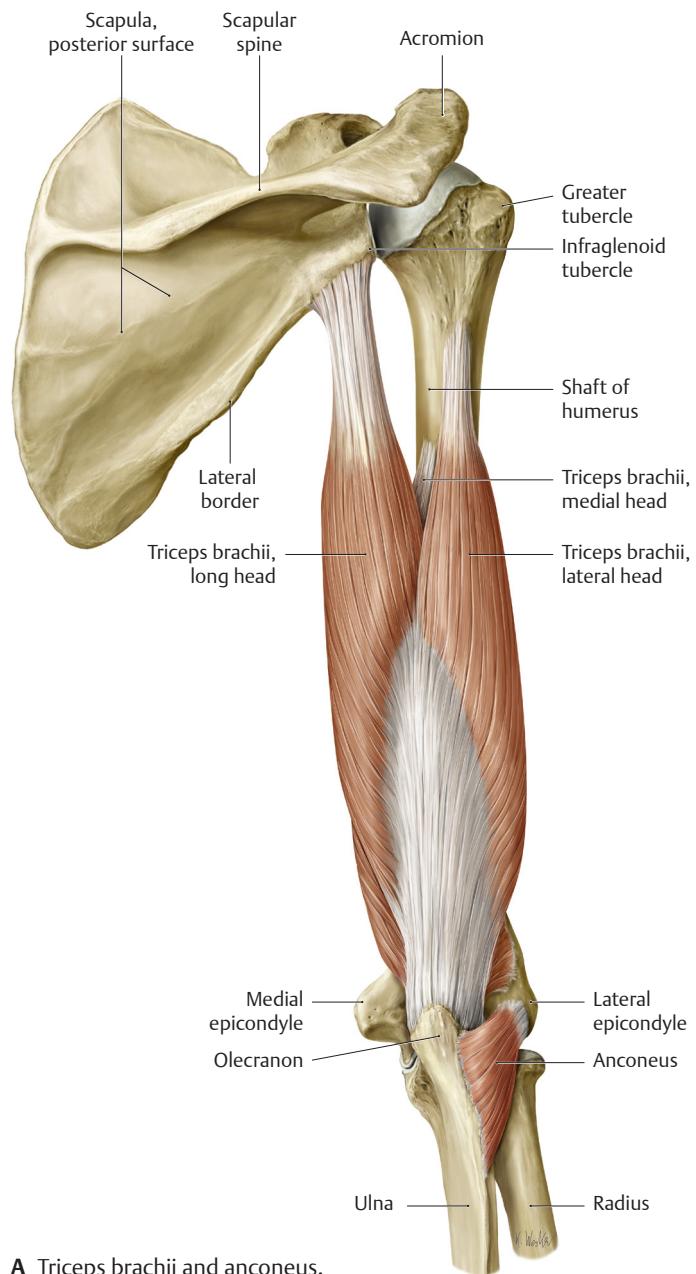
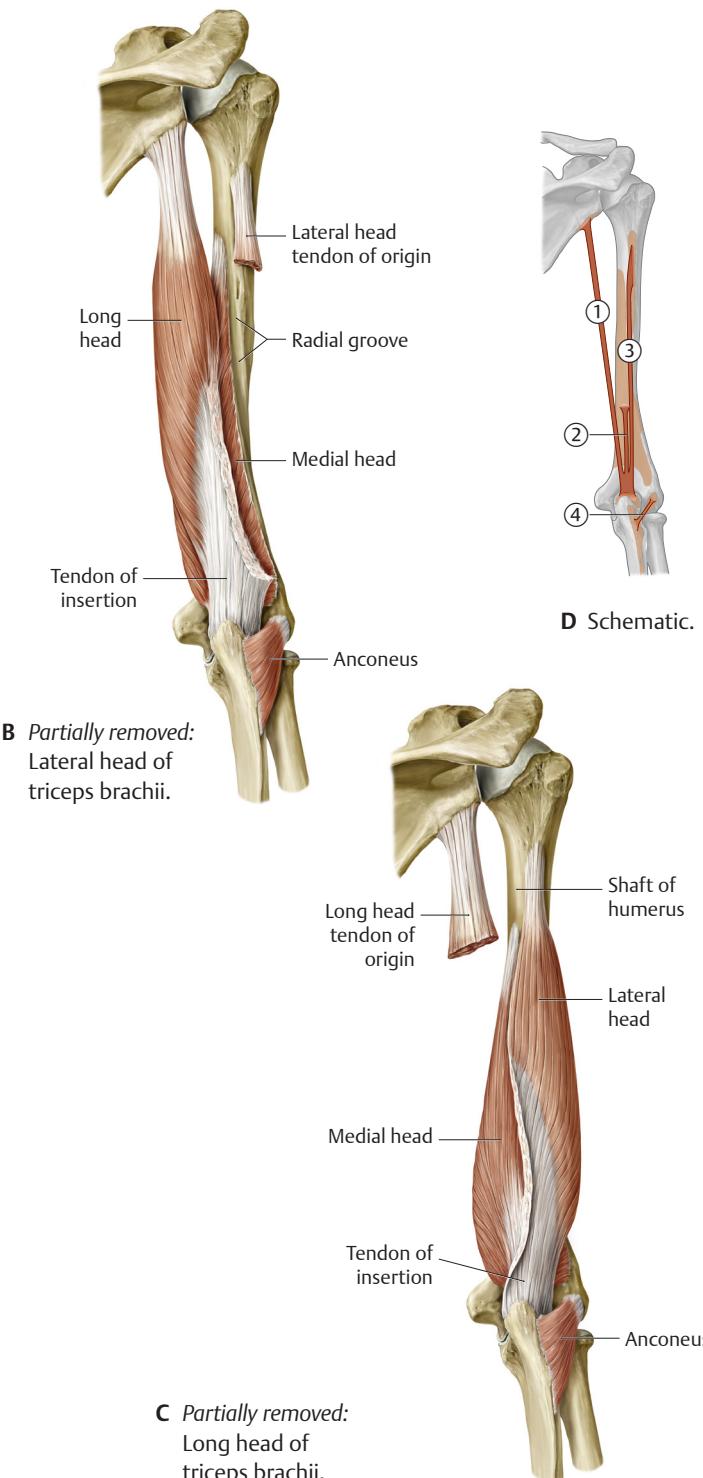
Table 2.7 Anterior muscles: Biceps brachii and brachialis

