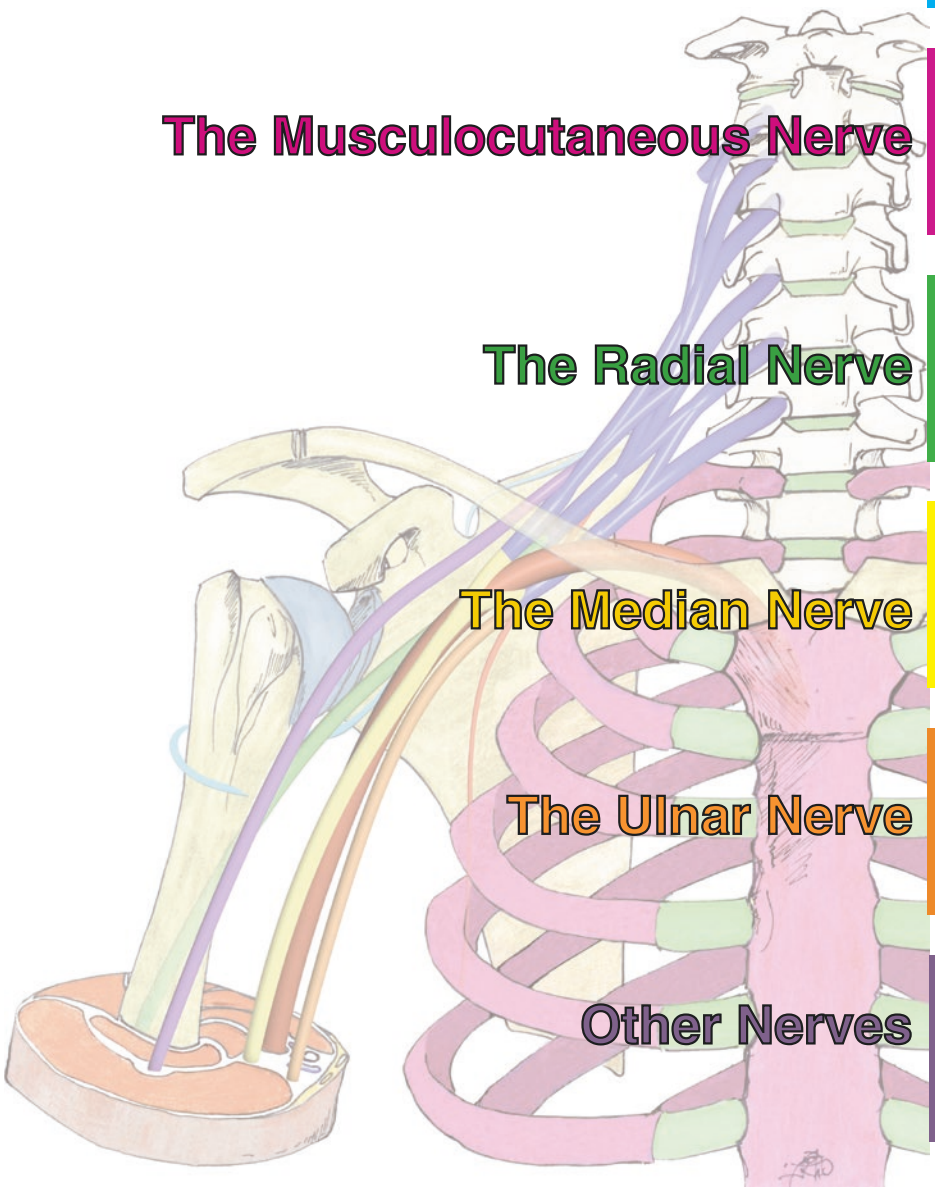
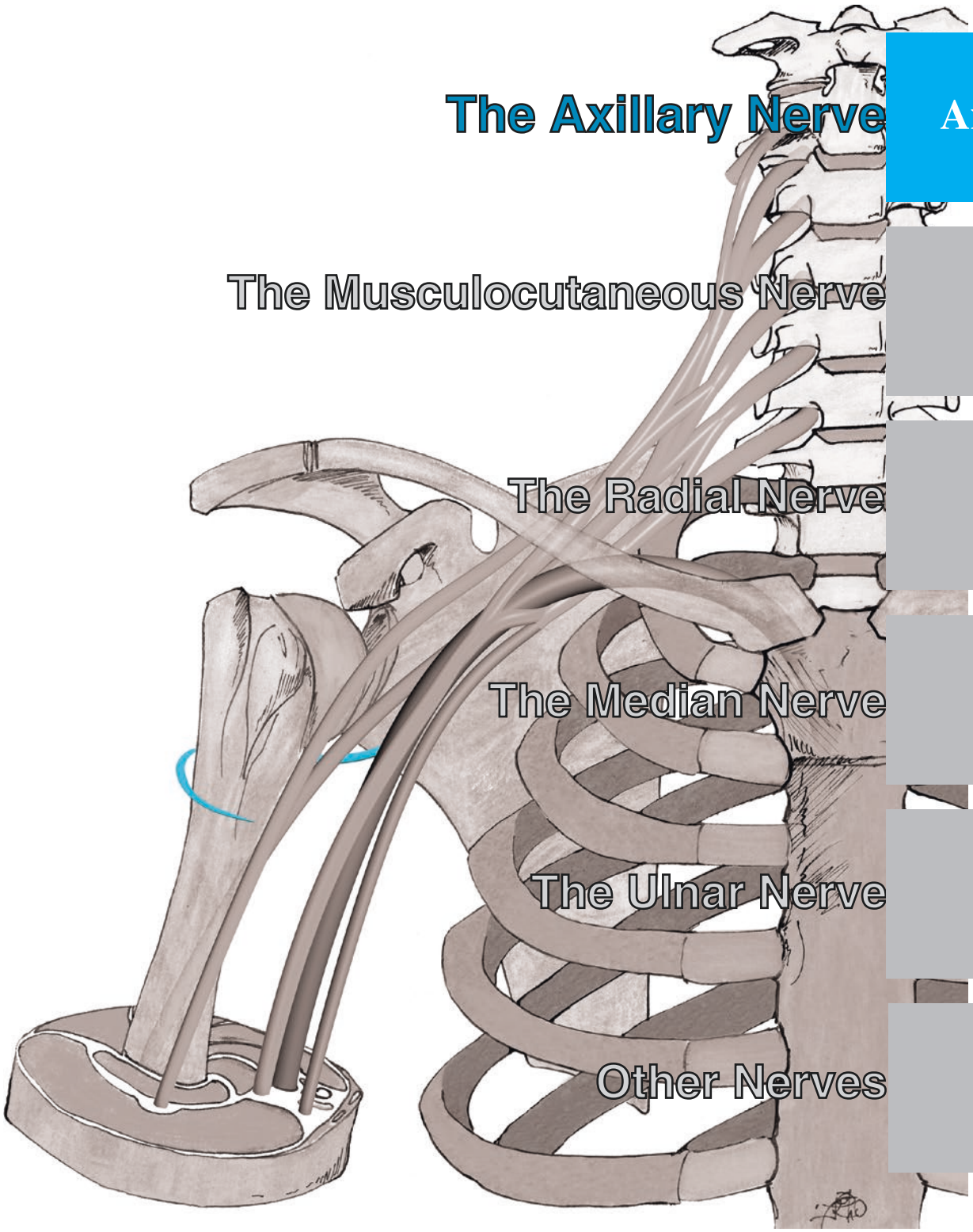
PERIPHERAL BRANCHES





The Axillary Nerve

The Musculocutaneous Nerve

The Radial Nerve

The Median Nerve

The Ulnar Nerve

Other Nerves

Morphological Data

The axillary nerve is a mixed nerve. It represents one of the two terminal branches of the posterior bundle of the brachial plexus and is responsible for the innervation of the scapular area and the shoulder stump.

