
Macroscopic View of the Cervical Plexus and Brachial Plexus

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The lateral anatomic region of the neck adjacent to the cervical spine contains, among its muscular elements, the cervical plexus and brachial plexus. Nerve plexuses are axon exchange networks that allow peripheral nerves to form from the fibers of two or more consecutive spinal nerves. In this sense, deep to the upper half of the sternocleidomastoid muscle, the spinal nerves from C1 to C4 exchange the axons of their anterior rami in the cervical plexus, giving rise to the peripheral nerves distributed in the anterolateral region of the neck.

Meanwhile, in the interscalene space, the anterior branches of spinal nerves C5 to T1 convene in the brachial plexus. Nerves resulting from this plexus pass under the clavicle and through the axilla to reach the upper extremity. Knowledge of the specific anatomic locations of these neural structures, as well as their function, is essential to the clinical application of anesthetic blocks and to understanding their results (Figs. 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7, 7.8, 7.9, 7.10, 7.11, 7.12, 7.13, 7.14, 7.15, 7.16, 7.17, 7.18, 7.19, 7.20, 7.21, 7.22, 7.23, 7.24, 7.25, 7.26, 7.27, 7.28, 7.29, 7.30, 7.31, 7.32, and 7.33).

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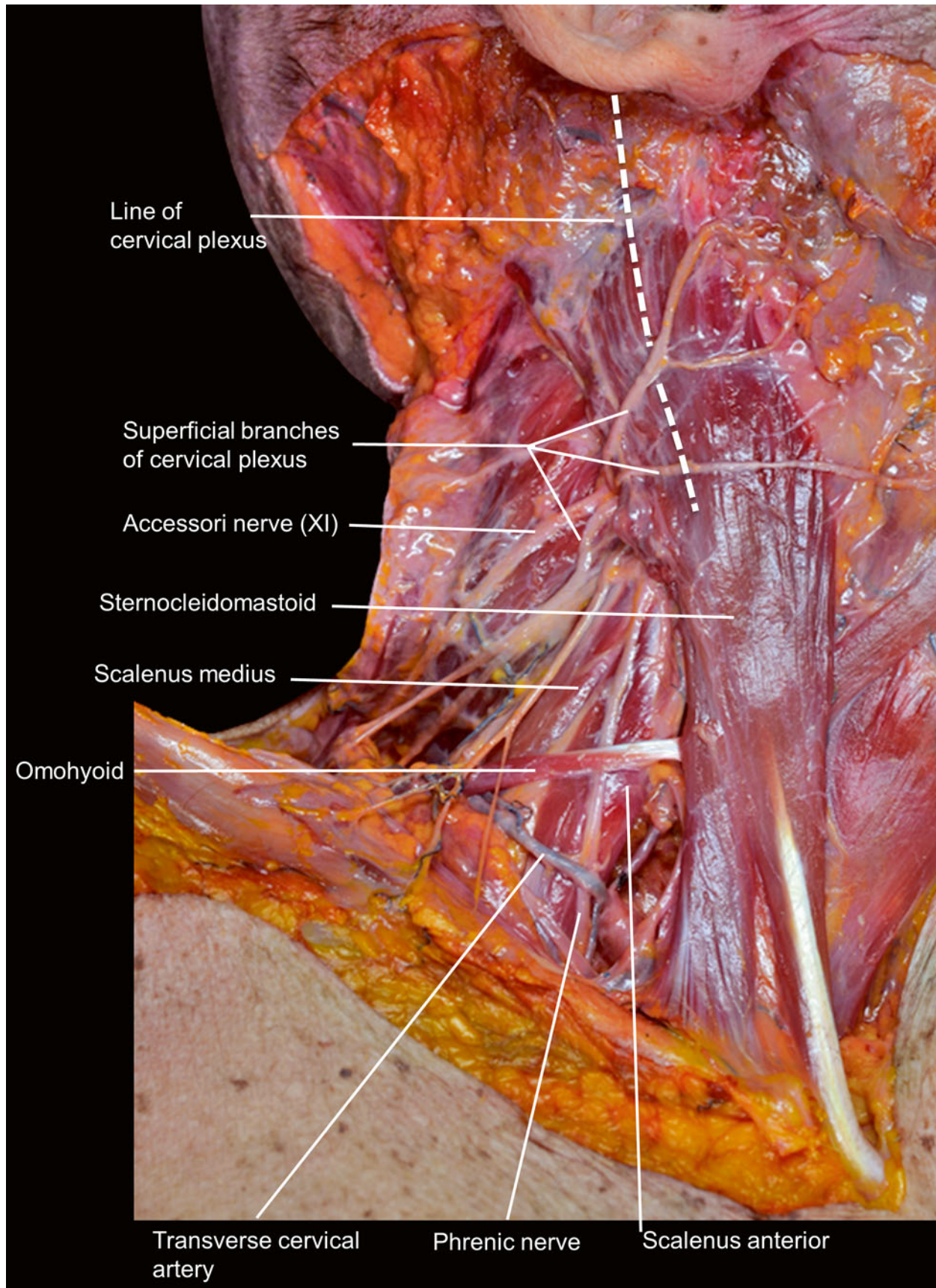


Fig. 7.1 Cervical plexus. The cervical plexus may be visualized as a line under the upper half of the sternocleidomastoid muscle, following the transverse processes of the first cervical vertebrae. Cutaneous branches of this plexus are distributed in the lateral superficial area of the neck

