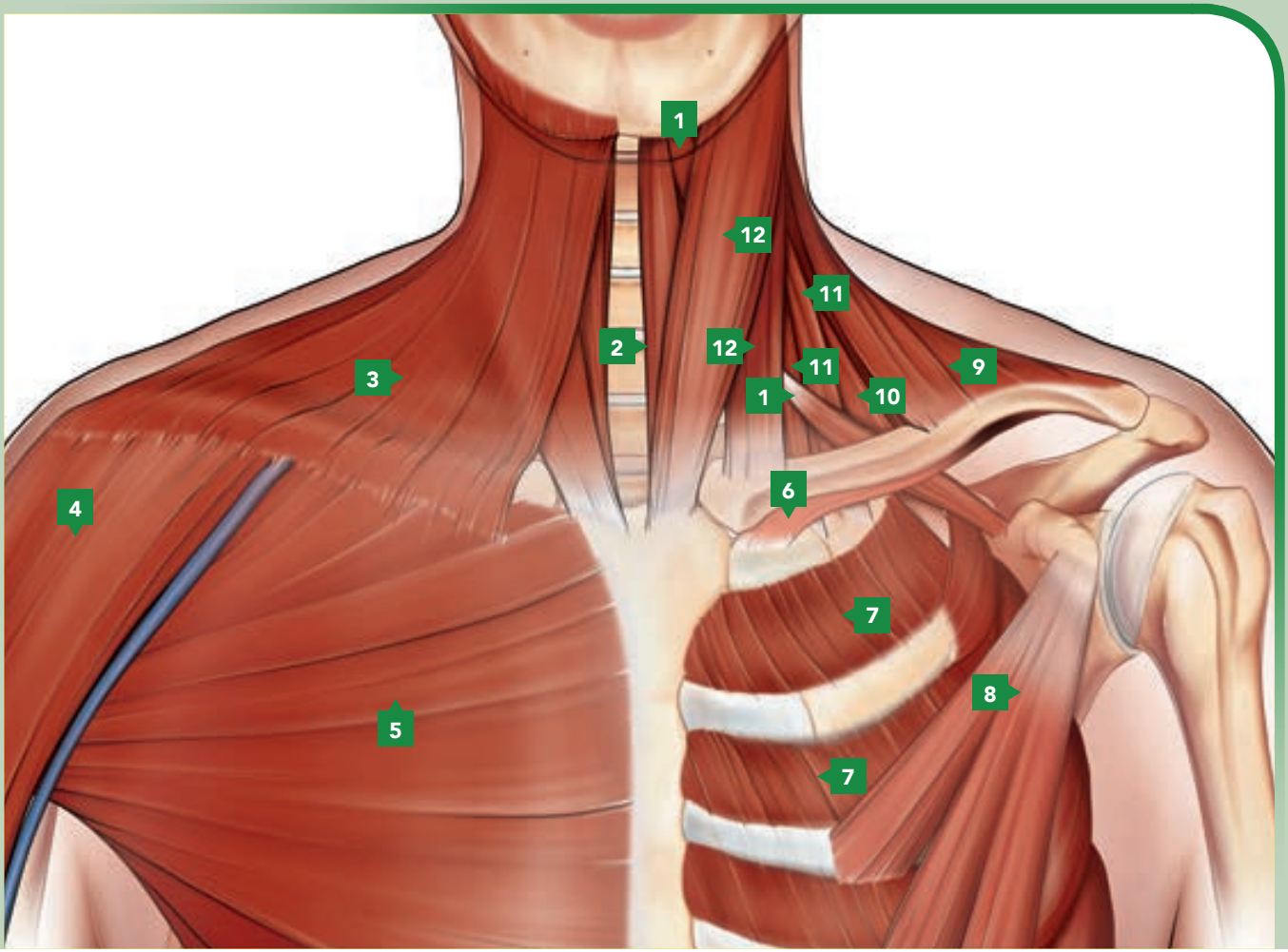
INDEX

SHOULDER APPROACHES

ELBOW APPROACHES

SURGICAL ANATOMY OF THE SHOULDER

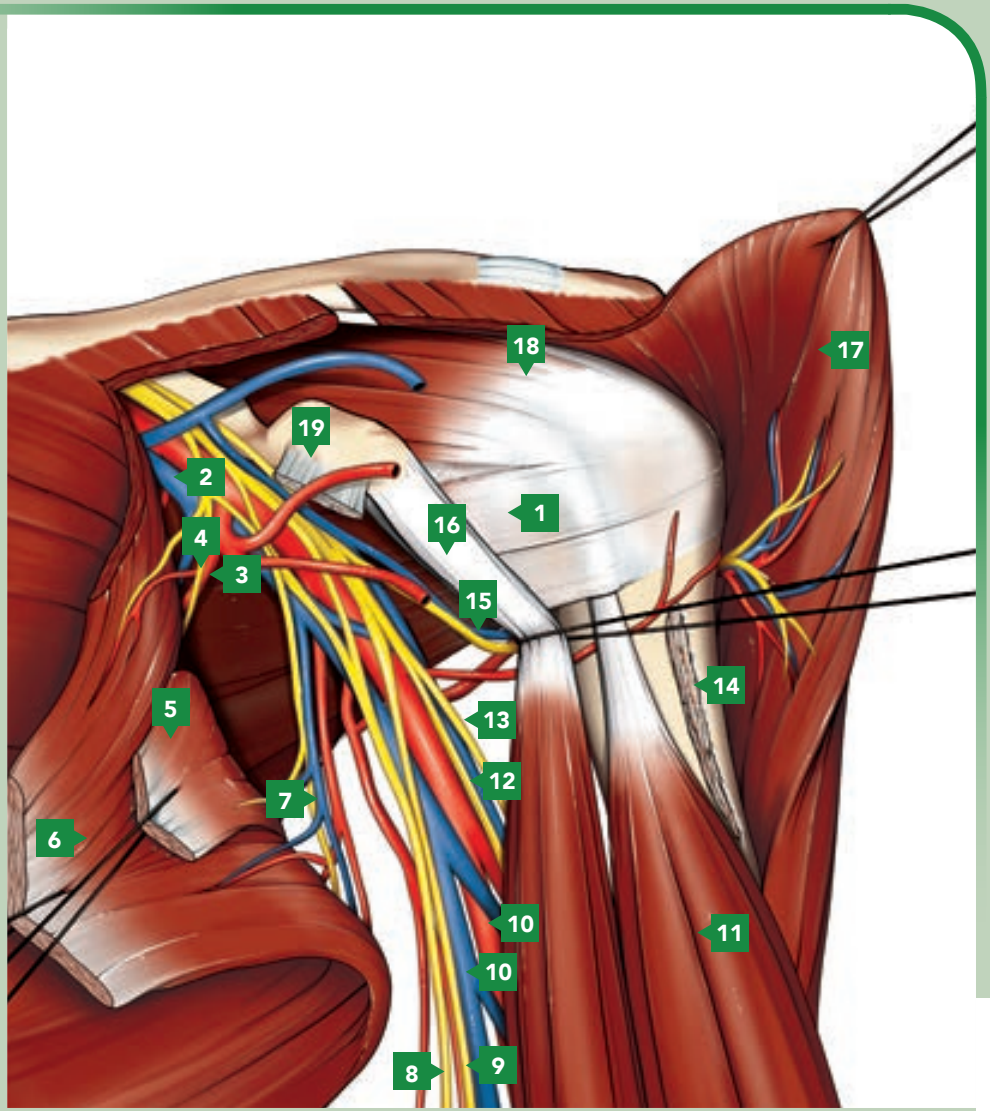
A comprehensive understanding of surgical anatomy, which encompasses a synthesis of descriptive and topographical anatomy, is paramount for performing surgical procedures with adequate safety and effective control of surgical gestures. Mastery of surgical anatomy serves as the indispensable foundation for all specialist branches within the field.
The integration of advanced surgical technologies, such as robotics and artificial intelligence, necessitates a robust foundation in anatomical knowledge.
The shoulder, the focal point of this study, is a highly intricate skeletal region from an anatomical perspective, exhibiting intricate and close relationships with other vital anatomical structures, including vascular, neurological, and visceral components.
The initial chapter is devoted to the precise iconographic delineation of the surgical anatomy of the shoulder, which serves as the primary facilitator of comprehension for the subsequent chapters, which address the numerous surgical access routes that can be employed.



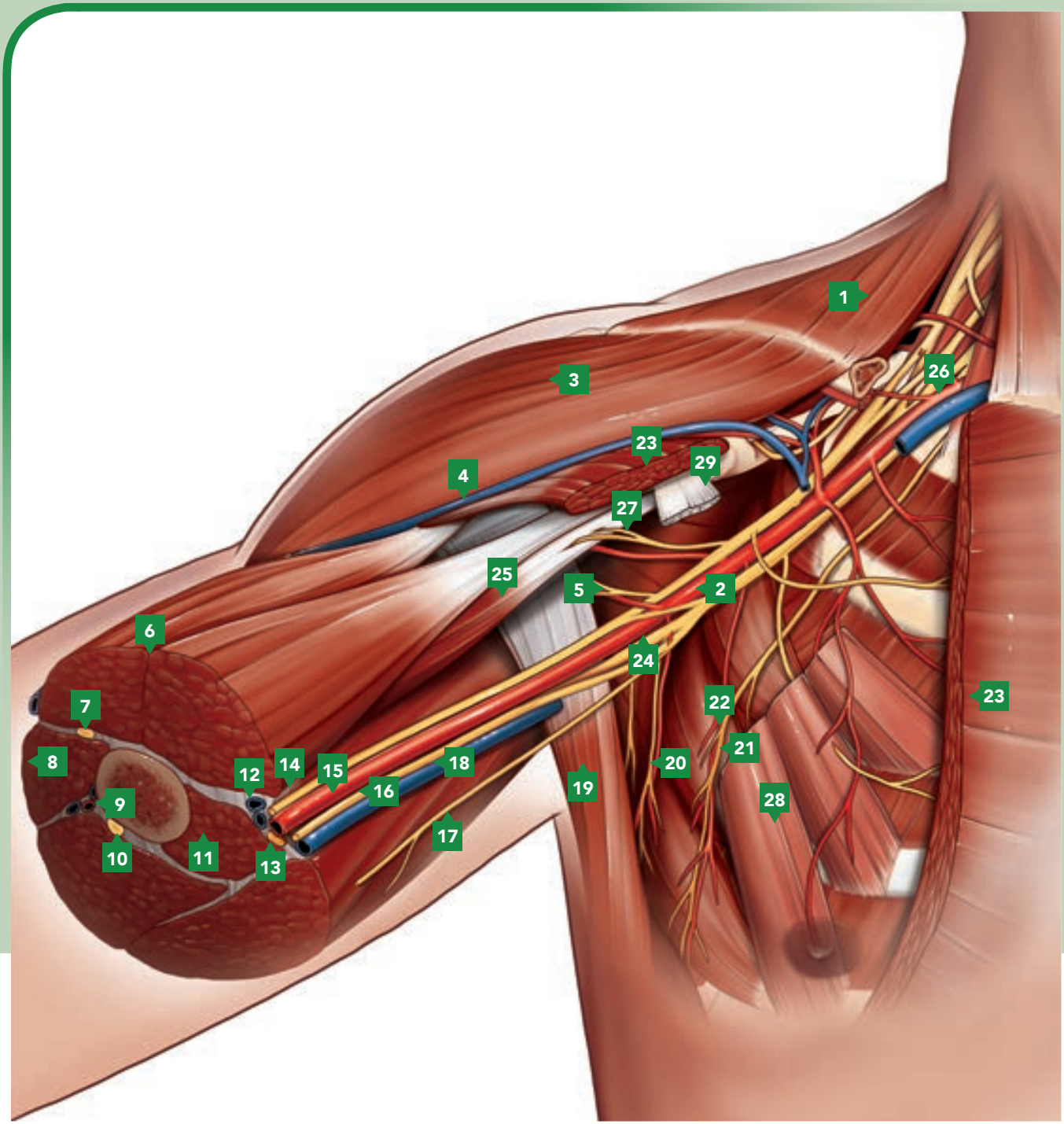
• Anatomical overview in anterior view, with specific reference to the muscular planes: the superficial muscular plane is located on the right, and the deep muscular plane is located on the left