Origin

It is made of nerve fibres coming from the posterior divisions of the upper trunk of the plexus, itself coming from the upper trunks of C5 and C6 (Figures Ax1 and Ax2).

Path

The axillary nerve originates from the anterior face of the subscapularis muscle, from behind the axillary artery, leaving the radial nerve in a medial position (Figure Ax3). It goes down and laterally and then crosses the lateral axillary space below the capsule of the glenohumeral joint. It then goes around the hind face of the surgical neck of the humerus in a bone groove against the deep face of the deltoid muscle and then expands from it (Figures Ax4 and Ax5).

Neurovascular Relations

In its posterior part, slightly before penetrating the lateral axillary space, the axillary nerve faces the posterior circumflex artery of the humerus below and remotely (Figure Ax4). It joins this artery at the inferior border of the subscapularis muscle until the posterior face of the humerus, whilst it goes around the surgical neck.

In the lateral axillary space, the posterior humeral circumflex artery comes across the axillary nerve from behind (Figure Ax6) and goes up again towards the proximal extremity of the humerus, at the deep face of the deltoid muscle (Figure Ax4).

Collateral Branches

The axillary nerve innervates the following branches in succession (Figures Ax2, Ax4, Ax5 and Ax6):

- Branches for the glenohumeral joint, from its anterior and posterior parts.
- Motor branches for the lower part of the subscapularis muscle, without taking charge of its main motor innervation which depends on the upper and lower subscapular nerves, which are direct collateral branches of the brachial plexus.
- The teres minor nerve: it originates in the lateral axillary space and goes around the inferior edge of the muscle before coming in contact with and going through it from its posterior face.
- Superior lateral cutaneous nerve of the arm: after finding its origin in the lateral axillary space, it goes around the deltoid muscle from its middle part and then runs behind it. It then comes across the aponeurosis of the deltoid muscle and distributes its branches to the adjacent skin. It takes charge of the sensitive function of the nerve (Figures Ax5 and Ax6).

Terminal Branches

The terminal branches of the axillary nerve are constituted by several motor branches for the deep face of the deltoid muscle (Figures Ax7, Ax8, Ax9 and Ax10).