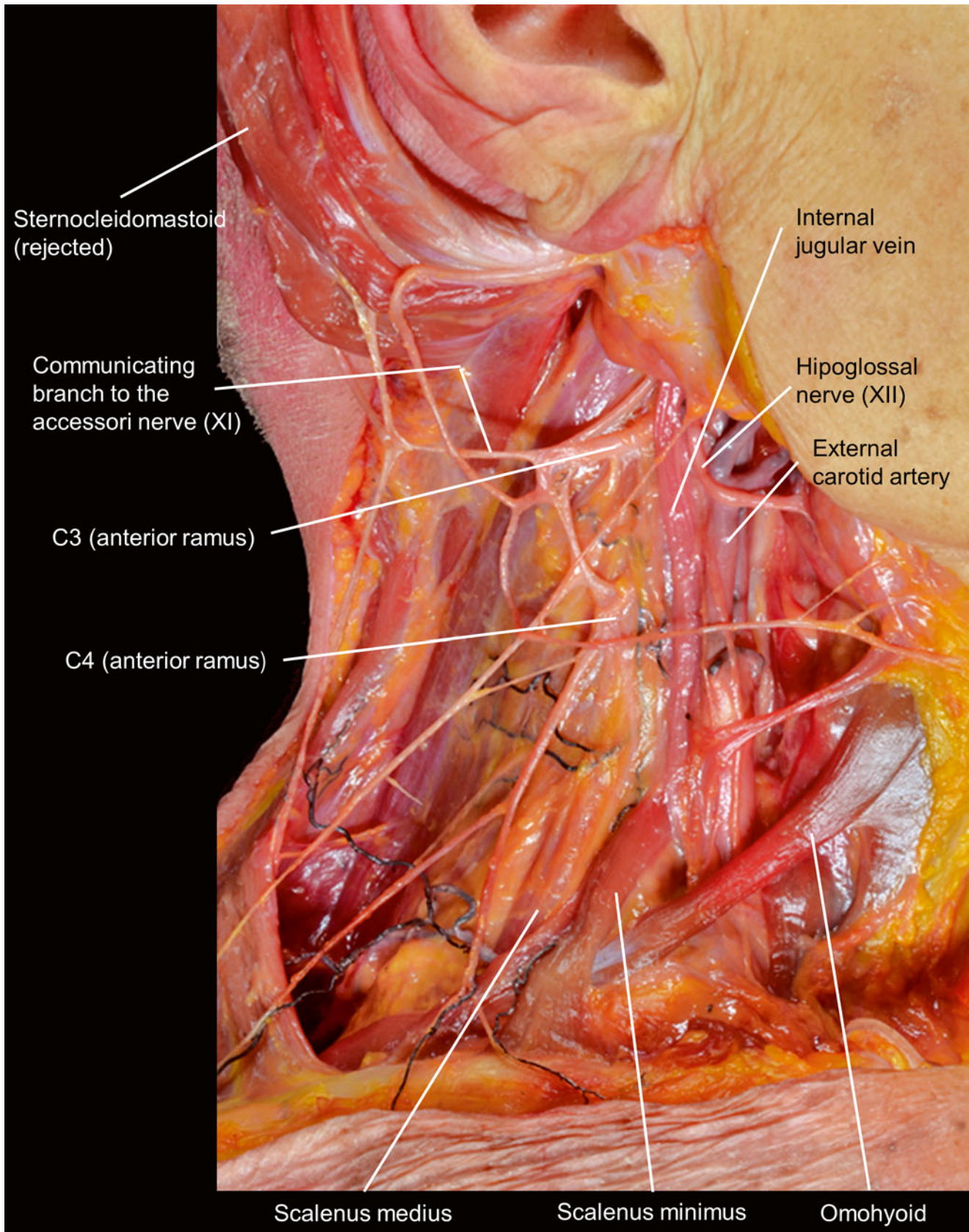


Fig. 7.2 Cervical plexus. Under the sternocleidomastoid muscle, the internal jugular vein is the element of the neck's neurovascular bundle that is most intimately related to the output course of the anterior branches of spinal nerves C1, C2, C3, and C4

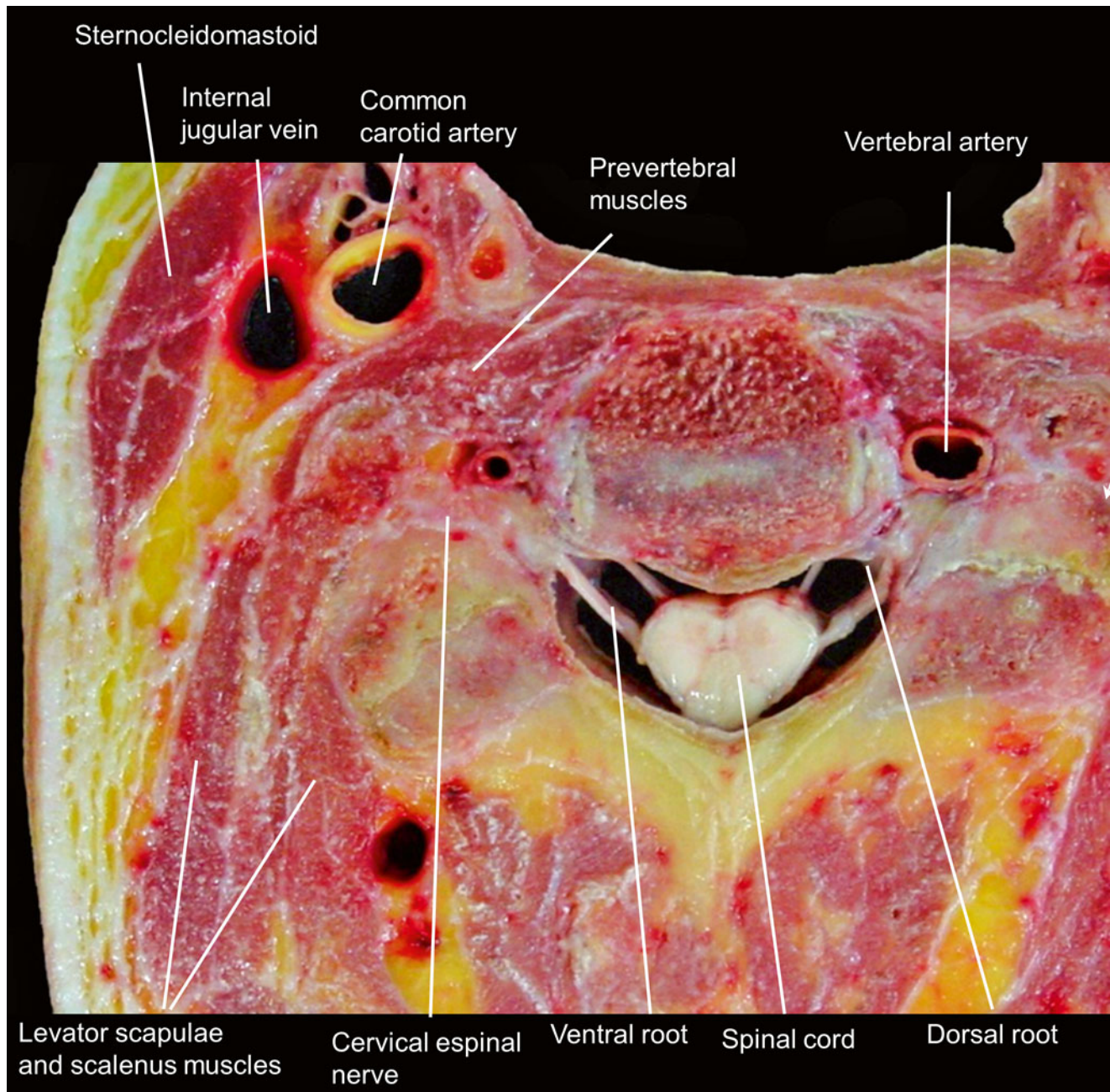


Fig. 7.3 Cervical plexus. In a cross-section of the cervical region, it may be seen that the output of the anterior branches of the spinal nerves forming the cervical plexus is located in the boundary between the insertion of the prevertebral muscles anteriorly and the levator scapulae

and scalene muscles posteriorly. On its way through the intervertebral foramen, each spinal nerve is located posterior to the ascending trajectory of the vertebral artery