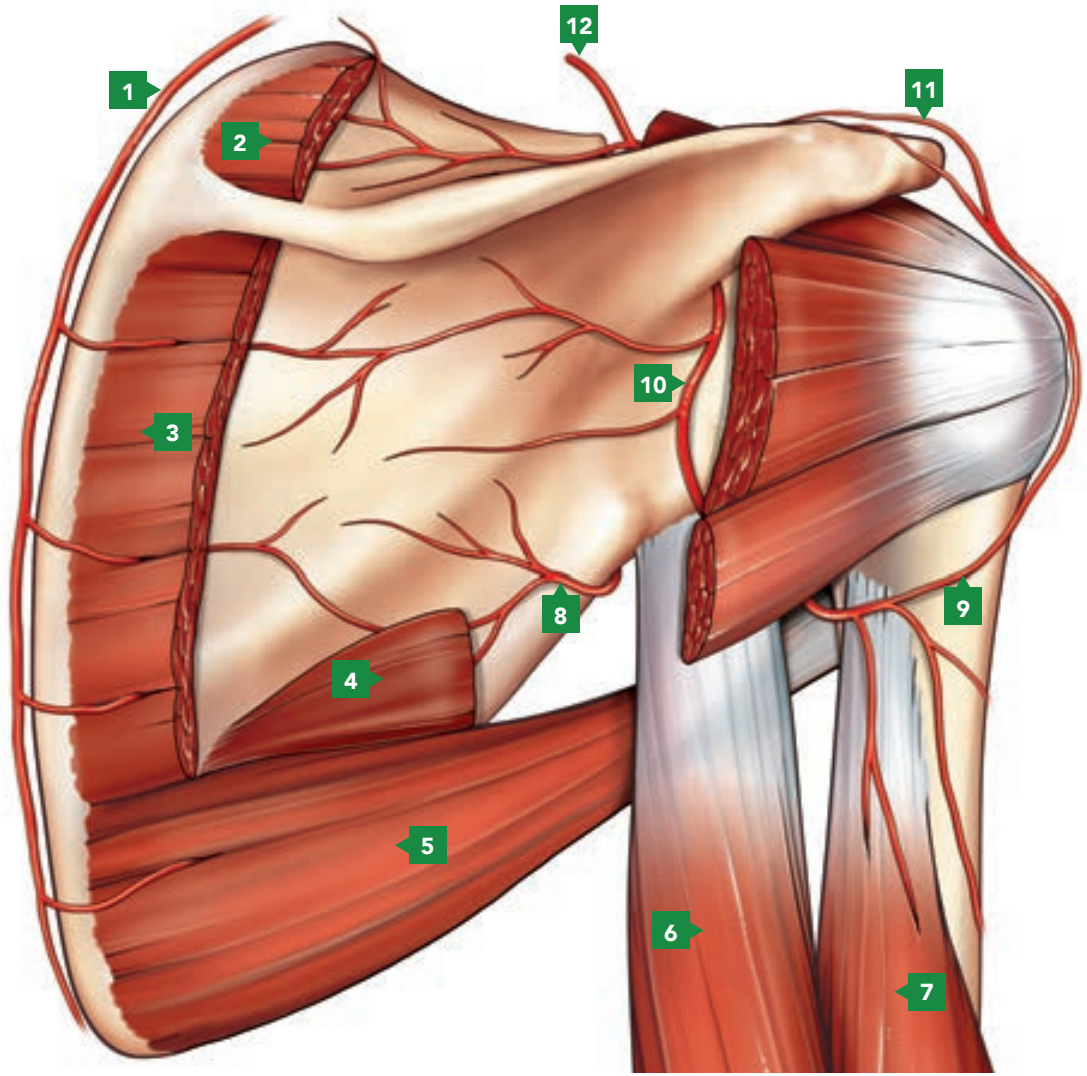
1 Omohyoid muscle
2 Sternohyoid muscle
3 Platysma muscle
4 Deltoid muscle
5 Pectoralis major muscle
6 Subclavius muscle
7 Intercostal muscles
8 Pectoralis minor muscle
9 Trapezius muscle
10 Levator scapulae muscle
11 Scalene muscles
12 Sternocleidomastoid muscle

1. Subscapularis tendon
2. Axillary artery and vein
3. Lateral thoracic artery
4. Long thoracic nerve
5. Pectoralis minor muscle
6. Pectoralis major muscle
7. Thoracodorsal neurovascular bundle
8. Ulnar nerve
9. Median nerve
10. Brachial arteries and veins
11. Long head of the biceps
12. Radial nerve
13. Musculocutaneous nerve
14. Humeral insertion of pectoralis major muscle
15. Humeral circumflex nerve
16. Conjunct tendon
17. Deltoid muscle
18. Supraspinatus tendon
19. Insertion of pectoralis minor muscle



● Anterior overview of the deep anatomical plane of the shoulder, with particular attention paid to the neurovascular bundle complex, which comprises the axillary-brachial subclavian vessels and the brachial nerve plexus

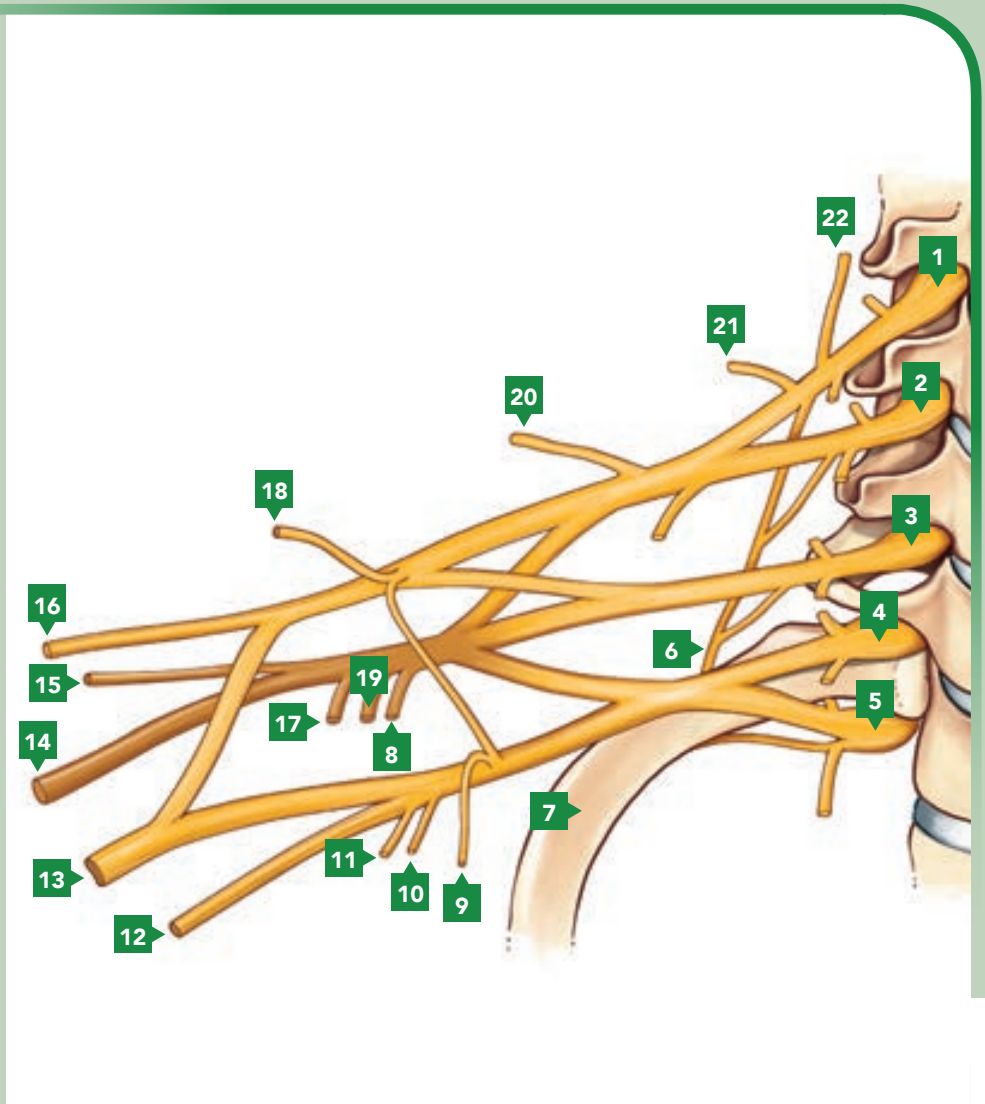

1
3
26
23
29
4
27
25
5
2
6
24
23
7
22
8
21
12
14
15
18
20
16
19
28
9
17
10
11
13



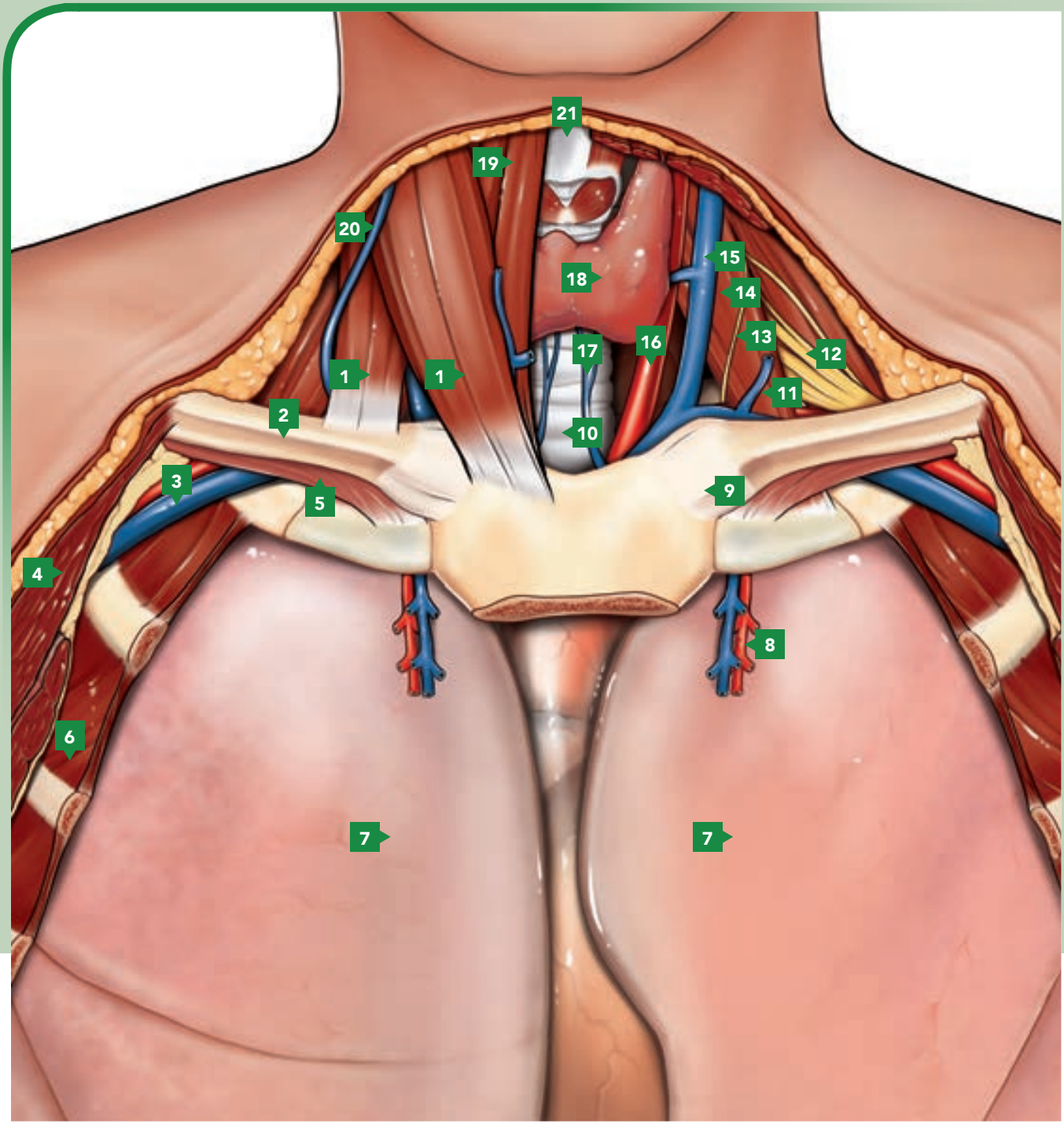
- Distribution of posterior arterial vessels