Muscle	Origin	Insertion	Innervation	Action
Biceps brachii	① Long head	Supraglenoid tubercle of scapula	Radial tuberosity and bicipital aponeurosis	Elbow joint: flexion; supination* Shoulder joint: flexion; stabilization of humeral head during deltoid contraction; abduction and internal rotation of the humerus
	② Short head	Coracoid process of scapula		
③ Brachialis	Humerus (distal half of anterior surface)	Ulnar tuberosity	Musculocutaneous n. (C5–C6) and radial n. (C7, minor)	Flexion at the elbow joint

* Note: When the elbow is flexed, the biceps brachii acts as a powerful supinator because the lever arm is almost perpendicular to the axis of pronation/supination.

Fig. 2.32 Triceps brachii and anconeus

Right arm, posterior view.

**A** Triceps brachii and anconeus.**B** Partially removed:
Lateral head of
triceps brachii.**C** Partially removed:
Long head of
triceps brachii.**Table 2.8 Posterior muscles: Triceps brachii and anconeus**

Muscle	Origin		Insertion	Innervation	Action
Triceps brachii	① Long head	Scapula (infraglenoid tubercle)	Olecranon of ulna	Radial n. (C6–C8)	Elbow joint: extension Shoulder joint, long head: extension and adduction
	② Medial head	Posterior humerus, distal to radial groove; medial intermuscular septum			
	③ Lateral head	Posterior humerus, proximal to radial groove; lateral intermuscular septum			
④ Anconeus	Lateral epicondyle of humerus (variance: posterior joint capsule)	Olecranon of ulna (radial surface)			Extends the elbow and tightens its joint