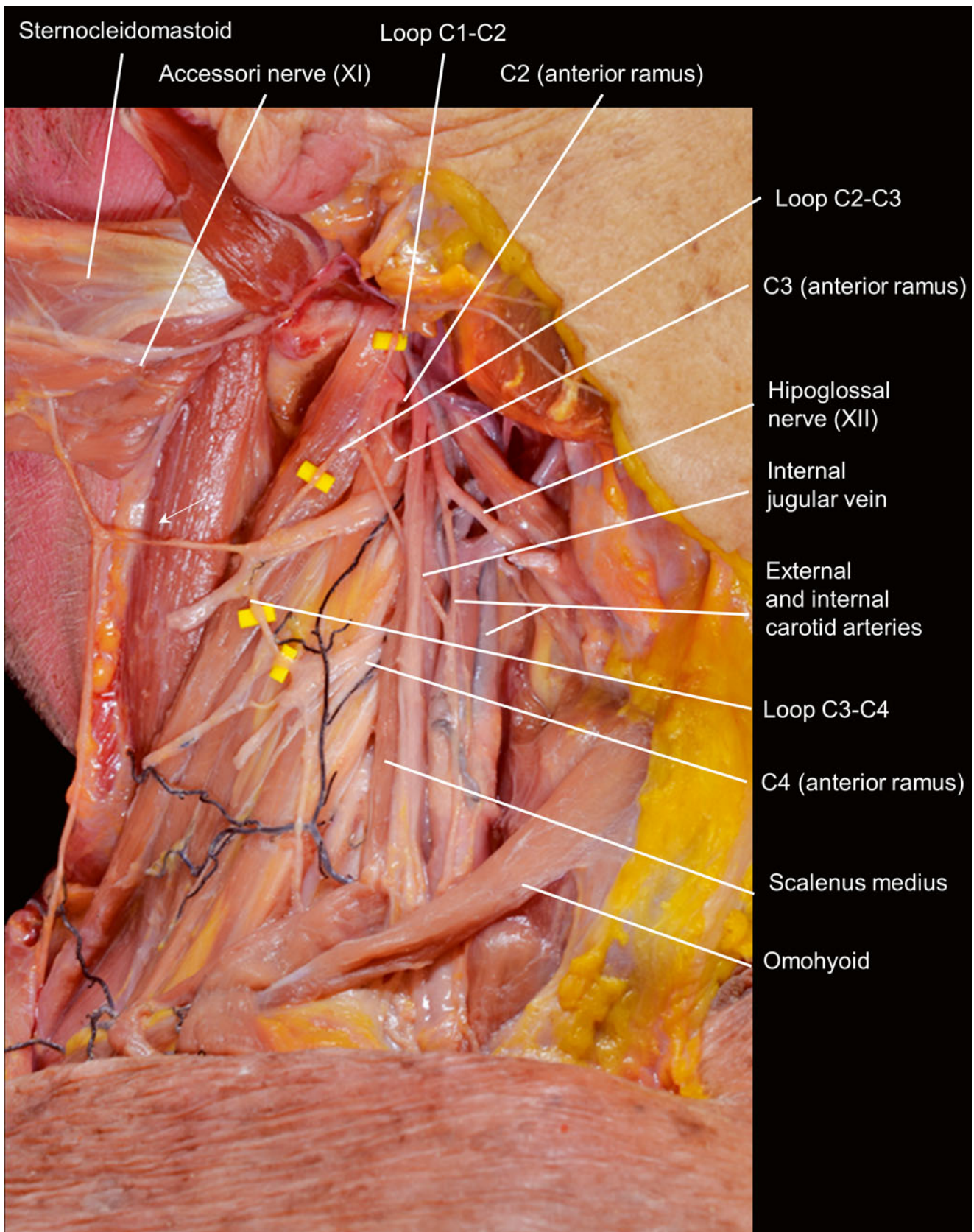


Fig. 7.4 Cervical plexus. The cervical plexus consists of three arches of nervous connection between the spinal nerves that integrate it. Each spinal nerve combines its axons with those of the adjacent spinal

nerves, forming the C1–C2 loop, or arch of the atlas (arranged around the first cervical vertebra); the C2–C3 loop, or arch of the axis (surrounding the second cervical vertebra); and the C3–C4 loop

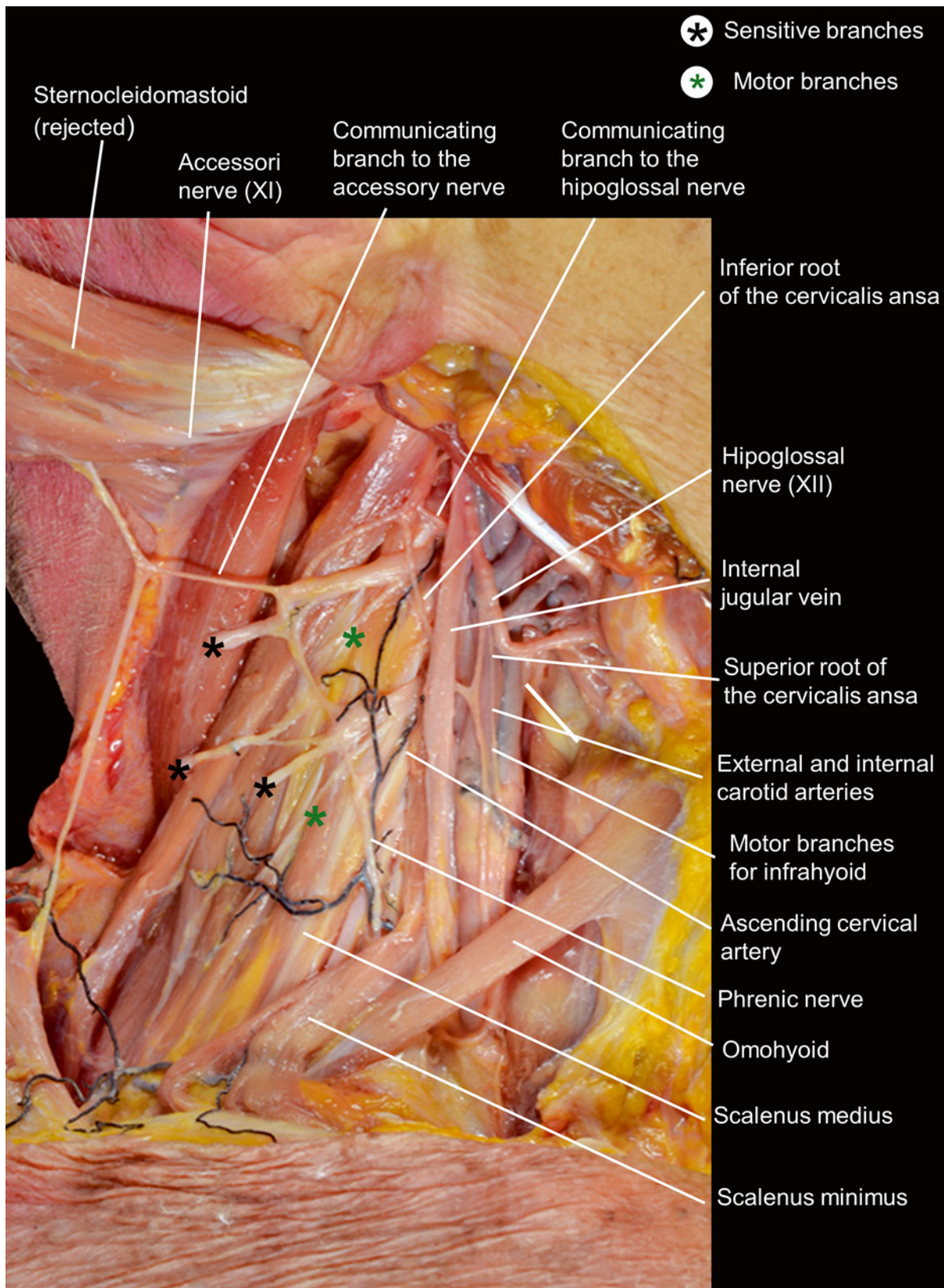


Fig. 7.5 Cervical plexus. From the connections among the C1, C2, C3, and C4 nerves, specific nerves of this plexus are issued: motor nerves that innervate muscles in the region, sensory nerves (cut in this preparation) that will access the superficial plane to be distributed widely in the anterolateral region of the neck, and communicating branches to the sympathetic chain and cranial nerves XI and XII. Connections to the hypoglossal nerve (XII pc) pro-

vide part of the motor innervation of this plexus. Thus, the thyrohyoid nerve, the geniohyoid nerve, and the upper root of the cervical loop correspond to C1 and C2 nerve fibers that previously were incorporated into the path of this cranial nerve. Further, the upper root of the cervical loop joins the inferior root formed by branches from C2 and C3. Motor innervation of the sternothyroid, thyrohyoid, and omohyoid muscles is provided by this cervical loop