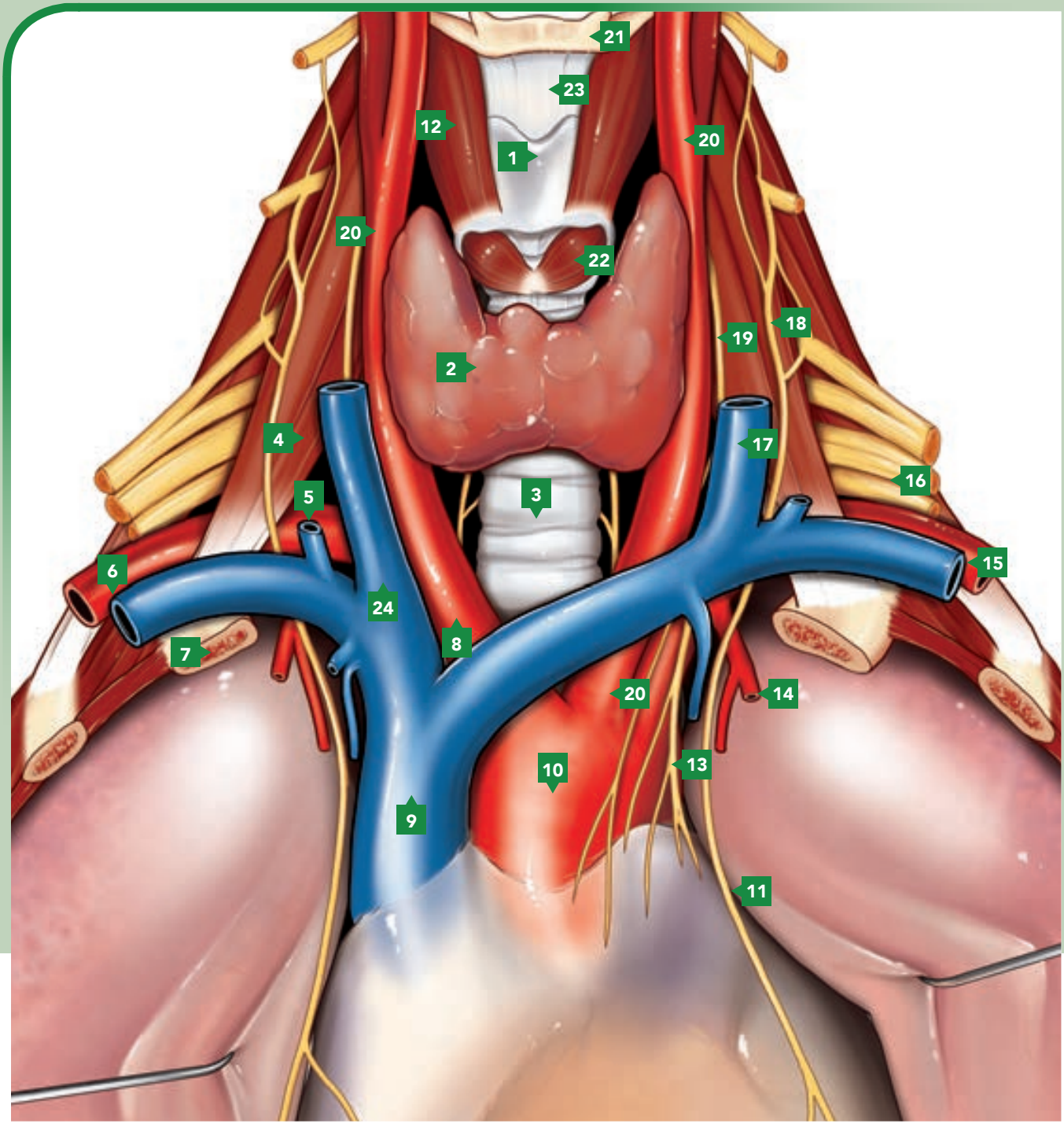
1 Dorsal artery of the scapula
2 Supraspinatus muscle
3 Infraspinatus muscle
4 Teres minor muscle
5 Teres major muscle
6 Long head of the triceps
7 Lateral head of the triceps
8 Circumflex artery of the scapula
9 Posterior circumflex artery
10 Infraspinatus branch of the suprascapular artery
11 Acromial branch of the thoracoacromial artery
12 Suprascapular artery

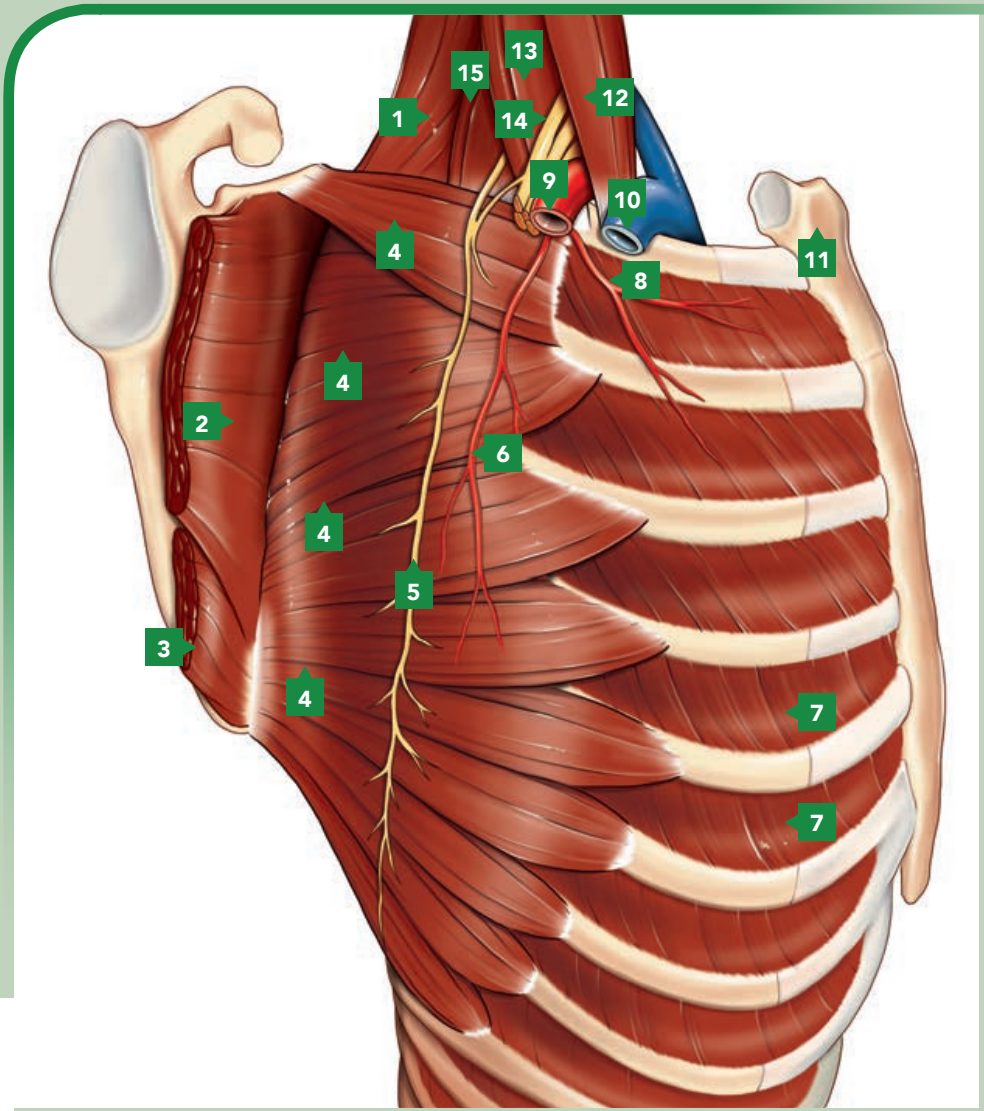
1 C5
2 C6
3 C7
4 C8
5 T1
6 Long thoracic nerve
7 First rib
8 Upper subscapular nerve
9 Medial pectoral nerve
10 Medial cutaneous nerve of the arm
11 Medial cutaneous nerve of the forearm
12 Ulnar nerve
13 Median nerve
14 Radial nerve
15 Circumflex axillary nerve
16 Musculocutaneous nerve
17 Inferior subscapular nerve
18 Lateral pectoral nerve
19 Thoradocorsal (or middle subscapular) nerve
20 Suprascapular nerve
21 Dorsal nerve of the scapula
22 Contribution from C4