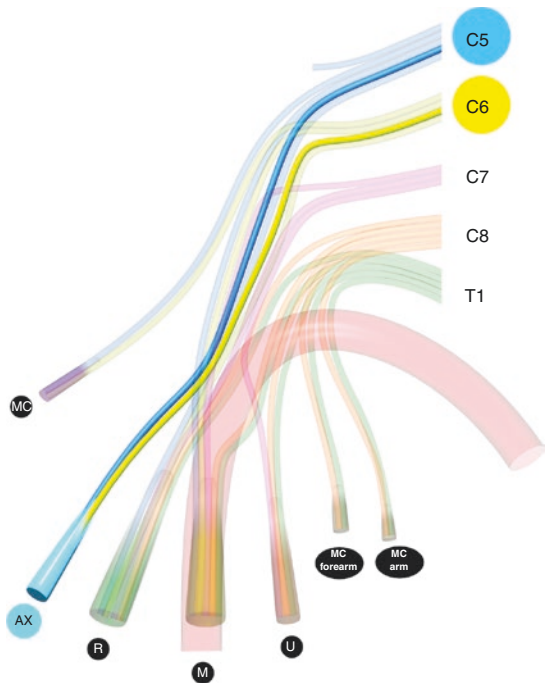


Figure Ax1. Origin of the axillary nerve

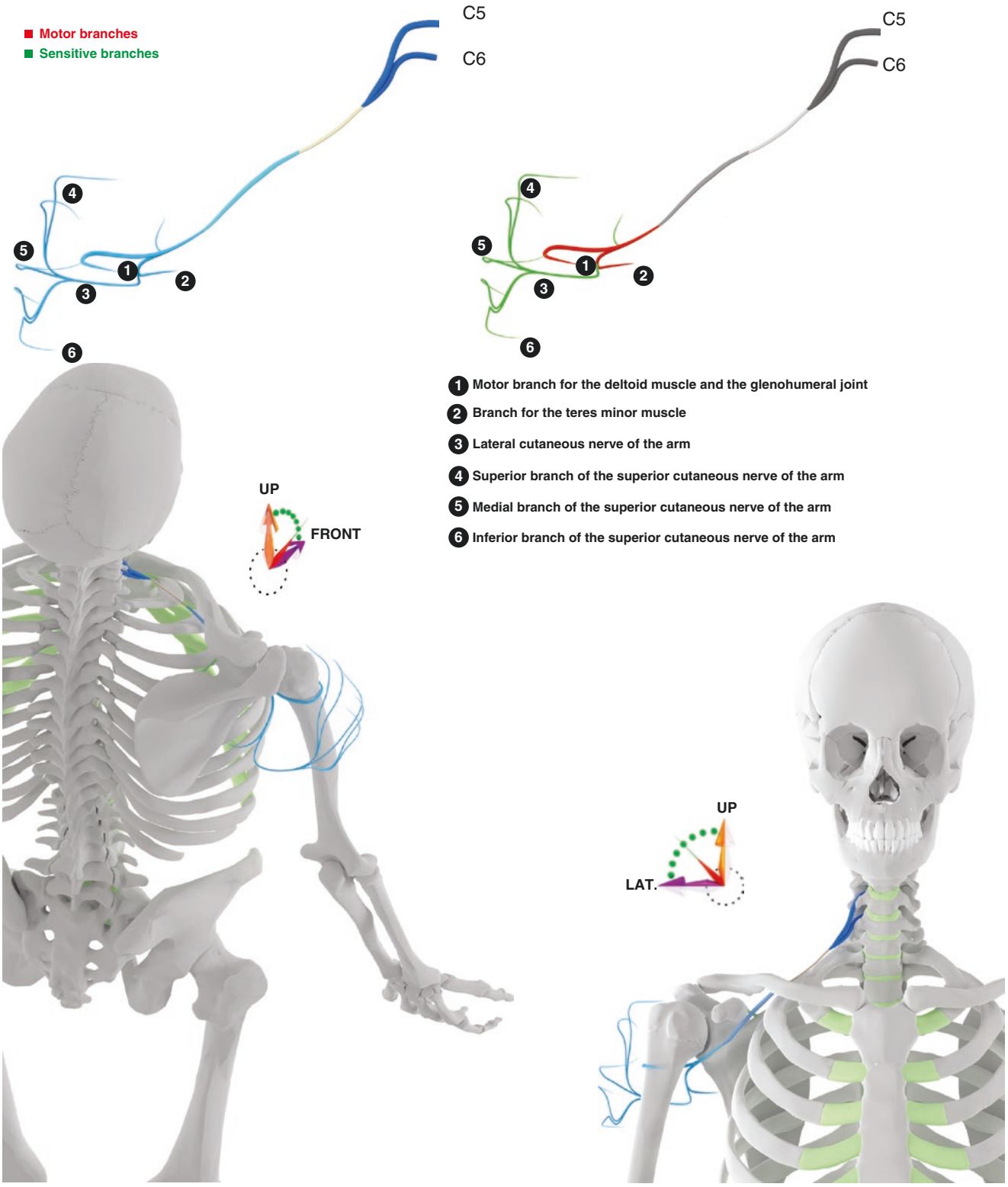


Figure Ax2. Topographical distribution of the axillary nerve and its relations with bones

The Axillary Nerve

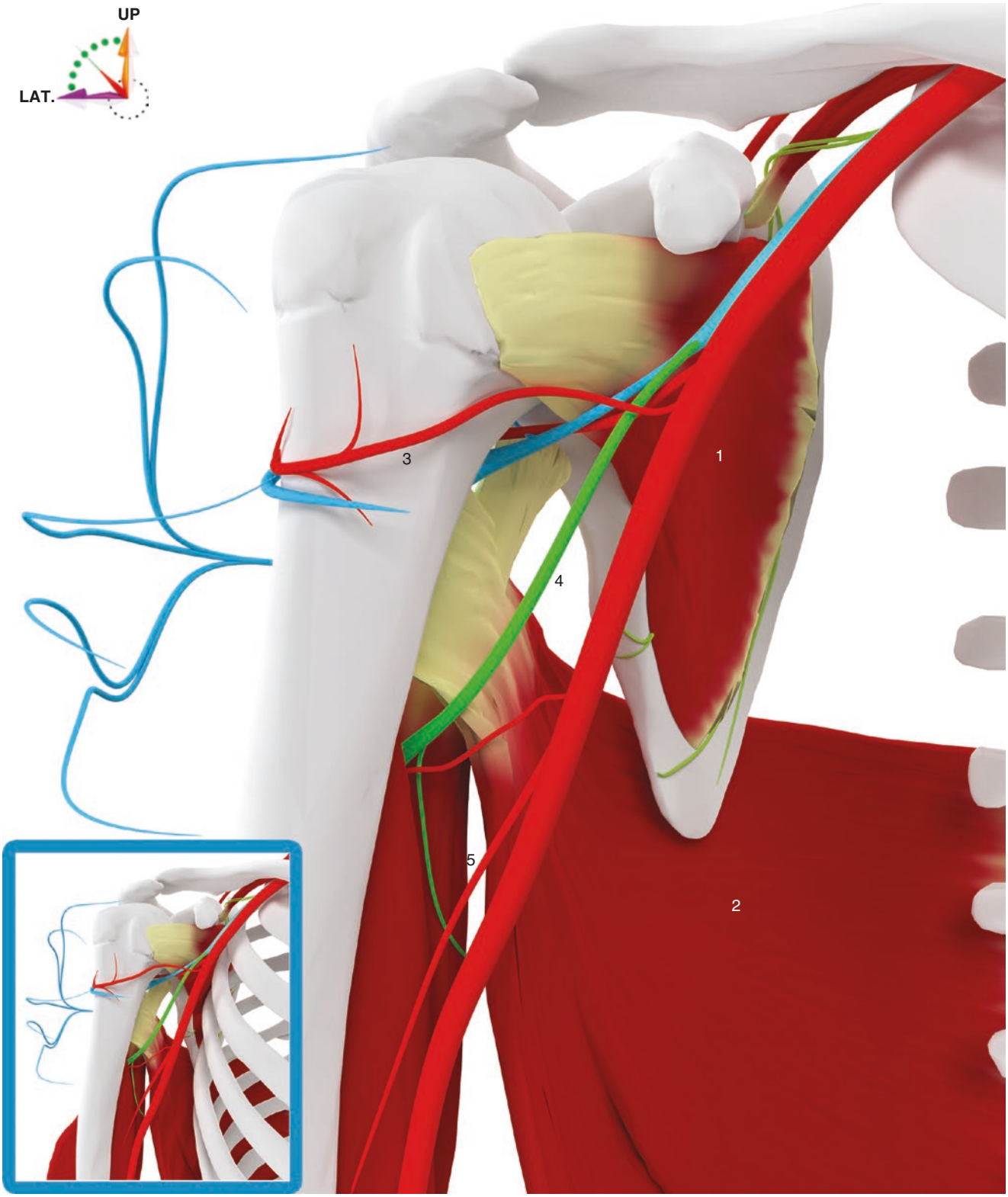
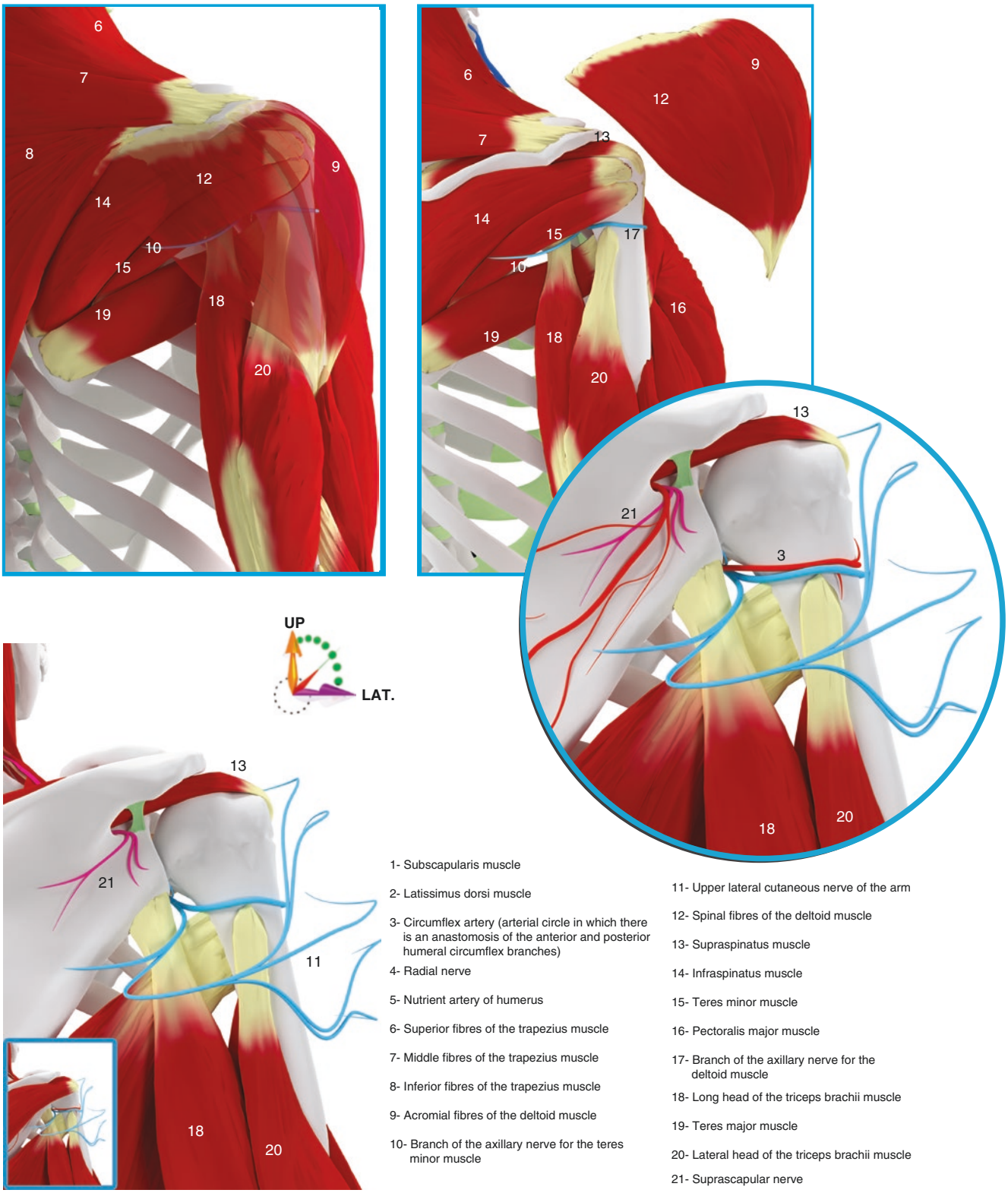