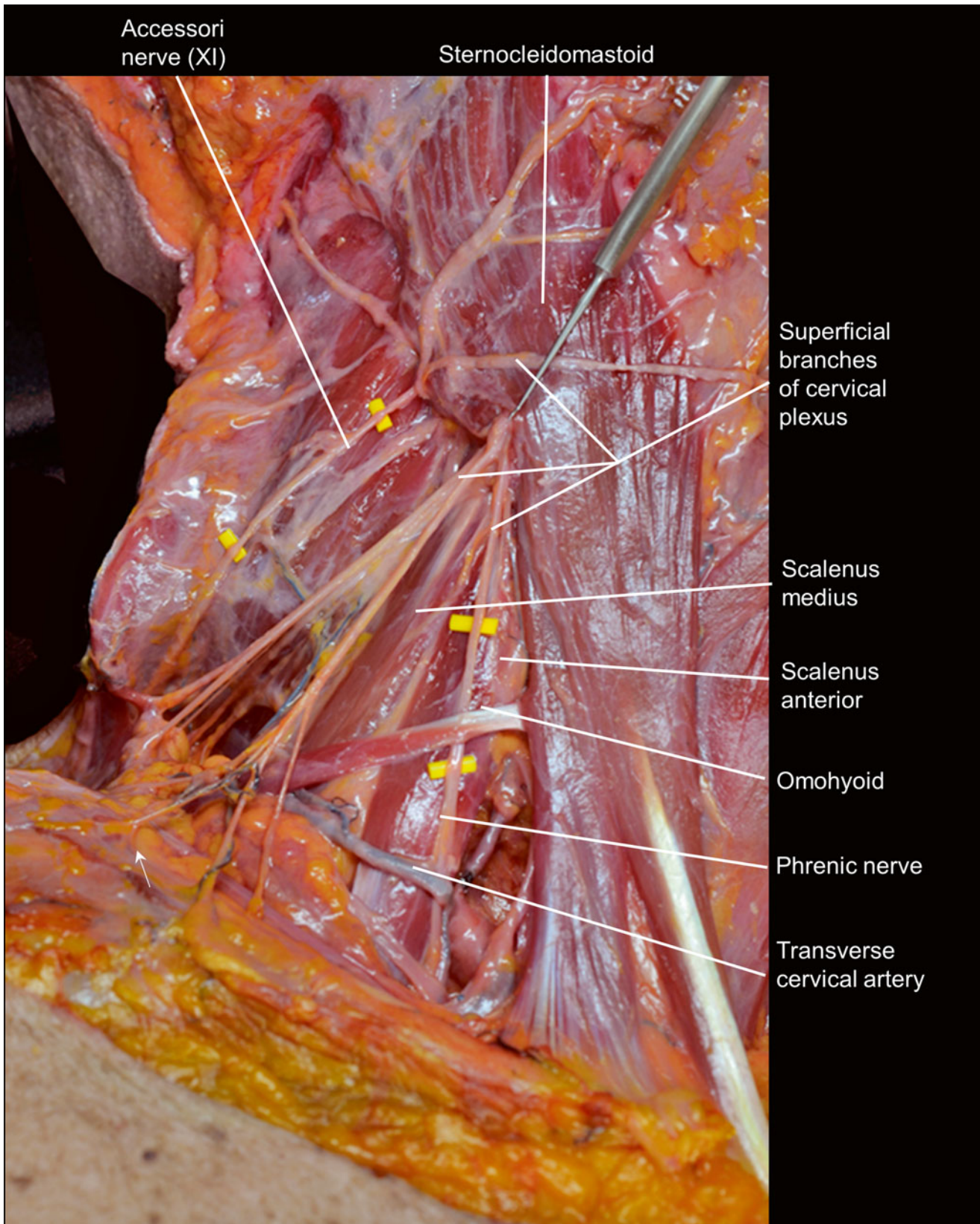


Fig. 7.6 Cervical plexus. One of the main branches of the cervical plexus is the phrenic nerve, which provides motor innervation to the diaphragm and sensory branches to the pericardium and the diaphragmatic and mediastinal pleurae. This nerve originates from C4, with contributions from C3 and C5, and descends along the anterior scalene muscle belly to access the thorax. In the distribution area of the cervical

plexus branches, also lies the path of the accessory nerve (cranial nerve XI). This trajectory may be found between the junction of the upper and middle third of the posterior sternocleidomastoid muscle border and the junction point of the lateral and middle third of the anterior border of the trapezius muscle

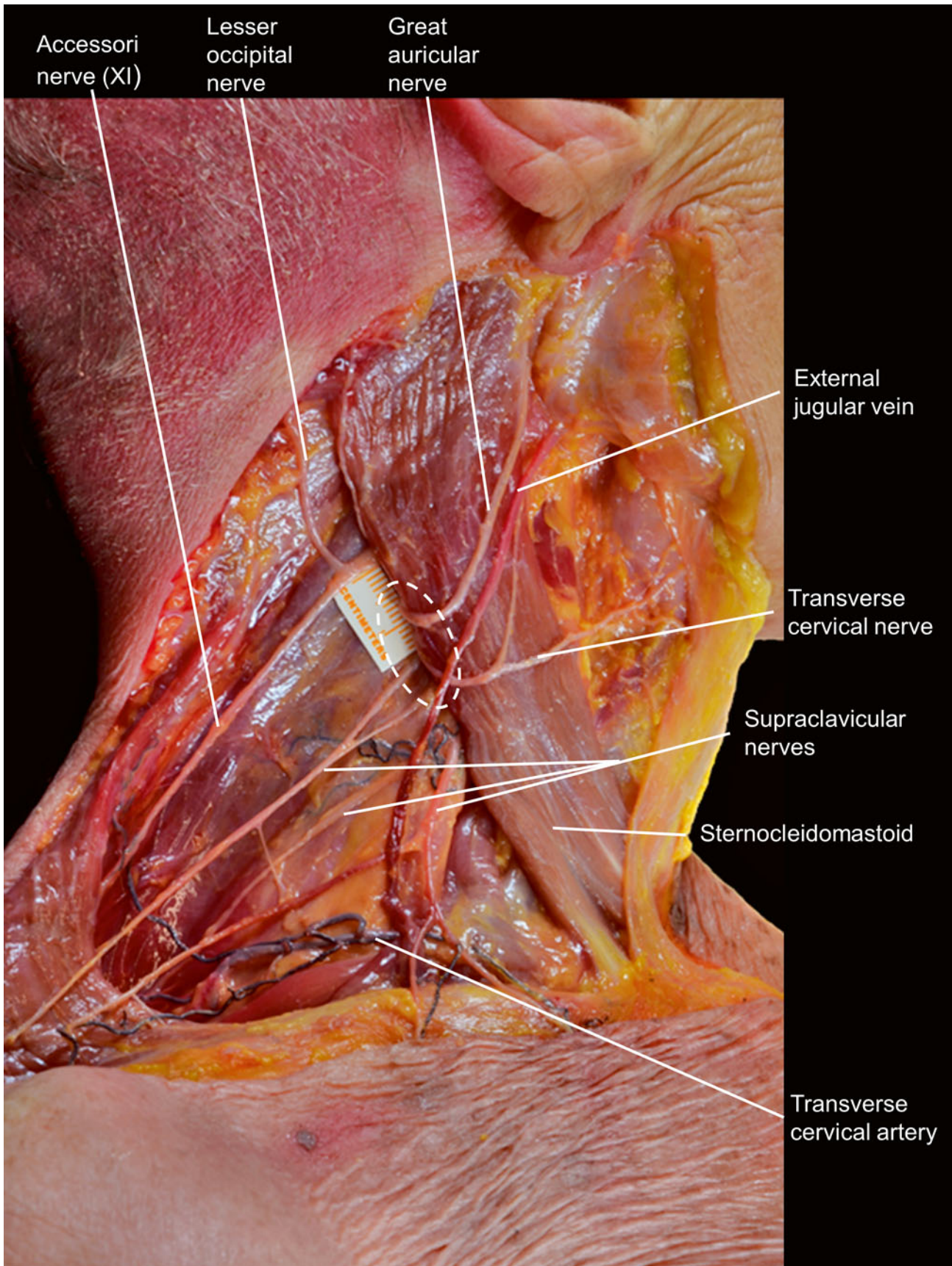


Fig. 7.7 Cervical plexus. Sensory nerves originate in the cervical plexus. Before their subcutaneous distribution, they are gathered in a small area called the nervous neck point or Erb's point. This point (circle) is an anatomic reference for anesthetic blockade of these nerve

branches, and it is located at the midpoint of the posterior border of the sternocleidomastoid muscle. Another reference to its location is the path of the external jugular vein; the nerve point is cranial to the crossing point between this vein and the posterior border of the muscle