● Brachial plexus overview


21
19
20
18
15
14
13
12
16
17
1
1
11
2
10
3
5
9
4
8
6
7
7

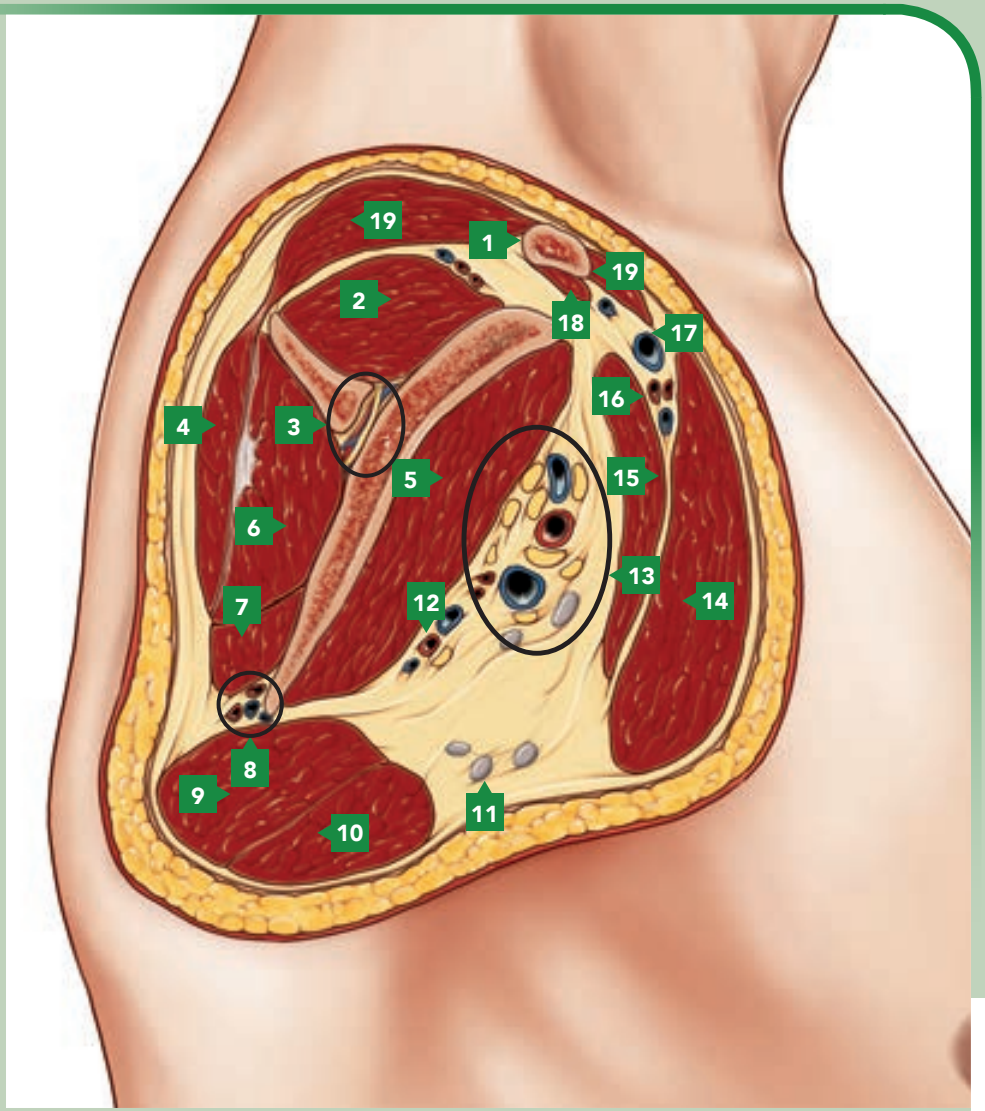

21
23
12
1
20
20
22
18
19
2
4
17
16
5
3
6
15
24
8
7
20
14
10
13
9
11



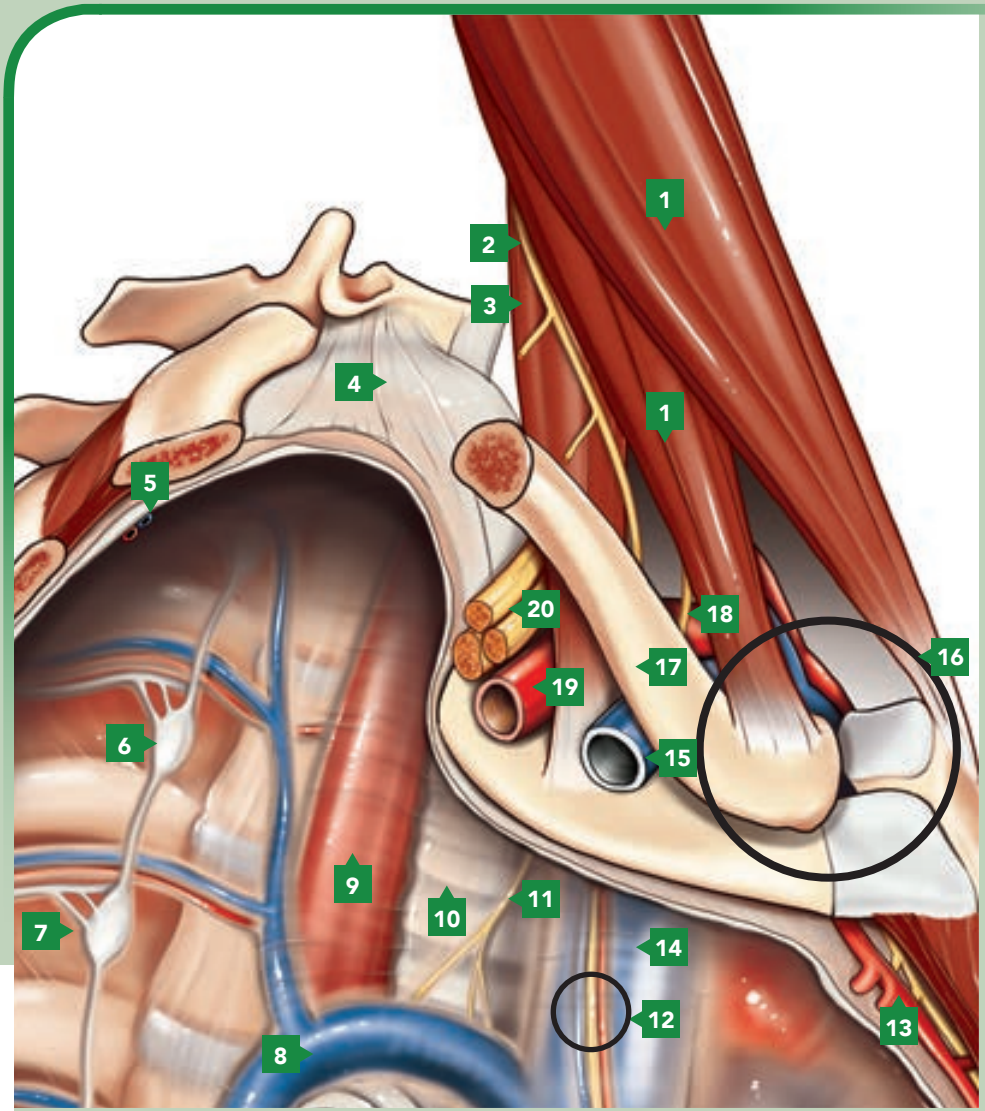
1 Levator scapulae muscle
2 Subscapularis muscle
3 Teres major muscle
4 Servatus anterior muscle
5 Bell's long thoracic nerve
6 Lateral thoracic artery
7 External intercostal muscles
8 Anterior thoracic artery
9 Subclavian artery
10 Subclavian vein
11 Sternal manubrium
12 Anterior scalene muscle
13 Middle scalene muscle
14 Brachial plexus
15 Posterior scalene muscle

● Anterolateral anatomical view highlighting the serratus anterior muscle, essential for stability of the scapula, and the long thoracic nerve of Bell, which innervates it

1 Clavicle
2 Supraspinatus muscle
3 Suprascapular neurovascular bundle
4 Spinal portion of the deltoid muscle
5 Subscapularis muscle
6 Infraspinatus muscle
7 Teres minor muscle
8 Circumflex scapular vessels
9 Teres major muscle
10 Latissimus dorsi muscle
11 Lymph nodes
12 Subscapular nerves and vessels
13 Axillary neurovascular bundle
14 Pectoralis major muscle
15 Pectoralis minor muscle
16 Thoracoacromial artery
17 Cephalic vein
18 Subclavius muscle
19 Deltoid muscle

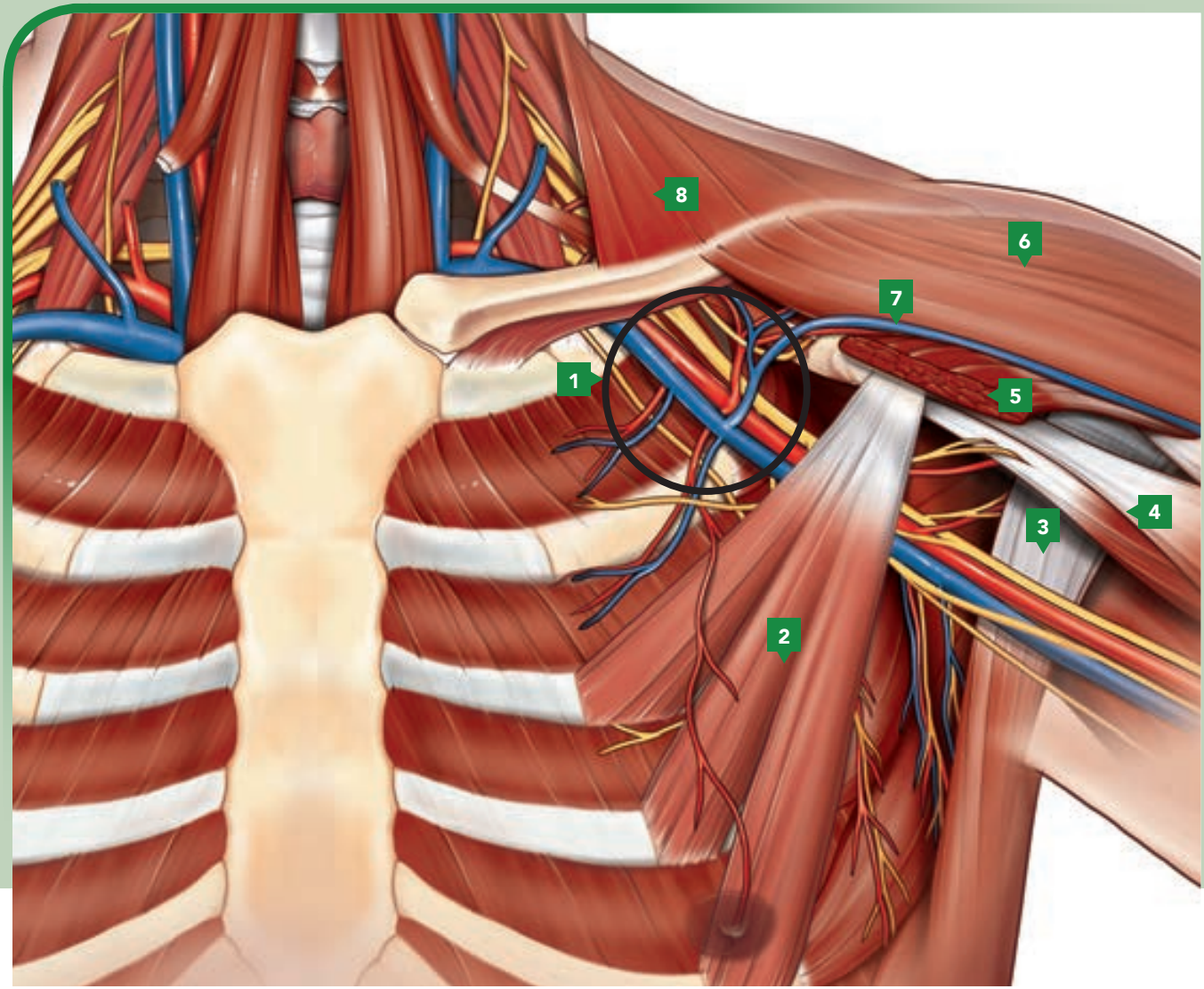


● Anatomical overview through a sagittal section through the axillary cavity, just medial to the glenoid cavity



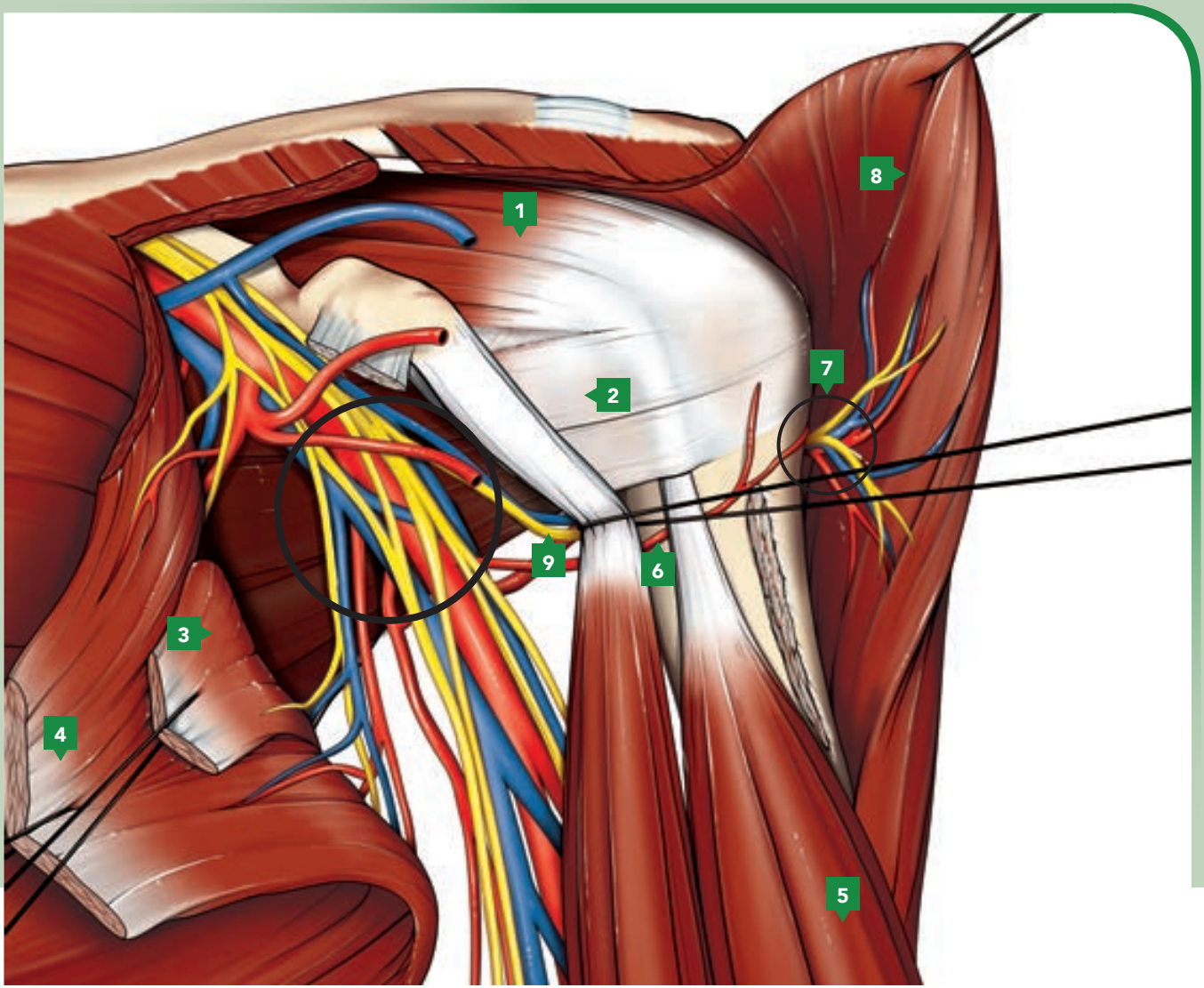
1 Sternocleidomastoid muscle
2 Phrenic nerve
3 Anterior scalene muscle
4 Pleural cupula
5 Supreme intercostal vein
6 Sympathetic nerve trunk
7 Intercostal muscle
8 Azygos vein
9 Oesophagus
10 Trachea
11 Right vagus nerve
12 Phrenic nerve and pericardial vessels
13 Right internal thoracic (or mammary) artery
14 Superior vena cava
15 Right subclavian vein
16 Posteriorly dislocated sternoclavicular joint
17 Clavicle
18 Vagus nerve
19 Right subclavian artery
20 Brachial plexus