Figure Ax3. Path of the axillary nerve and anterior view of its terminal branches



1- Subscapularis muscle
2- Latissimus dorsi muscle
3- Circumflex artery (arterial circle in which there is an anastomosis of the anterior and posterior humeral circumflex branches)
4- Radial nerve
5- Nutrient artery of humerus
6- Superior fibres of the trapezius muscle
7- Middle fibres of the trapezius muscle
8- Inferior fibres of the trapezius muscle
9- Acromial fibres of the deltoid muscle
10- Branch of the axillary nerve for the teres minor muscle
11- Upper lateral cutaneous nerve of the arm
12- Spinal fibres of the deltoid muscle
13- Supraspinatus muscle
14- Infraspinatus muscle
15- Teres minor muscle
16- Pectoralis major muscle
17- Branch of the axillary nerve for the deltoid muscle
18- Long head of the triceps brachii muscle
19- Teres major muscle
20- Lateral head of the triceps brachii muscle
21- Suprascapular nerve

Figure Ax4. Posterior view of the axillary spaces showing the path of the axillary nerve (from superficial to deep)

The Axillary Nerve

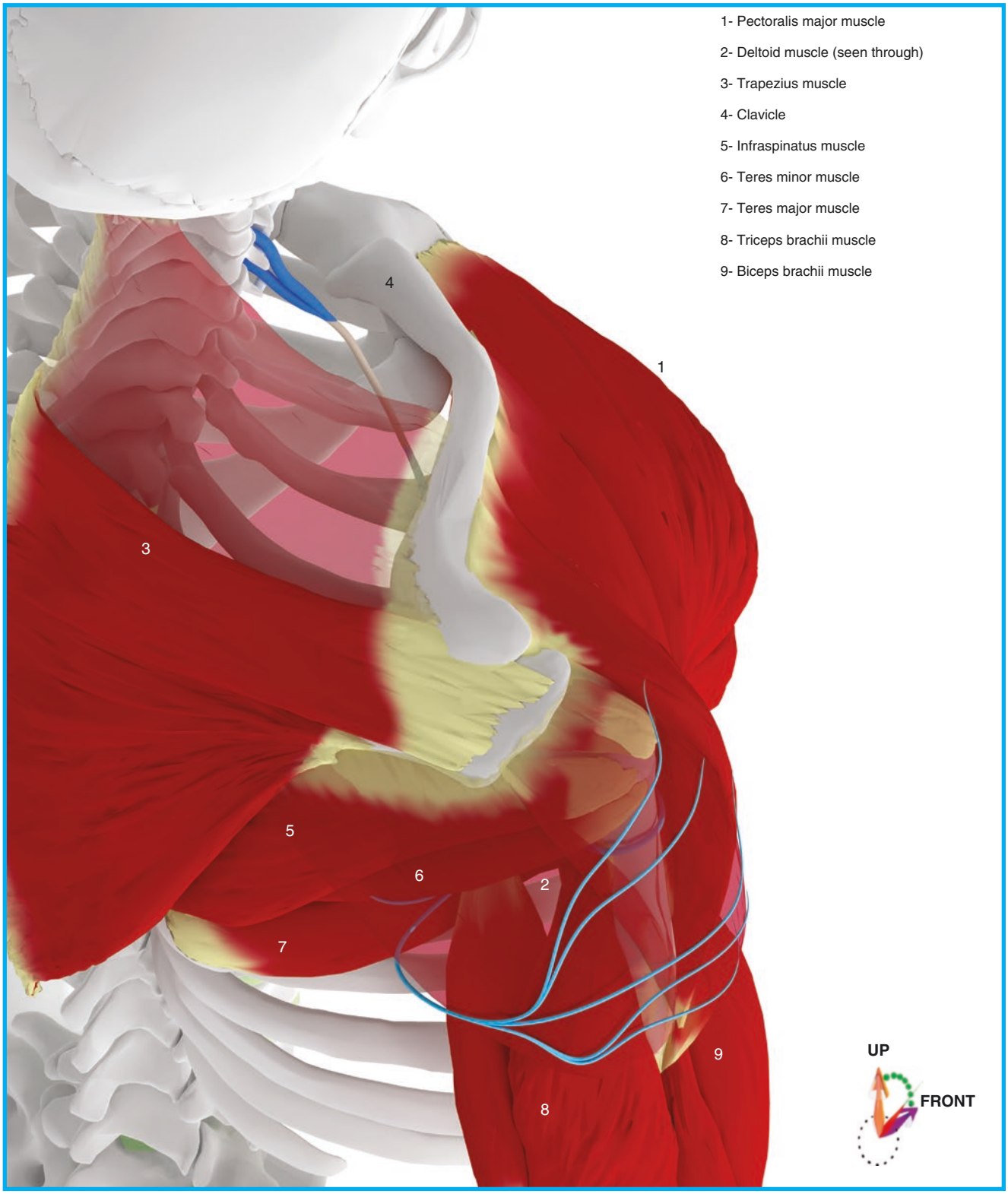


Figure Ax5. View from above of the lateral cutaneous nerve at the shoulder in contact with the deltoid muscle