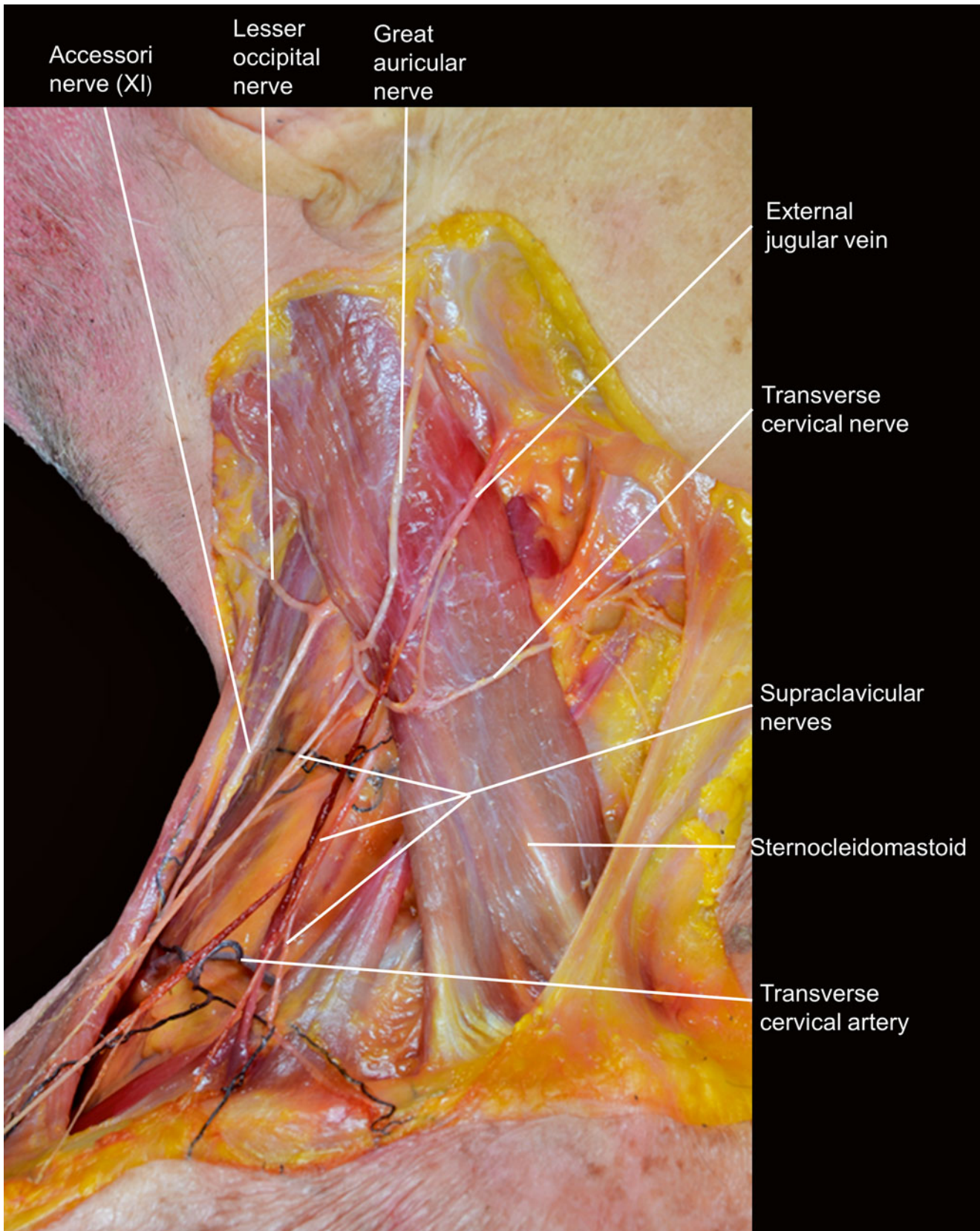


Fig. 7.8 Cervical plexus. From the nervous neck point, the sensory nerves of the cervical plexus radiate to the anterior region of the neck, the supraclavicular area from the sternum to the acromion, the retroauricular occipital zone, the parotid region, and the ear