● Anatomical view according to a mid-clavicle sagittal cut in the case of posterior dislocation of the clavicle in relation to the sternal manubrium. Evident relationship between clavicle and first rib with the neurovascular bundle running between them



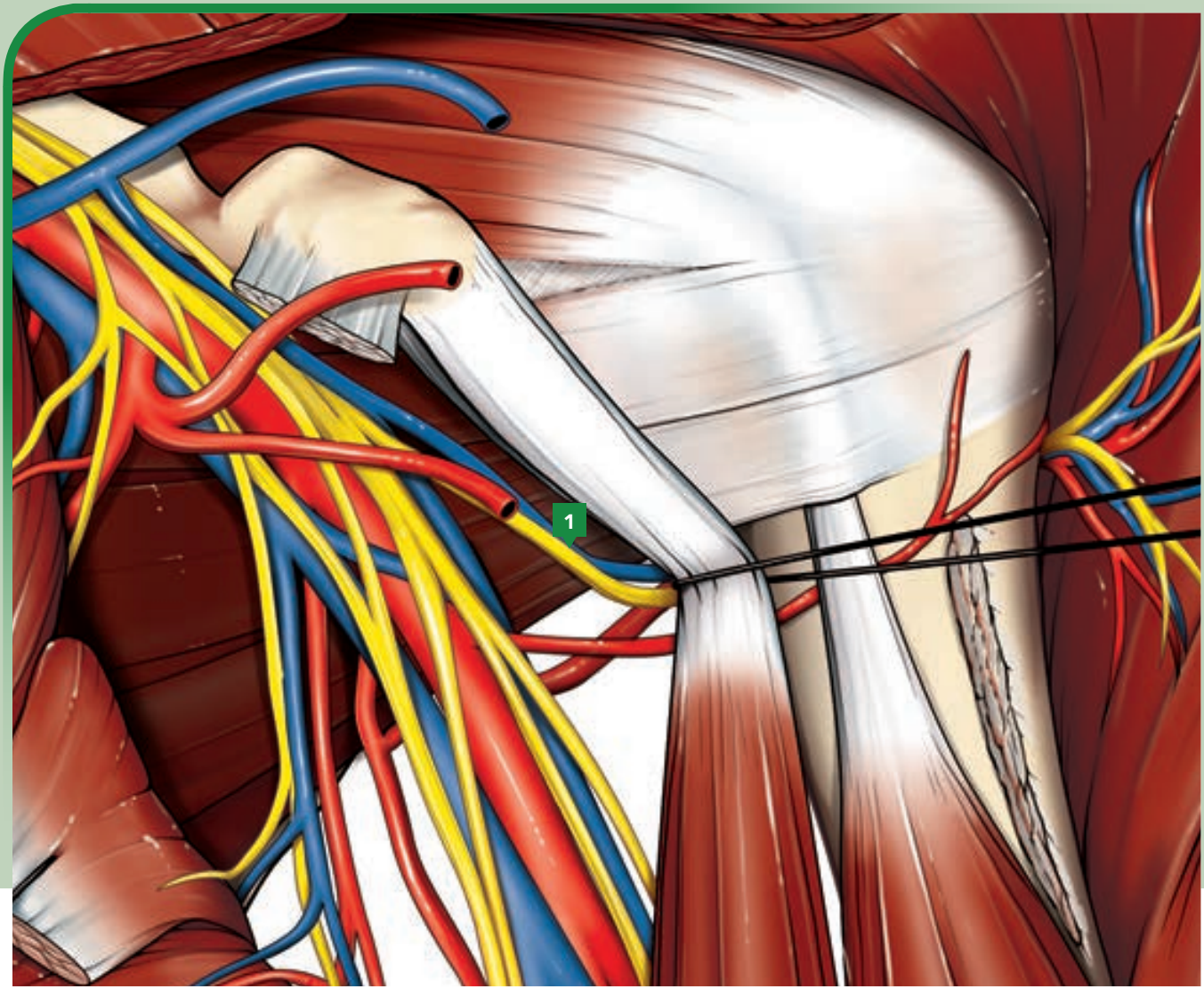
● Anterior anatomical structure subsequent to the detachment of the pectoralis major muscle

1. Axillary vascular-nervous bundle
2. Pectoralis minor muscle
3. Latissimus dorsi muscle
4. Short head muscles of the biceps brachii and coraco-brachii
5. Pectoralis major muscle (dissected)
6. Deltoid muscle
7. Cephalic vein
8. Trapezius muscle



● Visual representation of the anterior anatomical structure subsequent to the detachment and overturning of the pectoral muscles (large and small) and the deltoid

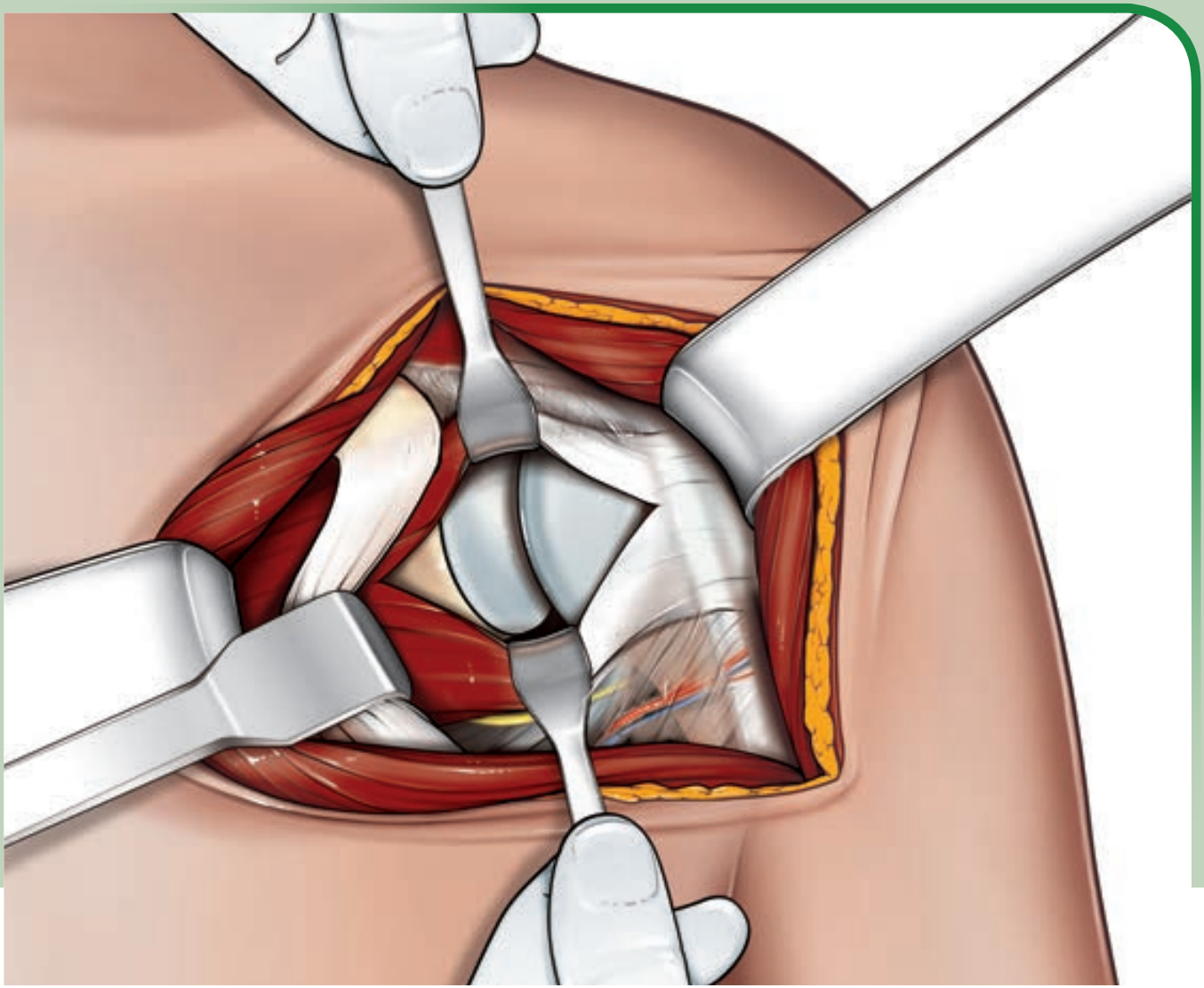
1. Supraspinatus muscle
2. Tendon of the subscapularis muscle
3. Pectoralis minor muscle
4. Pectoralis major muscle
5. Long head of biceps brachii
6. Anterior circumflex artery
7. Circumflex neurovascular bundle
8. Deltoid muscle
9. Humeral (or axillary) circumflex nerve



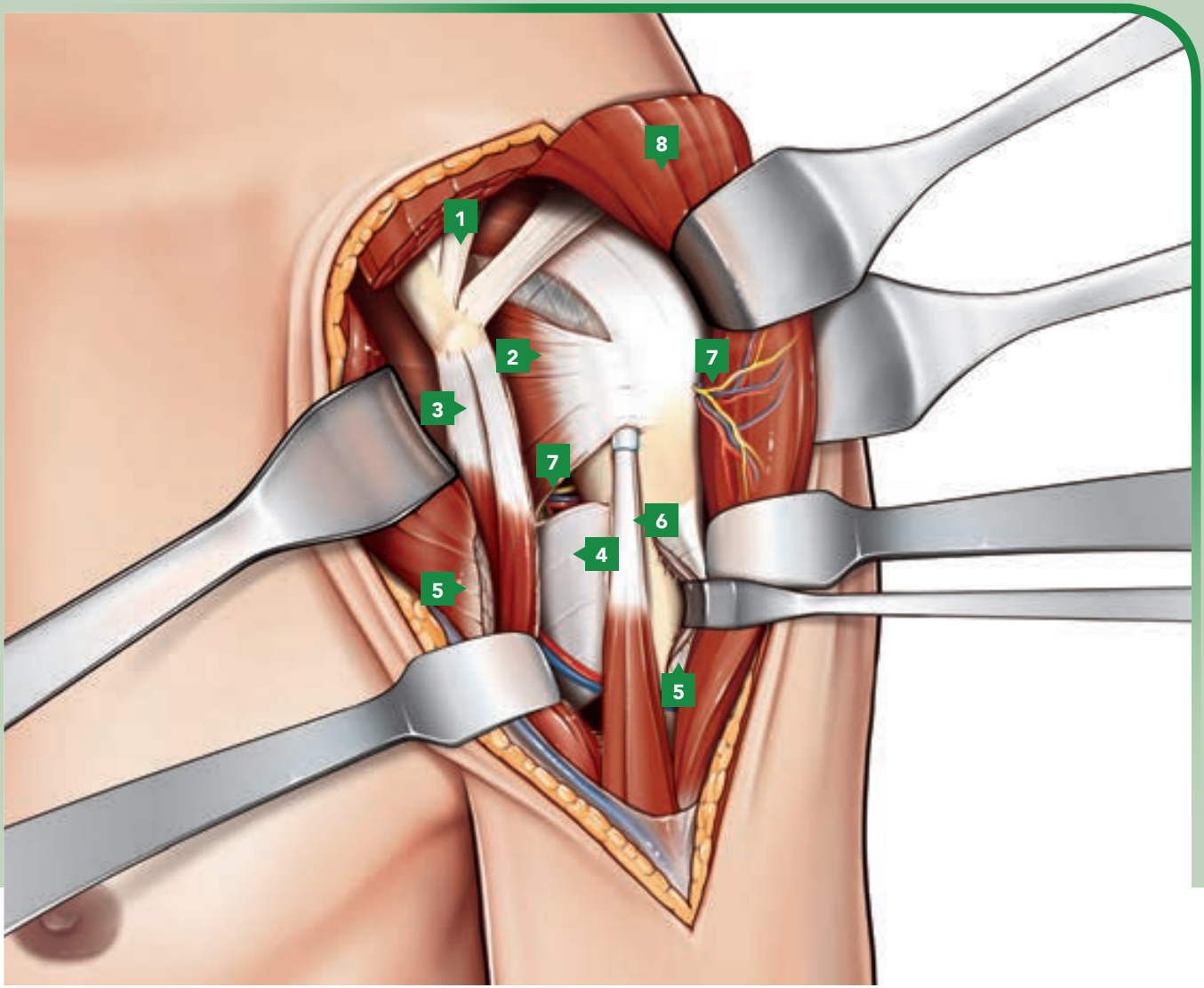
- The humeral circumflex or axillary nerve is located on the inferior surface of the subscapularis and extends posteriorly to Velpeau's quadrilateral space, in close proximity to the scapular neck and the joint capsule.