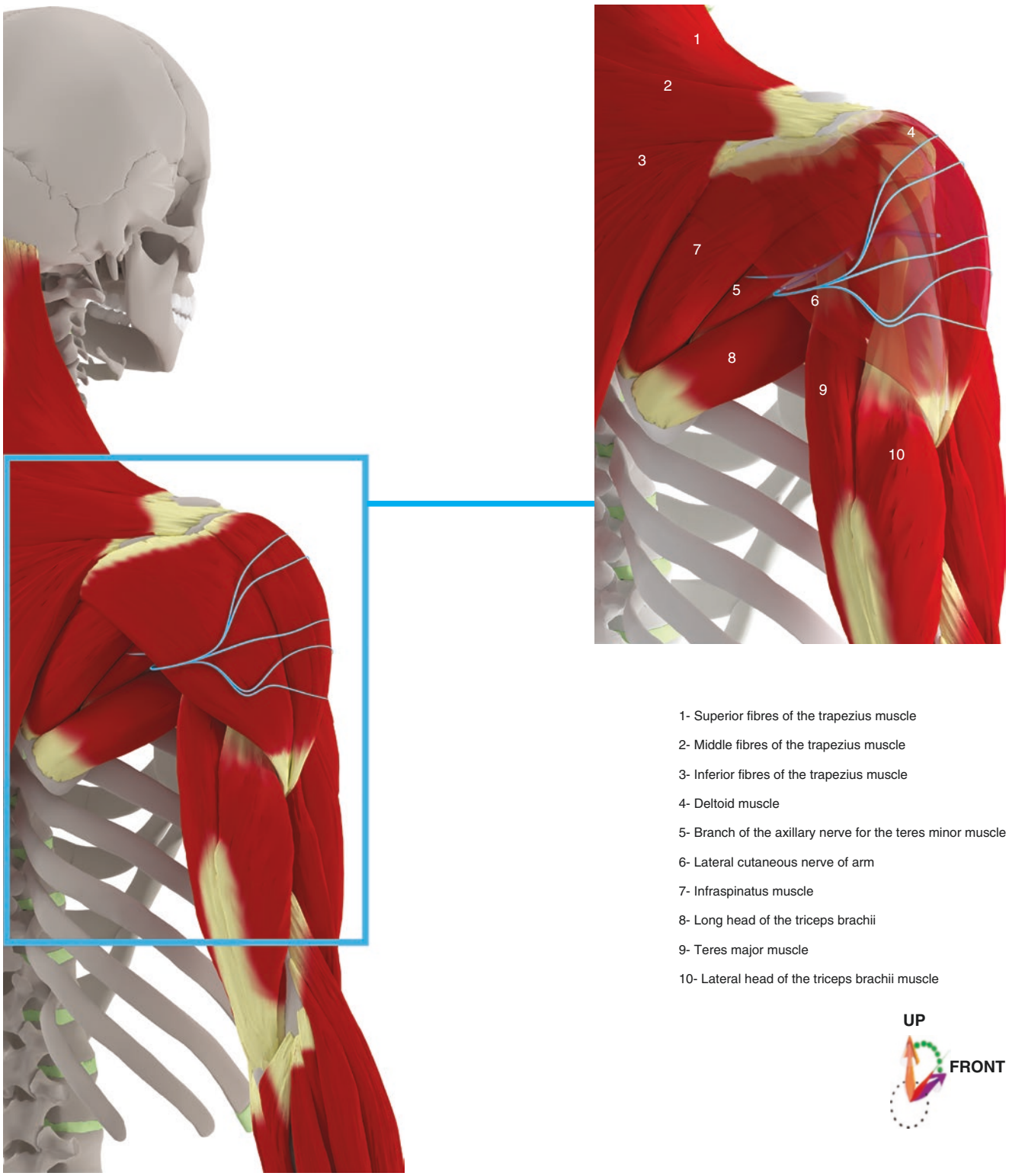
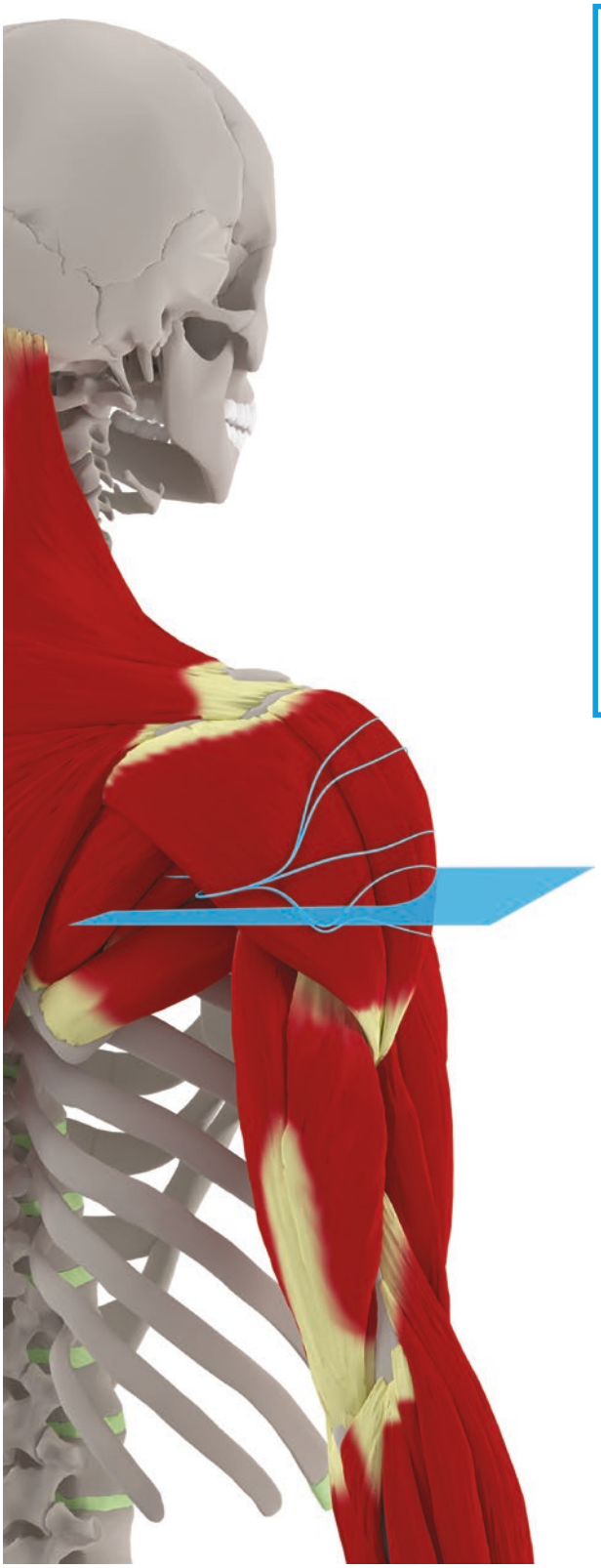
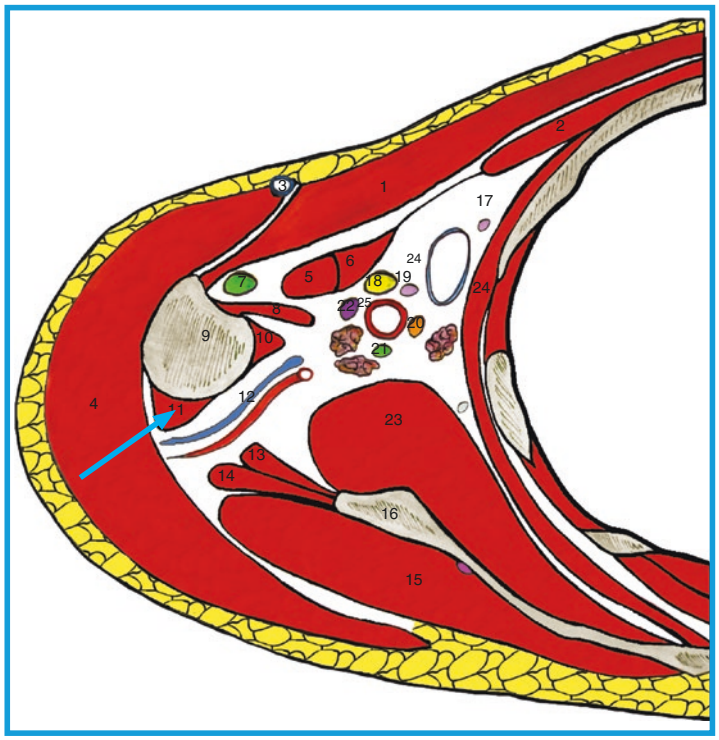