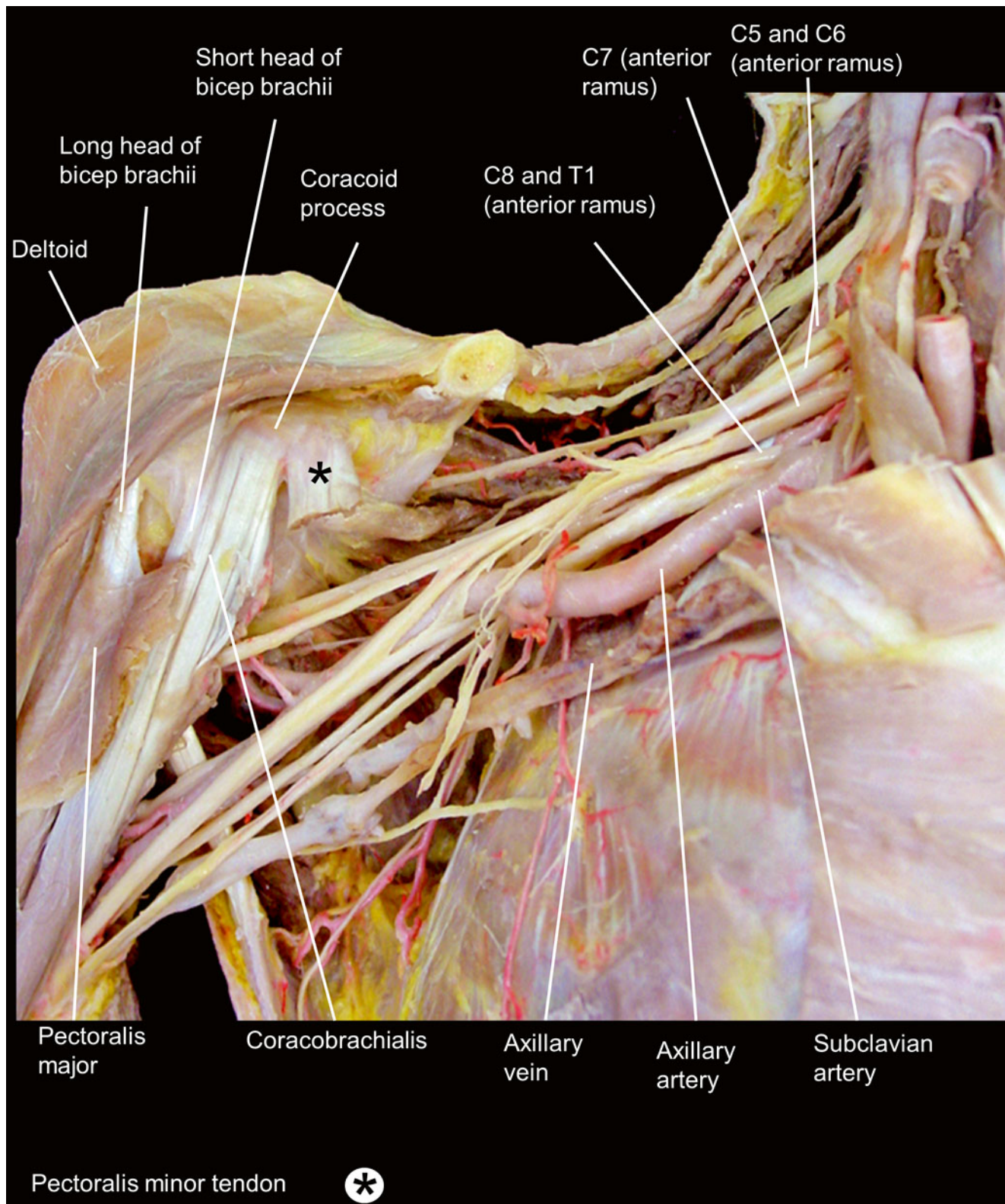


Fig. 7.9 Brachial plexus. The brachial plexus is formed by the anterior branches of the spinal nerves from C5 to T1. From the brachial plexus, the peripheral nerves to the upper extremities originate. From the output of these spinal nerves in the paravertebral line of the lower cervical region, the brachial plexus passes through the interscalene

space, the costoclavicular corridor, and the axillary cavity to reach the root of the upper extremity, where its terminal branches are constituted. In this trajectory, the plexus is accompanied by the axillary artery and the subclavian–axillary vein

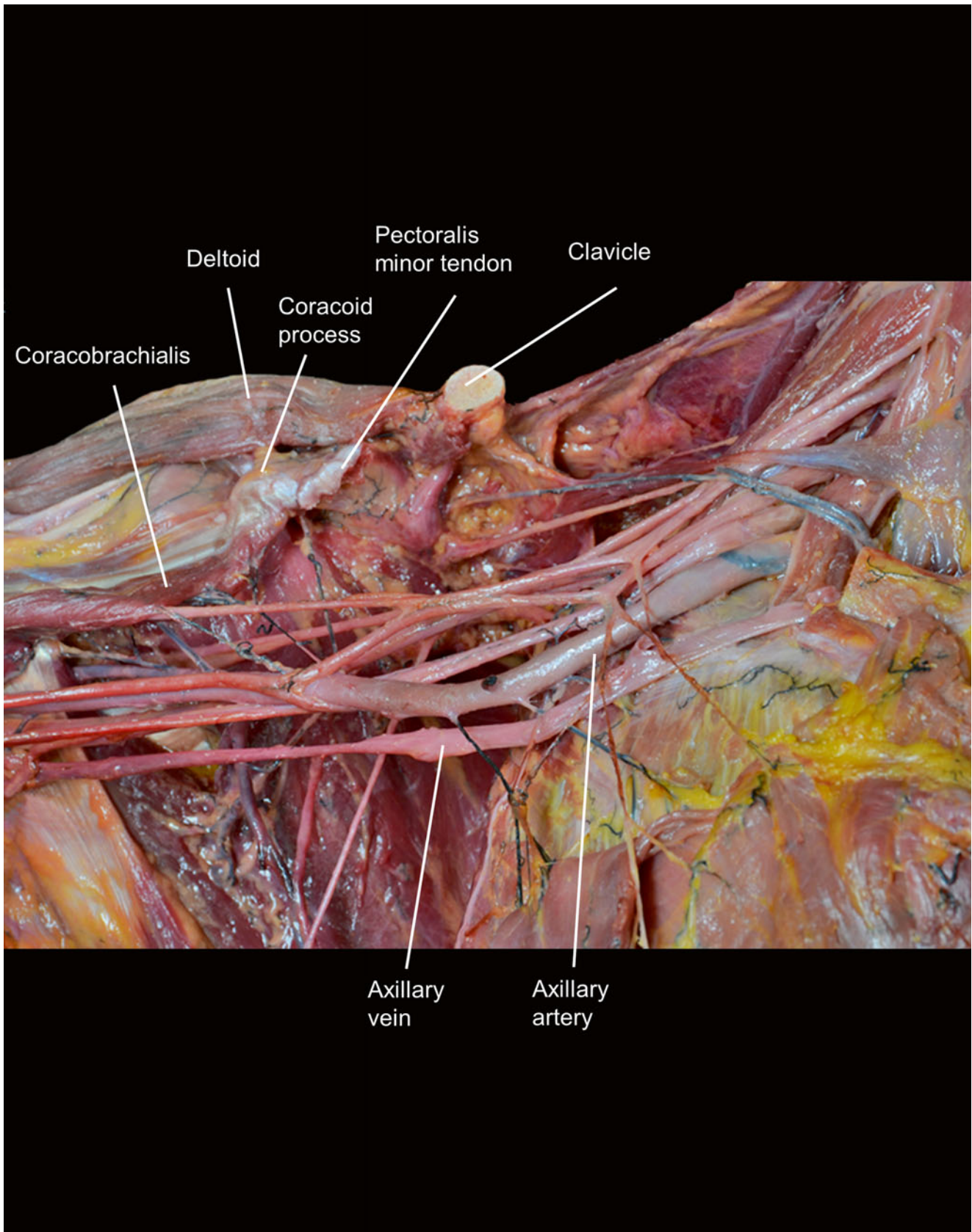


Fig. 7.10 Brachial plexus. The main trajectory of the brachial plexus is inferior, lateral, and posterior to the axillary cavity. It has an overall hour-glass shape, expanded at the ends and clustered at its center, coinciding with its passage below the clavicle