For further information, please refer to the first chapter of surgical anatomy, which provides comprehensive indications of the anatomical components present

1 Anterior view of the cours of the humeral circumflex (or axillary) nerve

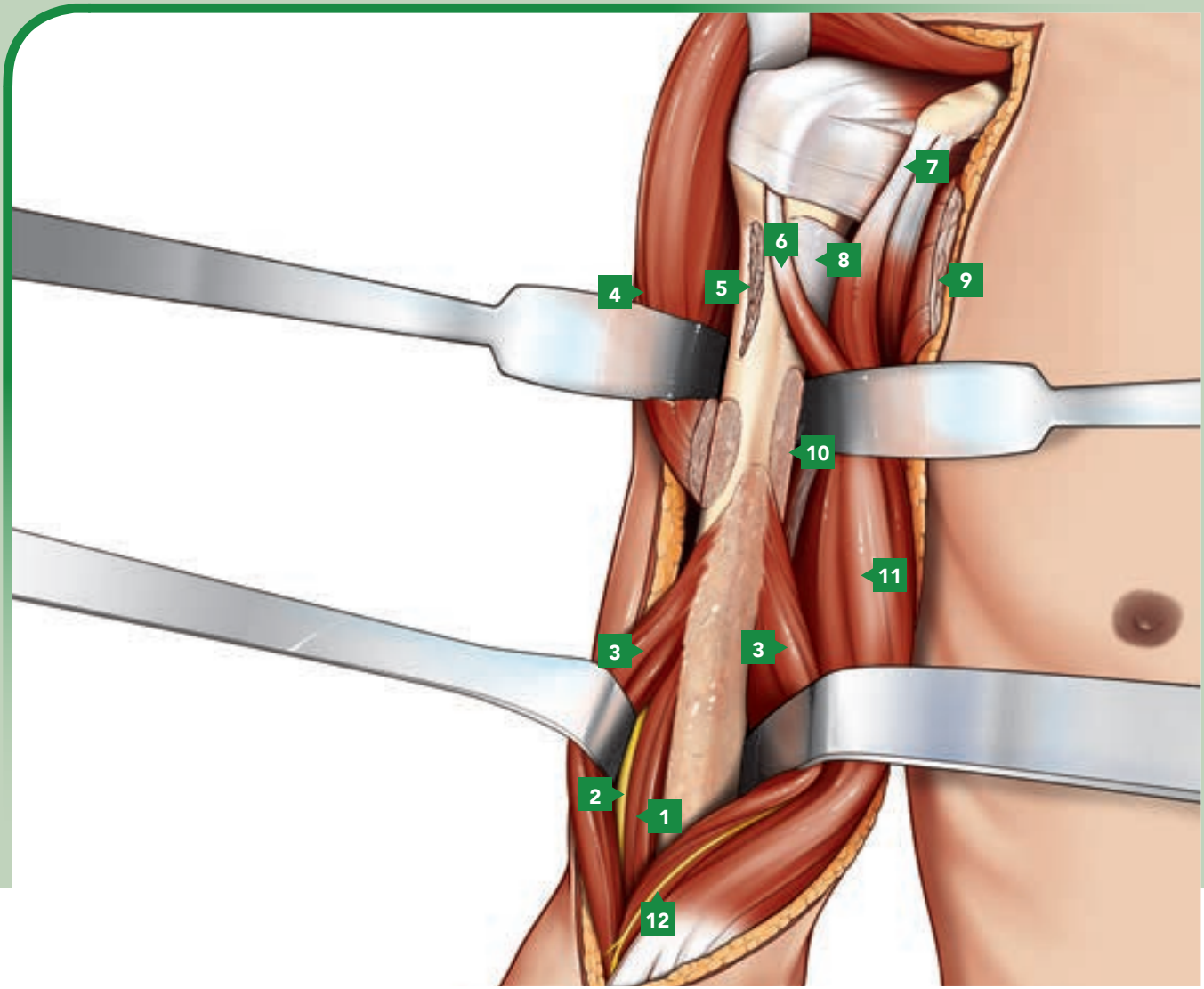


● The process of expanding the scapulohumeral exposure is achieved through the medial extension of the subscapularis dissection, in conjunction with the extrarticular rotation of the limb



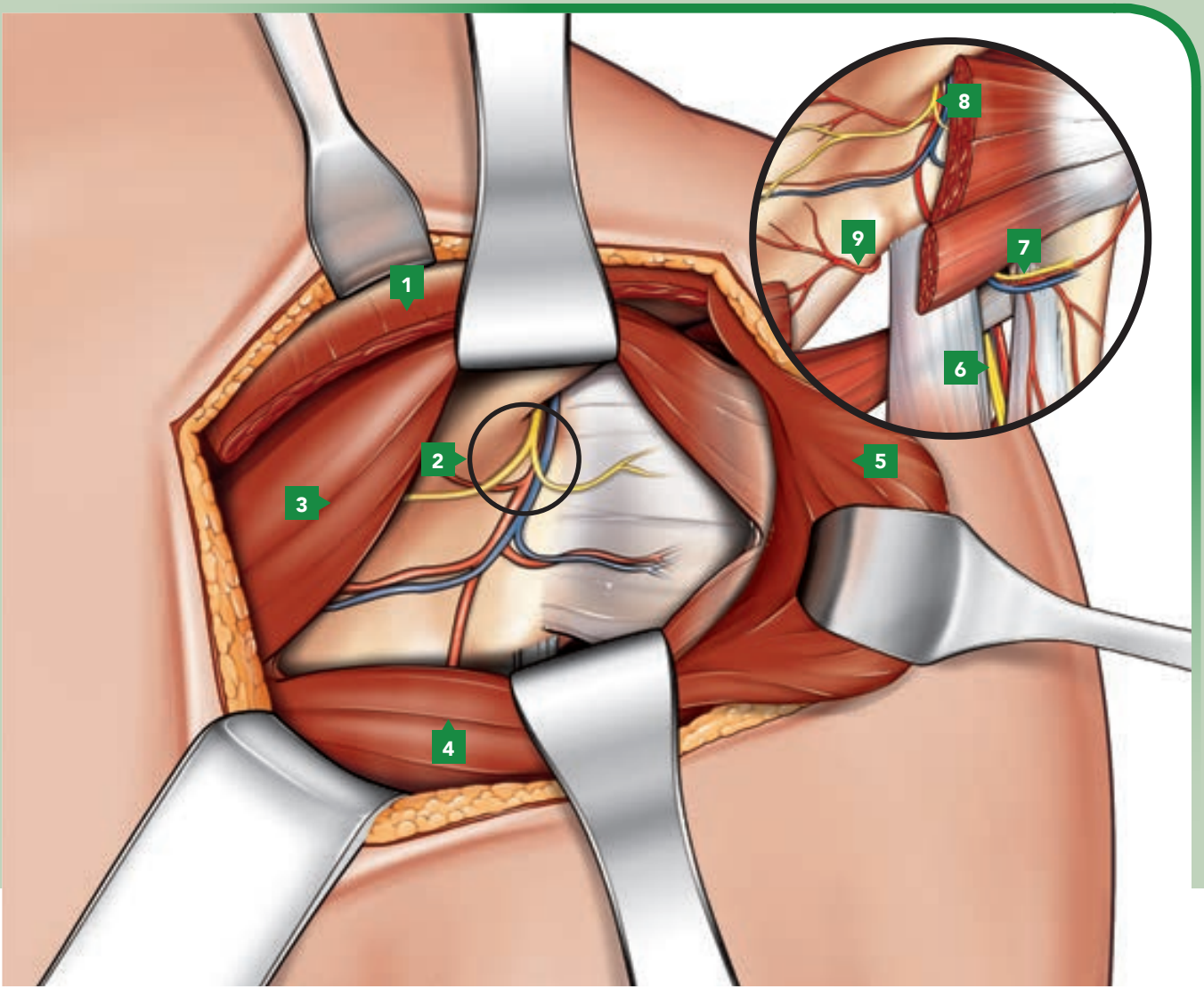
- This provides sufficient access to the proximal and tertiary thirds of the humerus

1 Coraco-acromial ligaments
2 Subscapularis muscle
3 Conjoined tendon
4 Latissimus gran dorsalis muscle
5 Pectoralis major muscle
6 Long head of the biceps
7 Circumflex nerve
8 Deltoid muscle



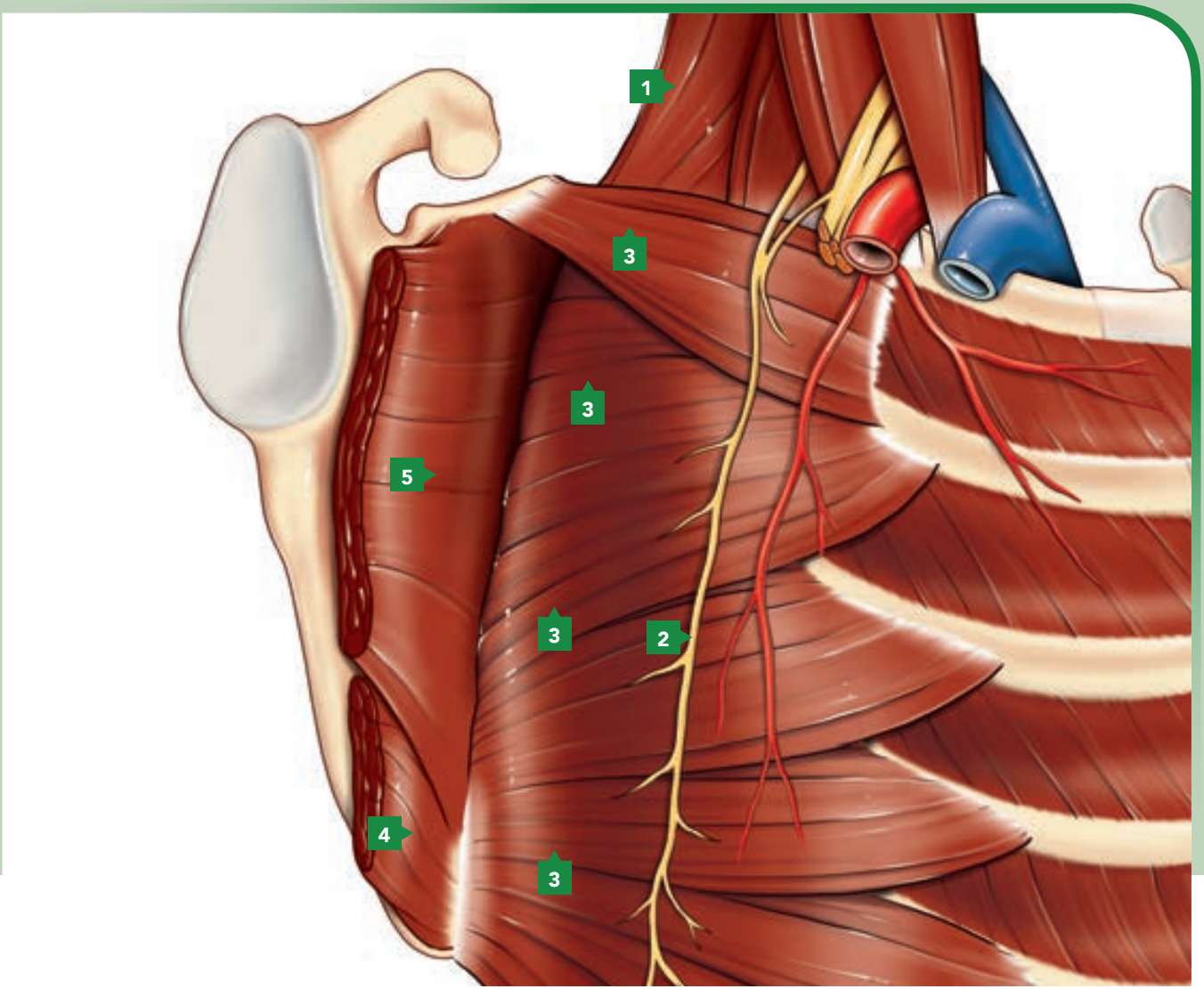
• Following the detachment of the coracobrachialis insertions and the longitudinal dissociation of the brachialis muscle, the humeral diaphysis is exposed.
It is imperative to exercise great caution in relation to the radial nerve, which traverses the field between the brachioradialis and brachialis muscles and is susceptible to injury from the action of retractors or direct trauma