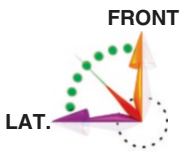
Figure Ax6. Sensitive branches of the axillary nerve in the shoulder (posterior view)

The Axillary Nerve



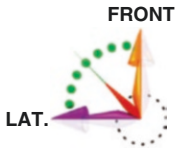


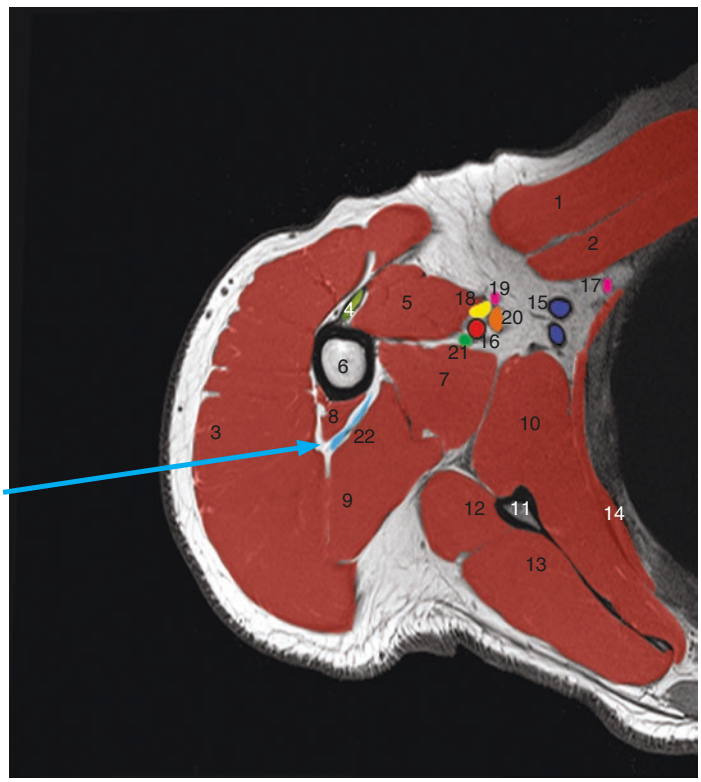
1- Pectoralis major muscle
2- Pectoralis minor muscle
3- Cephalic vein
4- Deltoid muscle
5- Short head of the biceps brachii muscle
6- Coracobrachialis muscle
7- Tendon of the long head of the biceps brachii muscle
8- Latissimus dorsi muscle
9- Humerus
10- Teres major muscle
11- Lateral head of the triceps brachii muscle
12- Circumflex artery and axillary nerve
13- Long head of the triceps brachii muscle
14- Teres minor muscle
15- Infraspinatus muscle
16- Scapula
17- Medial cutaneous nerve of arm
18- Median nerve
19- Medial cutaneous nerve of forearm
20- Ulnar nerve
21- Radial nerve
22- Musculocutaneous nerve
23- Subscapular muscle
24- Serratus anterior muscle



Axillary nerve (12)
Medial cutaneous nerve of arm (17) and forearm (19)
Median nerve (18)
Ulnar nerve (20)
Radial nerve (21)
Musculocutaneous nerve (22)

Figure Ax7. Relations of the axillary nerve in the shoulder in axial view





1- Pectoralis major muscle

2- Pectoralis minor muscle

3- Deltoid muscle

4- Long head of the biceps brachii muscle

5- Latissimus dorsi muscle

6- Humerus

7- Teres major muscle

8- Lateral head of the triceps brachii muscle

9- Medial head of the triceps brachii muscle

10- Subscapularis muscle

11- Scapula

12- Teres minor muscle

13- Infraspinatus muscle

14- Serratus anterior

15- Brachial vein

16- Brachial artery

17- Medial cutaneous nerve of arm

18- Median nerve

19- Medial cutaneous nerve of forearm

20- Ulnar nerve

21- Radial nerve

22- Axillary nerve

Figure Ax8. MRI scans and axillary nerve in the shoulder

The Axillary Nerve

Motor Function

The axillary nerve allows abduction and lateral rotation of the arm by innervation of the deltoid muscle (Figures Ax9 and Ax10).

Sensitive Function

The sensitive innervation territory of the axillary nerve corresponds to the shoulder stump (Figure Ax10).