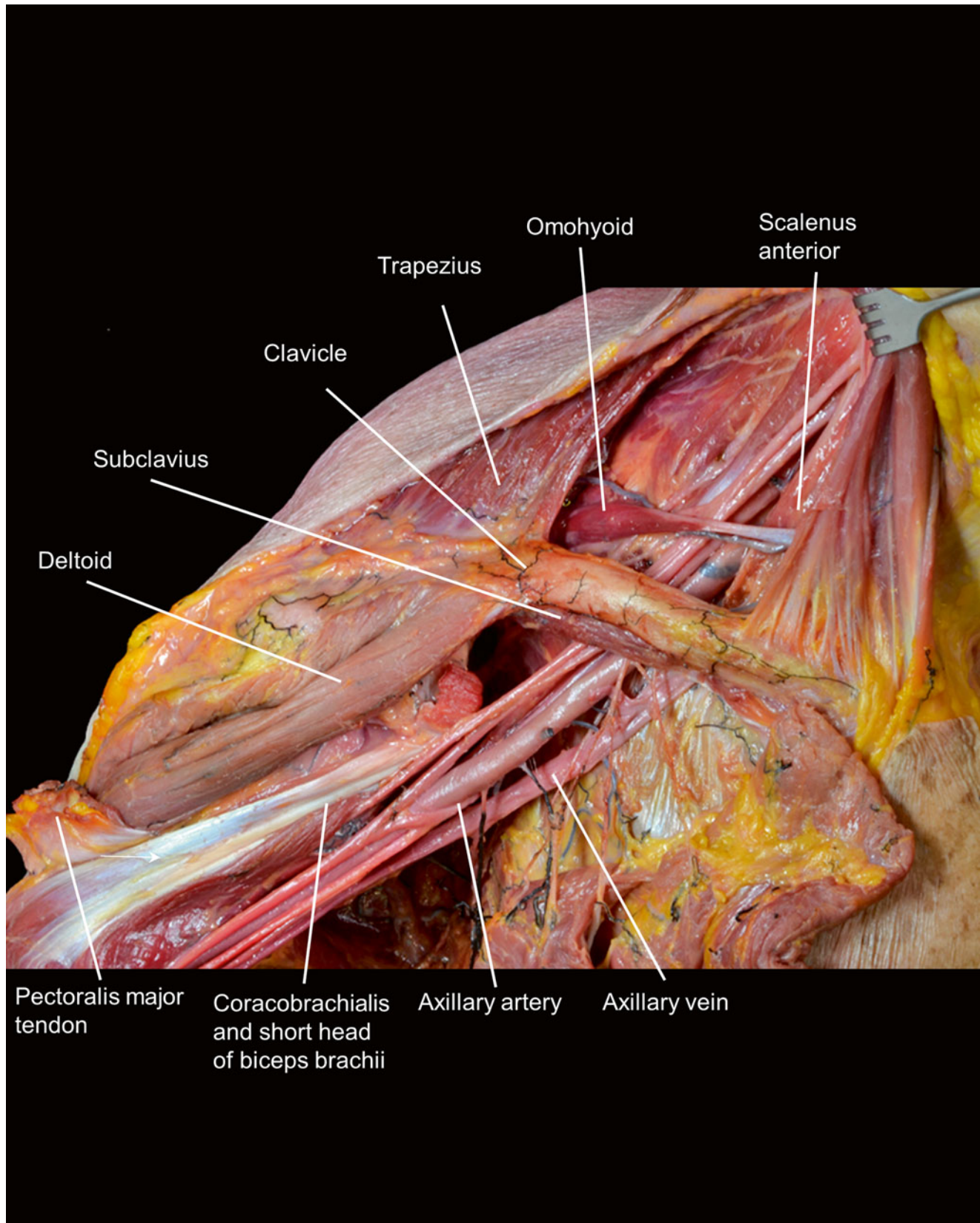


Fig. 7.11 Brachial plexus. The passage of the brachial plexus under the clavicle allows it to divide into two main segments: the supraclavicular plexus and the infraclavicular plexus. Each segment has charac-

teristic anatomic references, specific topographic relations, collateral branches, and functional implications

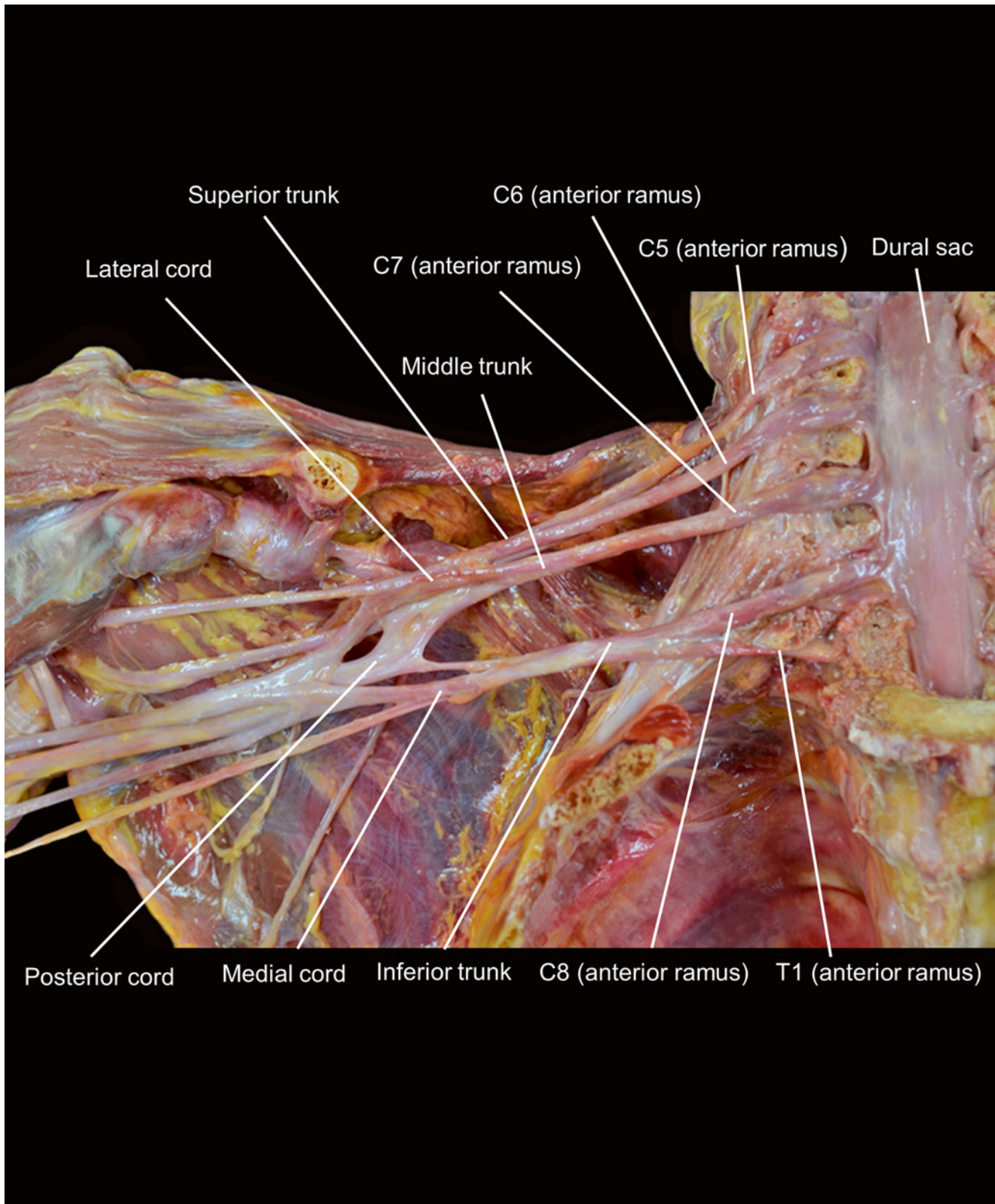


Fig. 7.12 Brachial plexus. The axonal recombination that occurs in the brachial plexus allows sensory and motor information from the spinal nerves that constitute it to be distributed to different peripheral nerves. This exchange follows a pattern that creates a series of defined and recognizable neural elements. Thus, the anterior rami of spinal nerves

C5 to T1 combine to form trunks, each of which divides into an anterior and a posterior division. The combination of the anterior divisions on one hand and the posterior divisions on the other hand leads to the formation of brachial plexus fasciculi