1 Brachioradialis muscle
2 Radial nerve
3 Brachialis muscle
4 Deltoid muscle
5 Humeral insertion of the pectoralis major muscle
6 Long head of the biceps
7 Conjoined tendon
8 Latissimus dorsi muscle
9 Pectoralis major muscle
10 Inserts of coracobrachialis muscle
11 Biceps brachii muscle
12 Lateral cutaneous nerve of the forearm



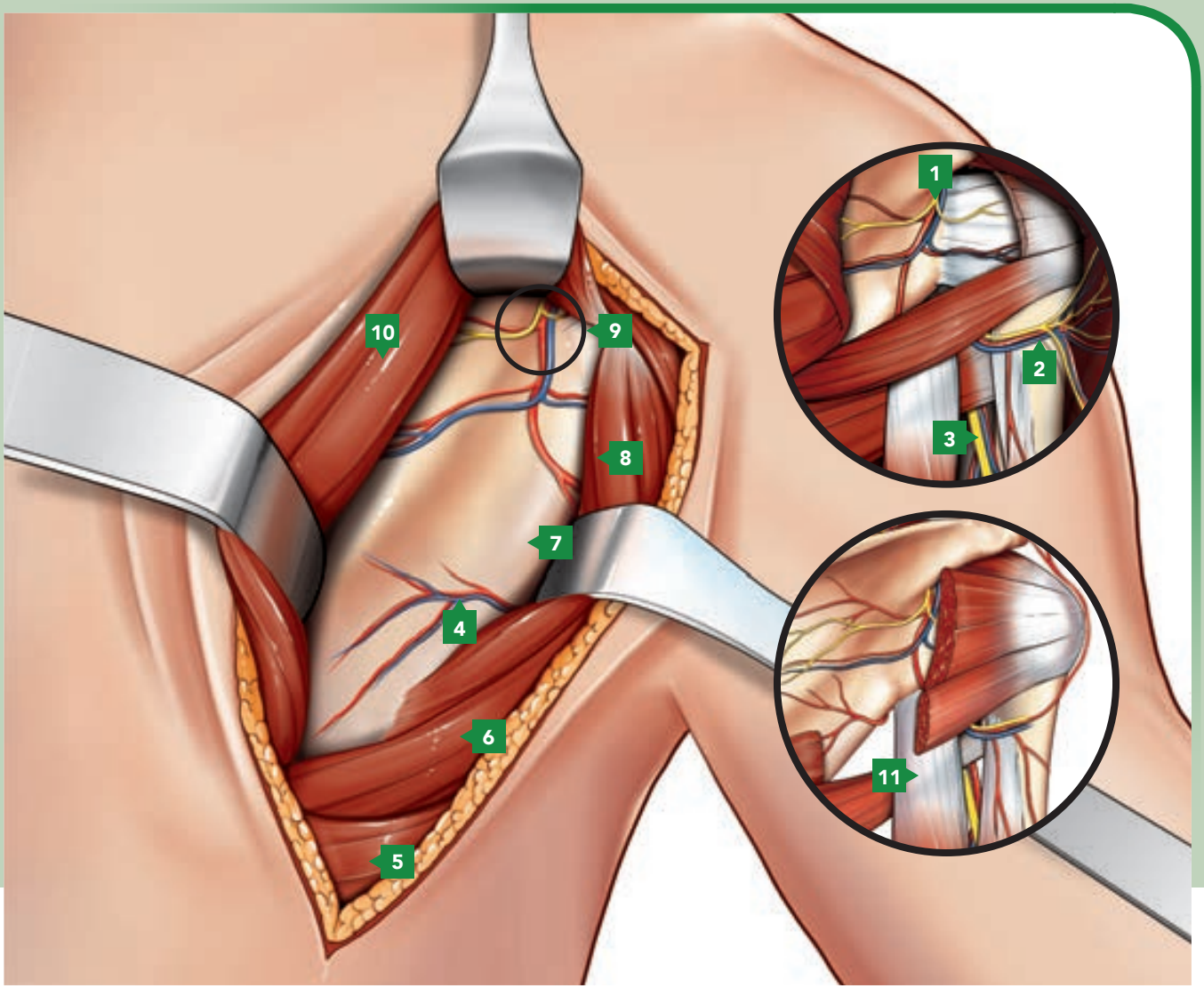
• By spreading the infraspinatus and the teres minor muscle, the scapulohumeral joint is exposed. It is imperative to exercise caution when approaching the vessels and nerves of the suprascapularis bundle. Damage to the suprascapular nerve can result in injury to the supraspinatus and infraspinatus muscles. The circumflex nerve, which runs below the teres minor, is less at risk in this approach because it is protected by it. The exposed area is richly vascularised (by the suprascapularis and circumflex of the scapula)

1 Deltoid muscle
2 Suprascapular neurovascular bundle
3 Infraspinatus muscle
4 Teres minor muscle
5 Deltoid muscle
6 Radial nerve
7 Circumflex nerve
8 Suprascapular nerve
9 Circumflex artery of the scapula



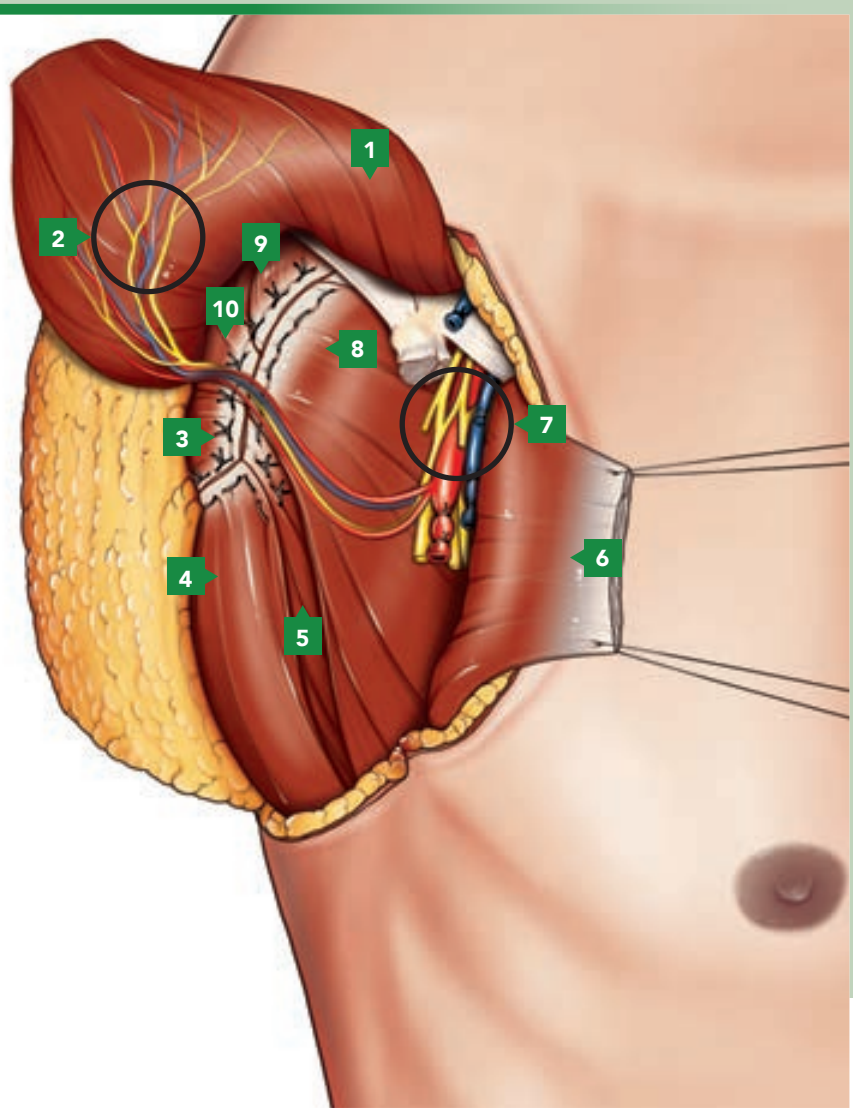
• Anatomical overview of the scapular region, along with the satellite muscles, in their anterior aspect

1 Levator scapulae muscle
2 Long thoracic nerve
3 Servatus anterior muscle
4 Teres major muscle
5 Subscapularis muscle



• By dissociating and spreading the space between the infraspinatus and the teres minor, the lateral scapular margin can be exposed up to the scapular-humeral joint. It is imperative to exercise meticulous caution with regard to the nervous structures in the area and the propensity for haemorrhaging, attributable to the abundance of vessels, with particular reference to the circumflex scapular artery

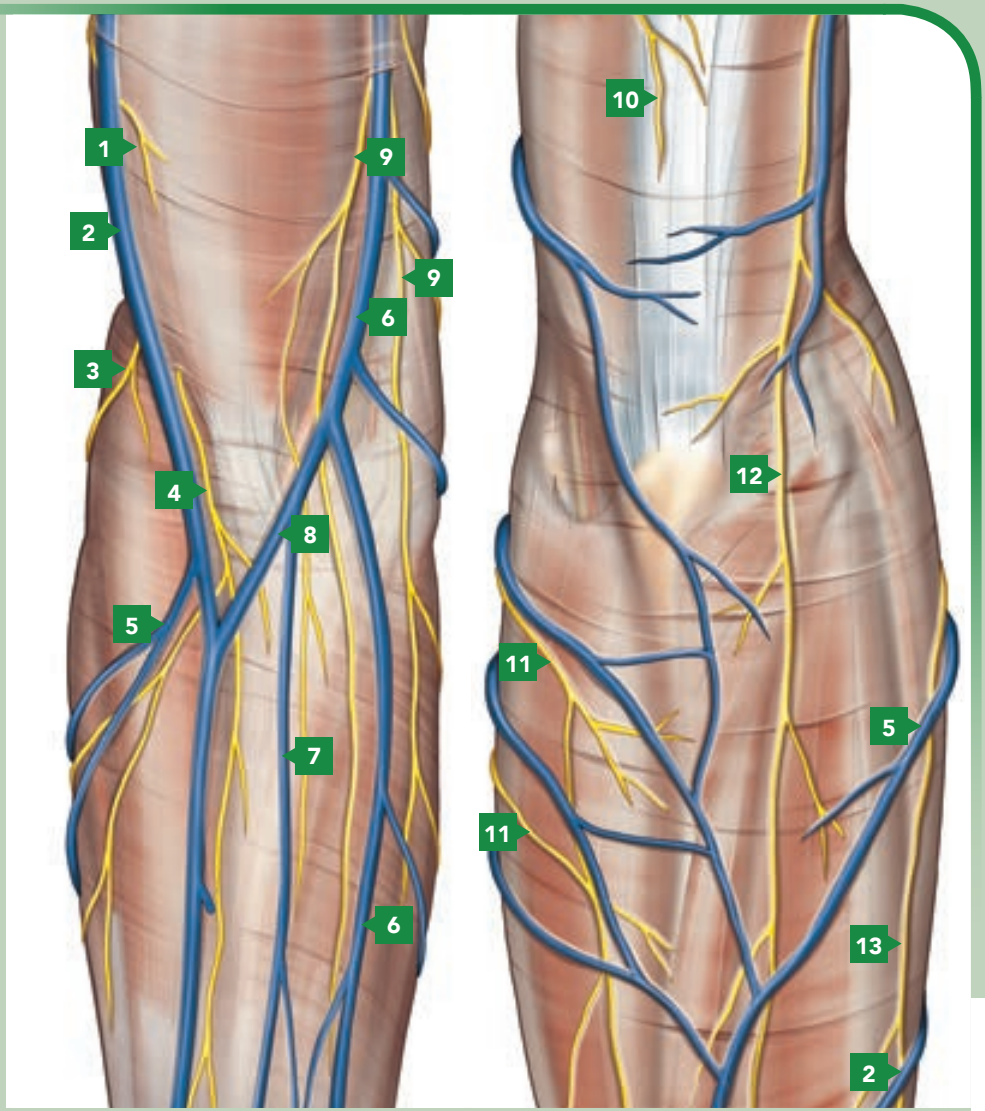
1 Suprascapular nerve
2 Circumflex nerve
3 Radial nerve
4 Circumflex vessels of the scapula
5 Latissimus dorsi muscle
6 Teres major muscle
7 Lateral border of the scapula
8 Teres minor muscle
9 Suprascapular neurovascular bundle
10 Infraspinatus muscle
11 Long head of the triceps