Anastomoses

The axillary nerve frequently makes anastomoses with:

- The radial nerve by way of the lateral cutaneous nerve of the arm (a collateral branch of the axillary nerve) to join the posterior cutaneous nerve of the arm
- The medial cutaneous nerve of the arm, which is a terminal branch of the medial cord of the brachial plexus

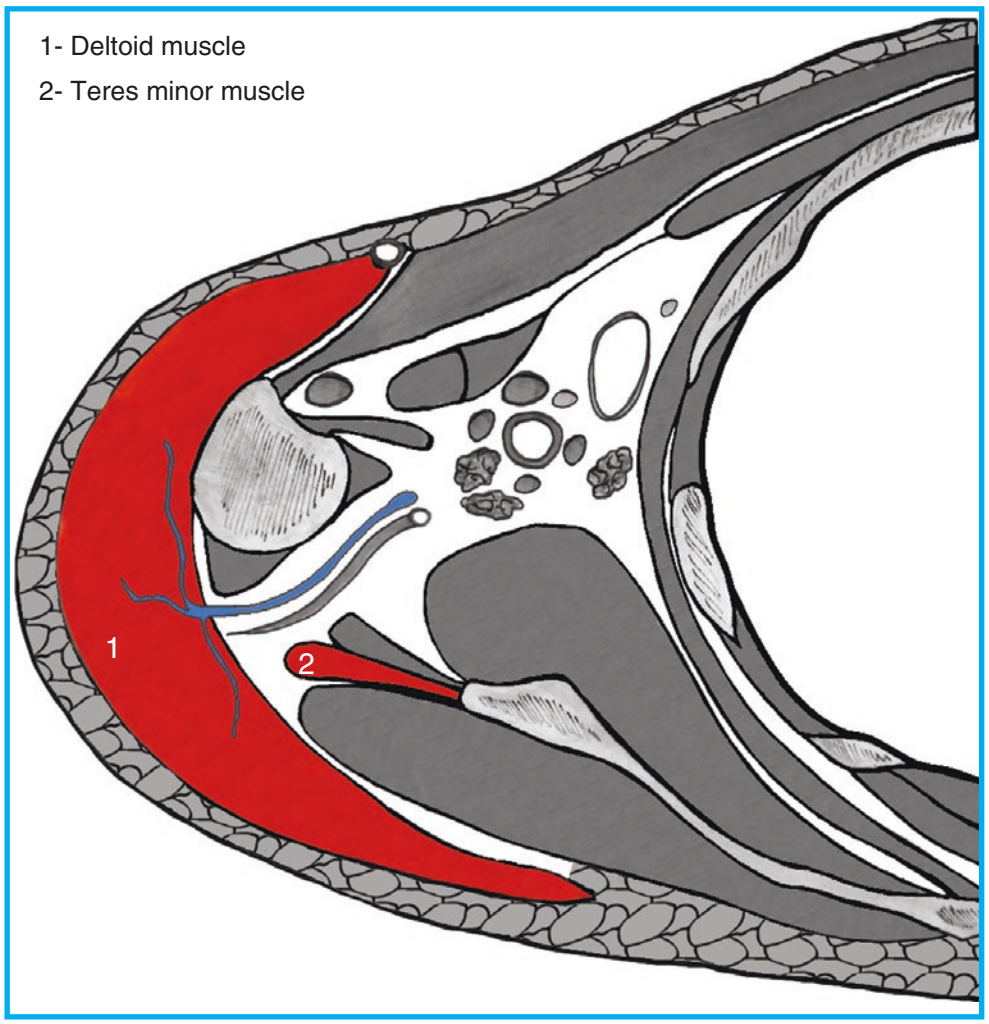


Figure Ax9. Motor innervation of the axillary nerve (axial view)

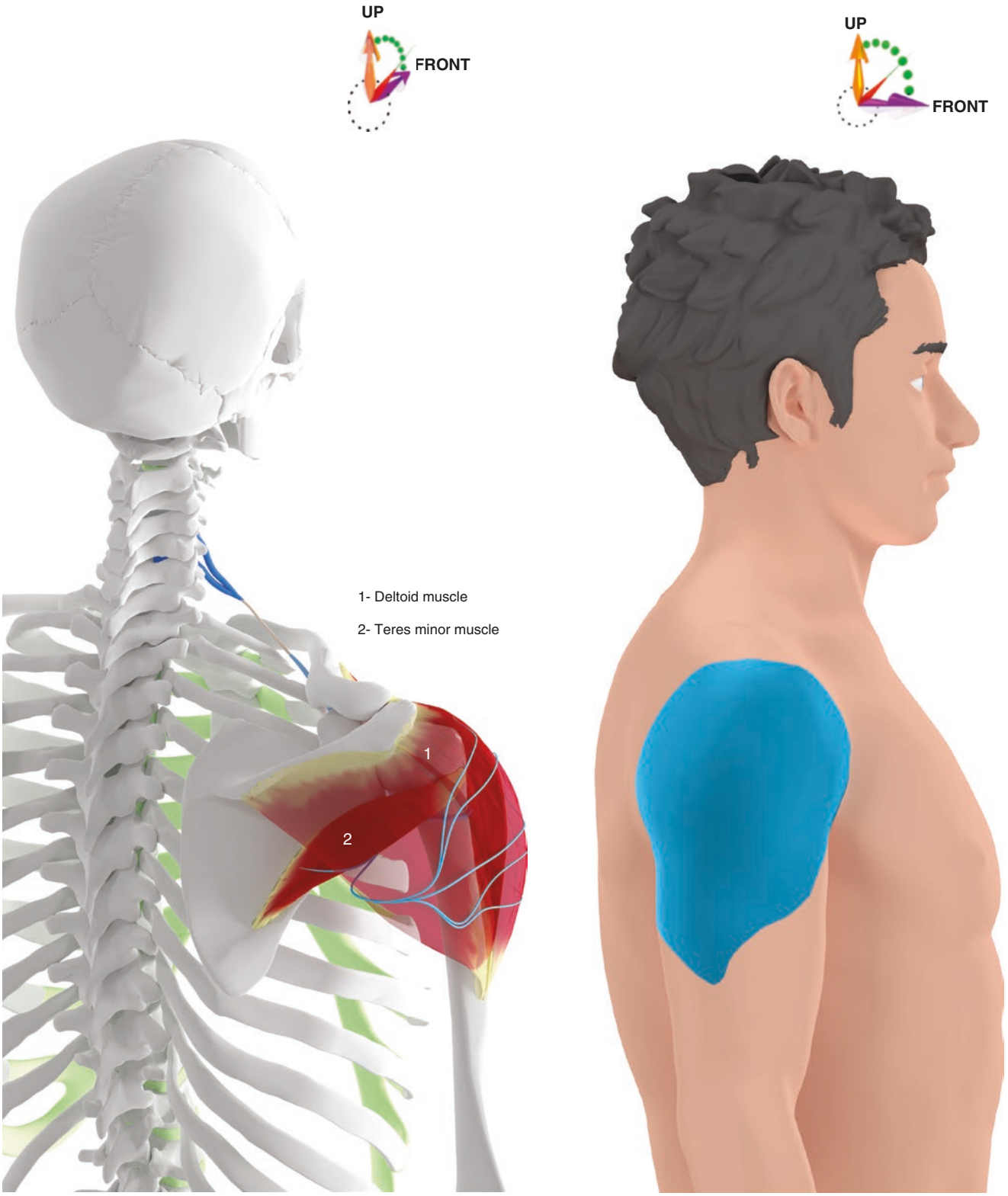


Figure Ax10. Motor and sensitive innervation of the axillary nerve

Pathology

The axillary nerve can be damaged when it crosses the lateral axillary space (formerly known as the quadrilateral space of Velpeau). This space is laterally limited by the humerus, medially by the long head of the triceps brachialis, above it by the teres minor muscle and below it by the teres major muscle (Figure Ax11).