• Deep tissue. The muscle is arranged in two layers, and the procedure is to be performed with great accuracy by means of a strong suture of the existing muscle flaps. The subscapularis, supraspinatus, infraspinatus, teres minor, teres major and latissimus dorsi muscles are also identified and fixed in a more profound manner

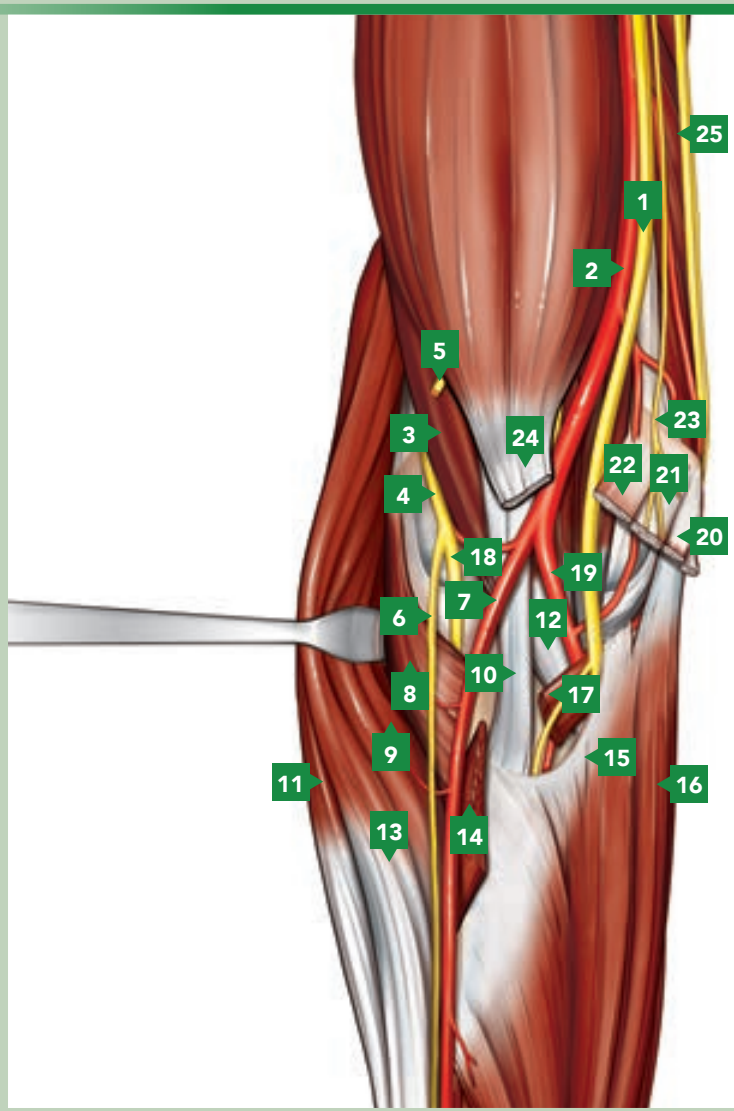
1 Deltoid muscle
2 Circumflex neurovascular bundle
3 Teres minor muscle
4 Latissimus dorsi muscle
5 Teres major muscle
6 Pectoralis major muscle
7 Axillary neurovascular bundle
8 Subscapularis muscle
9 Supraspinatus muscle
10 Infraspinatus muscle

1 Lower lateral cutaneous nerve of the arm
2 Cephalic vein
3 Posterior cutaneous nerve of the forearm (from the musculocutaneous nerve)
4 Lateral cutaneous nerve of the forearm
5 Accessory cephalic vein
6 Basic vein
7 Intermediate (or median) vein of the forearm
8 Intermediate cubital vein
9 Branches of the medial cutaneous nerve of the arm
10 Branches of the posterior cutaneous nerve of the arm (from the radial nerve)
11 Posterior branches of the medial cutaneous nerve of the forearm
12 Posterior cutaneous nerve of the forearm (from the radial nerve)
13 Posterior branch of the lateral cutaneous nerve of the forearm (from the musculocutaneous nerve)



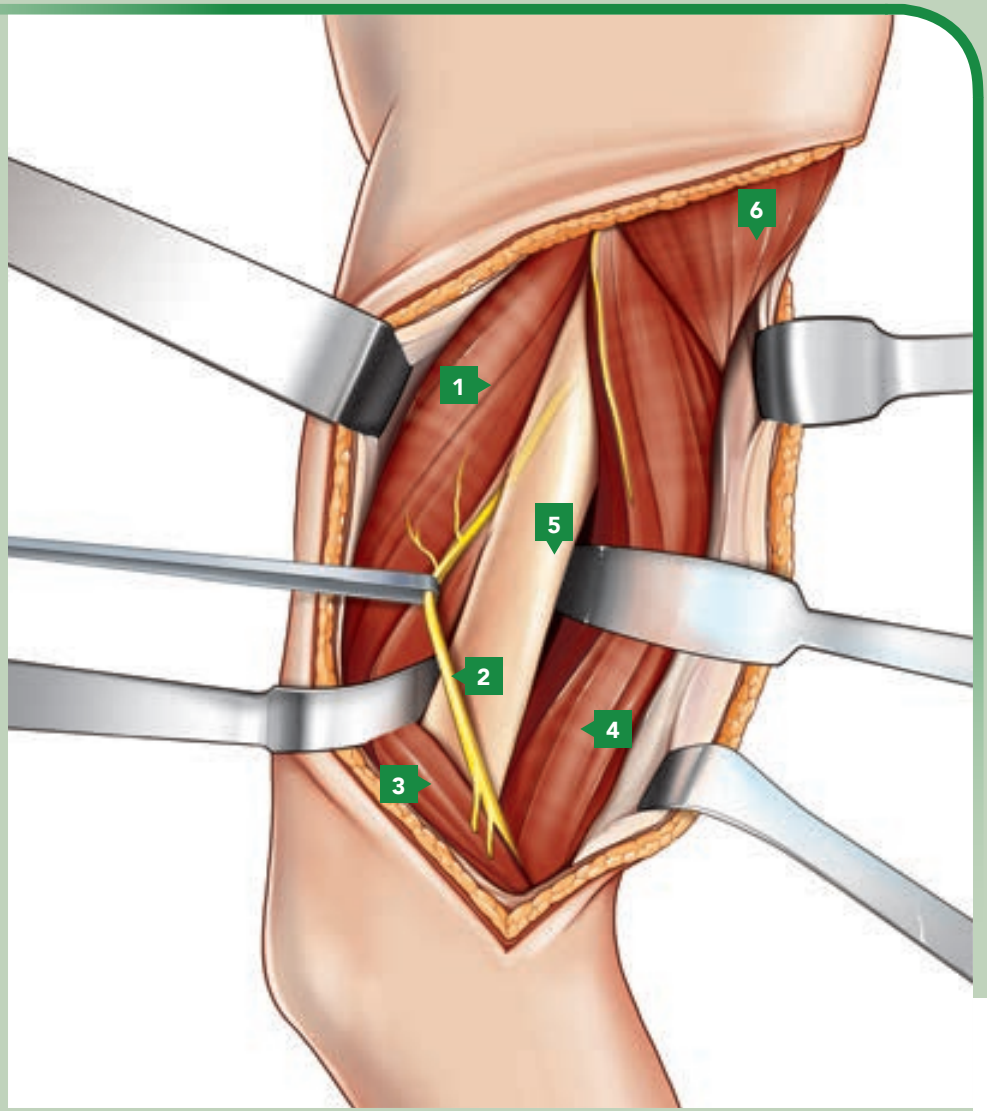
● Superficial anatomical view with highlighting of the venous course and cutaneous sensory nerves

1 Median nerve
2 Brachial artery
3 Brachialis muscle
4 Radial nerve
5 Musculocutaneous nerve
6 Superficial branch of the radial nerve
7 Radial artery
8 Supinator muscle
9 Brachioradialis muscle
10 Biceps tendon
11 Extensor digitorum muscle
12 Brachialis tendon
13 Extensor carpi radialis muscles (long and short)
14 Radial insertion of the pronator teres muscle
15 Flexor digitorum superficialis muscle
16 Flexor carpi ulnaris muscle
17 Ulnar head of the pronator teres muscle
18 Deep branch of the radial nerve
19 Ulnar artery
20 Palmaris longus muscle
21 Flexor carpi radialis muscle
22 Humeral head of the pronator teres muscle
23 Intermuscular fibrous septum
24 Lacertus fibrosus
25 Ulnar nerve

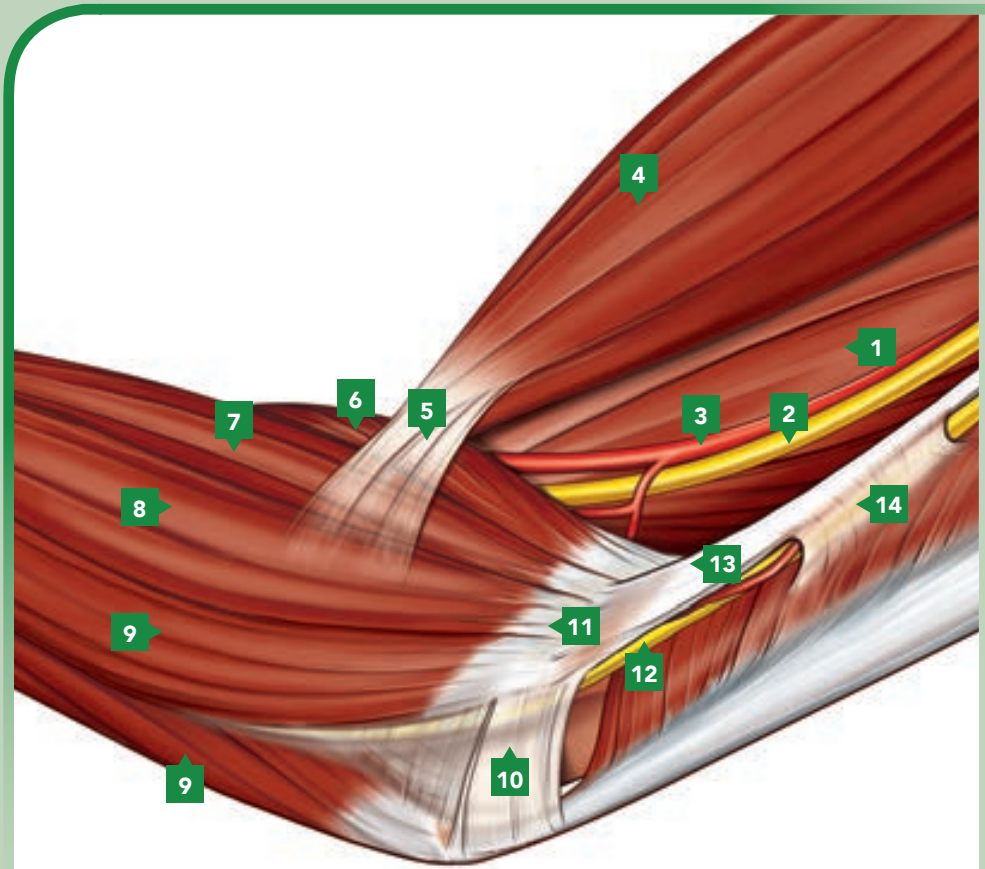


● Deep anatomical plane, after the proximal section of the pronator teres, the flexor carpi radialis and the palmaris longus. You can see the radial nerve where it divides, the brachial-ulnar-radial arterial vessels and the median nerve

1 Triceps brachii muscle
2 Radial nerve
3 Brachioradialis muscle
4 Brachialis muscle
5 Humeral shaft
6 Deltoid muscle



- The radial nerve traverses the anterior and posterior regions of the arm, following the humeral torsion groove. It courses posteriorly, passing between the brachialis (anteriorly) and the brachioradialis (posteriorly) muscles



1 Brachialis muscle
2 Median nerve
3 Brachial artery
4 Biceps muscle
5 Lacertus fibrosus
6 Humeral insertion of pronator teres muscle
7 Flexor carpi radialis muscle
8 Palmaris longus muscle
9 Flexor carpi ulnaris muscle
10 Osborne ligament
11 Common tendon insertion of flexor muscles
12 Ulnar nerve
13 Medial intermuscular fibrous septum
14 Fibrous arcade of Struthers

● Anatomical overview of the medial side. It is evident that there are anatomical relationships between the musculature and the median and ulnar nerves. The ulnar nerve is proximally enclosed by the fibrous arcade of Struthers, runs distally and passes posteriorly to the humeral epitrochlea, in the epitrochleo-olcranial groove enclosed by the Osborne ligament