Aetiology

- Traction: This is the most frequent mechanism of injury, generally during an anterior inferior scapulohumeral dislocation. A stretching of the arm in abduction also causes traction on the axillary nerve, which may not be isolated. A fracture at the level of the superior extremity of the humerus can, if proximal, affect the axillary nerve along with the radial nerve, or the musculocutaneous and suprascapular nerves. In most cases, obstetric lesions affect the brachial plexus, not its peripheral terminal branches.
- Section: An isolated section of the axillary nerve can occur in posterior injury in the lateral axillary space.
- Compression: The use of traditional "crutches" (with subaxillary support) can compress the axillary nerve in the lateral axillary space. This can be avoided by the use of elbow crutches. Chronic compressions, encountered mostly in people who do large amounts of sport activities, are caused by a muscular compression by repeated movements of abduction and lateral rotation of the arm. It is then considered as a real entrapment neuropathy.

If no mechanical or traumatic cause can be found, it is important not to overlook a nerve compression by a cyst or any other swelling. An MRI examination of the axillary spaces is highly recommended.

Clinical Significance

- Sensitive signs: In the event of a chronic entrapment neuropathy, pain in the axillary nerve area is sporadic, with a definite neuropathic character consisting of intense pain with a burn-type feeling, more intense during night-time and on which traditional analgesics have no effect. Aforementioned anastomoses may allow for partial sensitive substitution in the case of a damaged axillary nerve. Pain can become more intense during palpation in the area of the lateral axillary space under the teres minor muscle on the posterior face of the shoulder.
- Motor signs: The motor innervation of the deltoid muscle is exclusively dependant on the axillary nerve; an injury of this nerve will cause an amyotrophy in the shoulder. A detailed examination of the shoulder and of the whole upper limb is compulsory. Indeed, the axillary nerve is rarely the only thing damaged in such cases. A neurological and functional examination of the whole limb helps to find injury in other branches of the brachial plexus (generally the radial or suprascapular nerves).

Clinical Forms

A fracture at the superior extremity of the humerus, at the level of its surgical neck, can cause an injury of the axillary nerve and in turn a traction of the radial nerve at the level of the radial nerve's groove.

Complementary Examinations

- Shoulder radiography

These can be executed in a front view, in a neutral position, in a position of medial and lateral rotation and in the Y view. Radiographies allow the detection of indirect signs of a rotator cuff-related pathology.

- Electromyography

Even though its execution is rather difficult, electromyography helps objectify an electrophysiological injury of the axillary nerve, isolated or not.

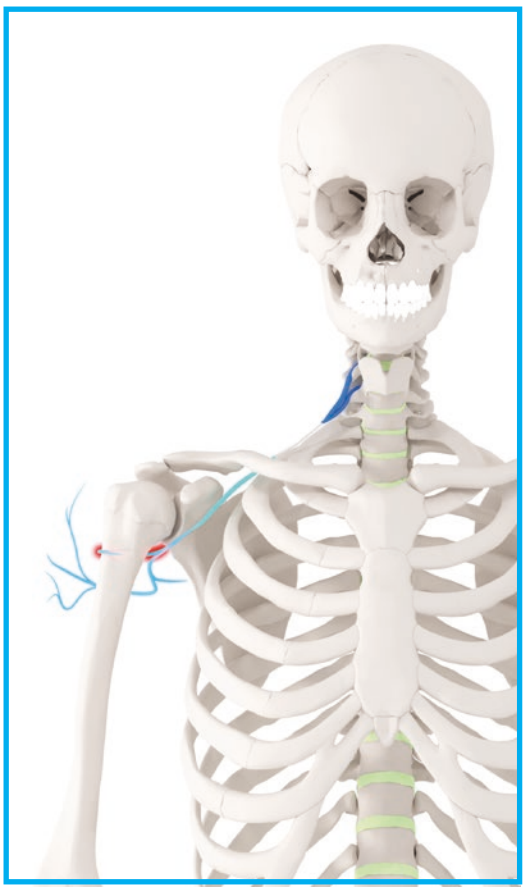
- Imaging of the soft parts of the shoulder

An MRI of the armpit area is the best option. Further examination with an arthrogram can also be very informative.

Treatment

In proven cases of entrapment neuropathy, the first treatment consists in putting the glenohumeral joint to rest. An infiltration of corticosteroids in the lateral axillary space allows for temporary relief of pain, especially in the case of pathologies associated with the rotator cuffs.

If conservative treatment fails and no orthopaedic cause can be found, a surgical treatment option is decompression. This treatment is only prescribed after 3 months without benefit from rest, physiotherapy and infiltration of the lateral axillary space.



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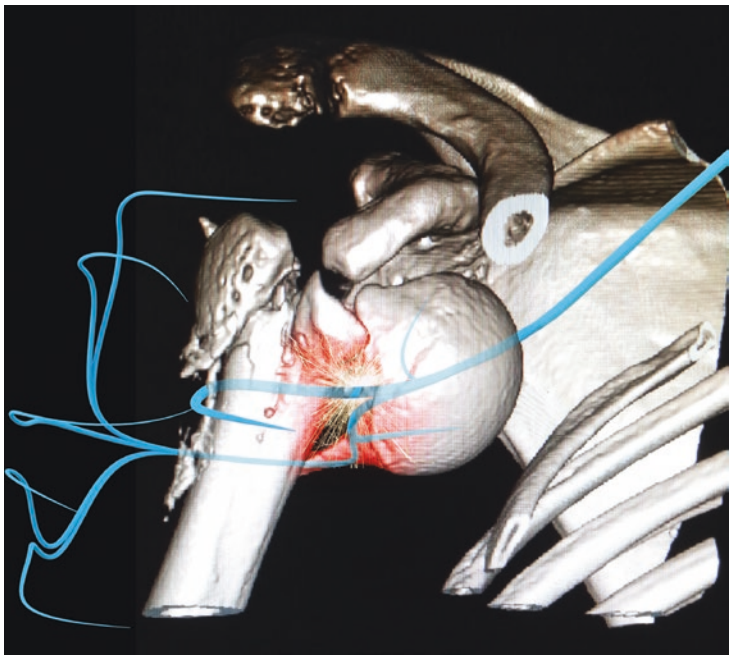

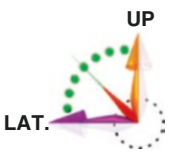

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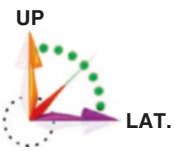

Figure Ax11. Pathologies of the axillary nerve. (**a**) 3D reconstruction of a complex fracture of the neck of humerus. From a clinical point of view, an anaesthesia of the stump and a deficit of abduction of the shoulder can be observed. (**b**) Patient showing a disuse atrophy of the left shoulder after a motorcycle accident