Terminal nerves of brachial plexus *

Collateral nerves of brachial plexus *

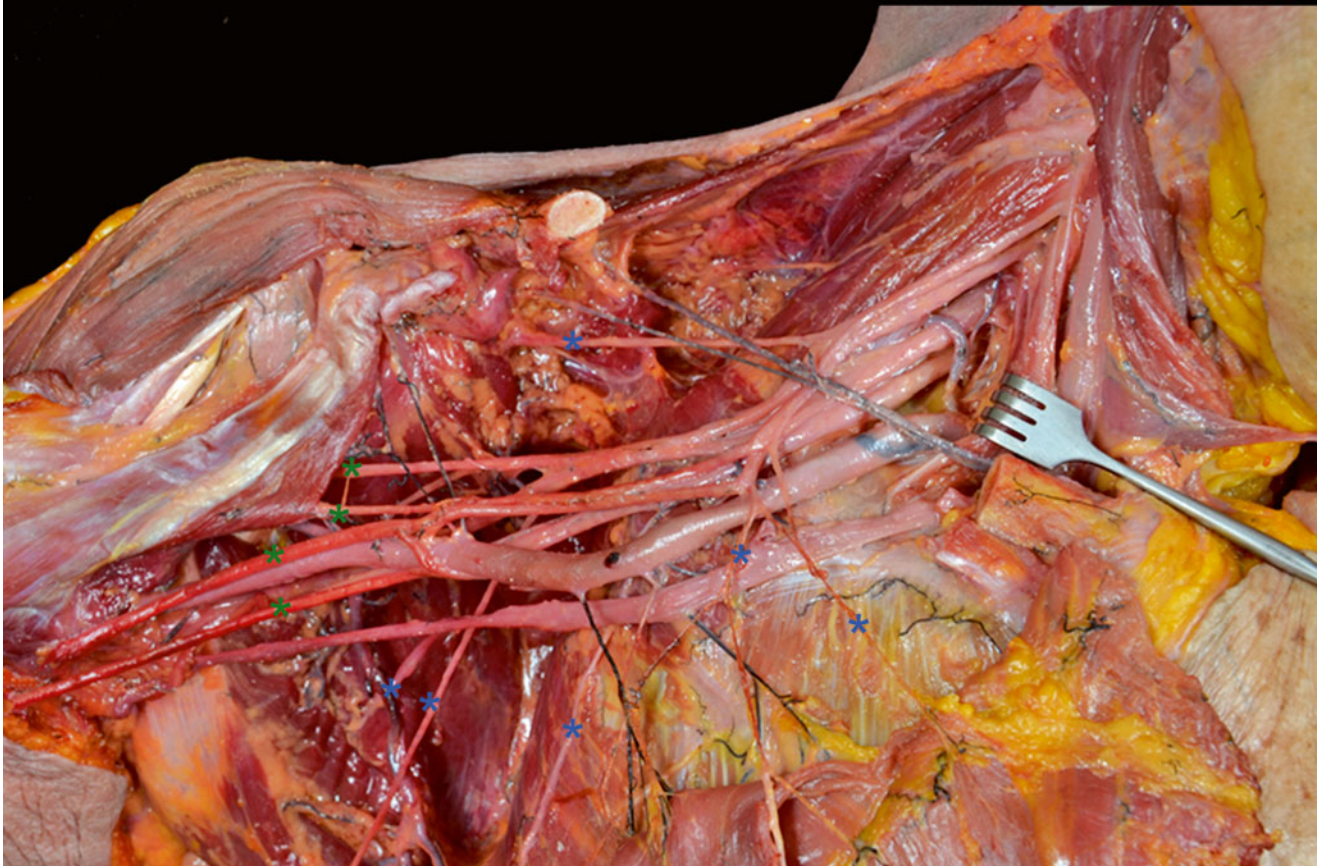


Fig. 7.13 Brachial plexus. From this sequence of brachial plexus elements (anterior branches of the spinal nerves, trunks, divisions, and fasciculi), different collateral nerves originate. These nerves innervate the structures of the upper extremity in the region of the shoulder girdle.

Meanwhile, the arm, forearm, and hand regions are innervated by the terminal nerves of the brachial plexus, which are formed by the division and/or combination of brachial plexus fasciculi

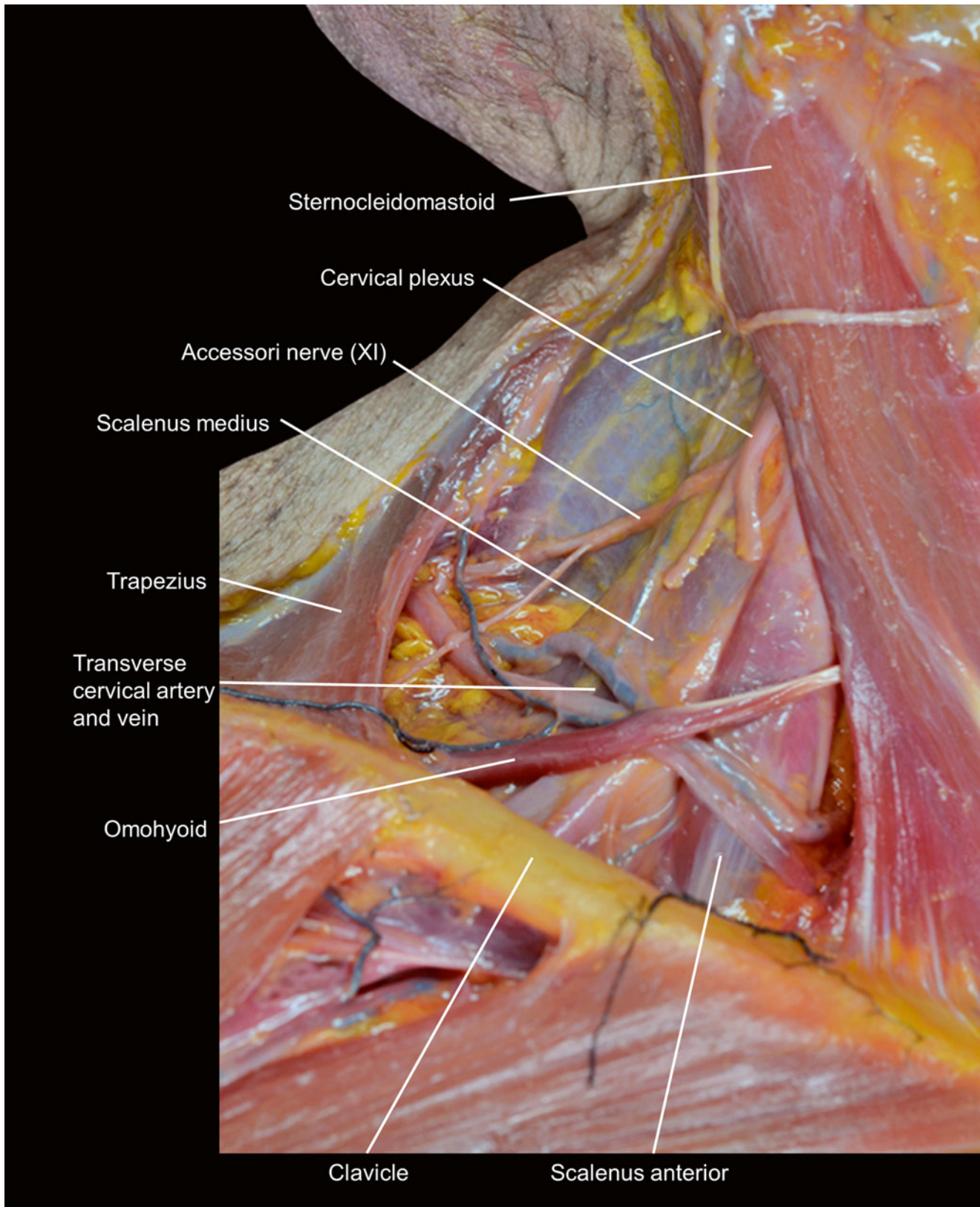


Fig. 7.14 Supraclavicular brachial plexus. The supraclavicular brachial plexus is located topographically in the lateral region of the neck, in the area bounded by the clavicle and the line drawn from the posterior border of the sternocleidomastoid muscle at the level of the cricoid

cartilage to the midpoint of the clavicle. The inferior belly of the omohyoid muscle crosses over the brachial plexus. This segment of the brachial plexus corresponds to the anterior branches of the spinal nerves and the trunks formed by their combinations

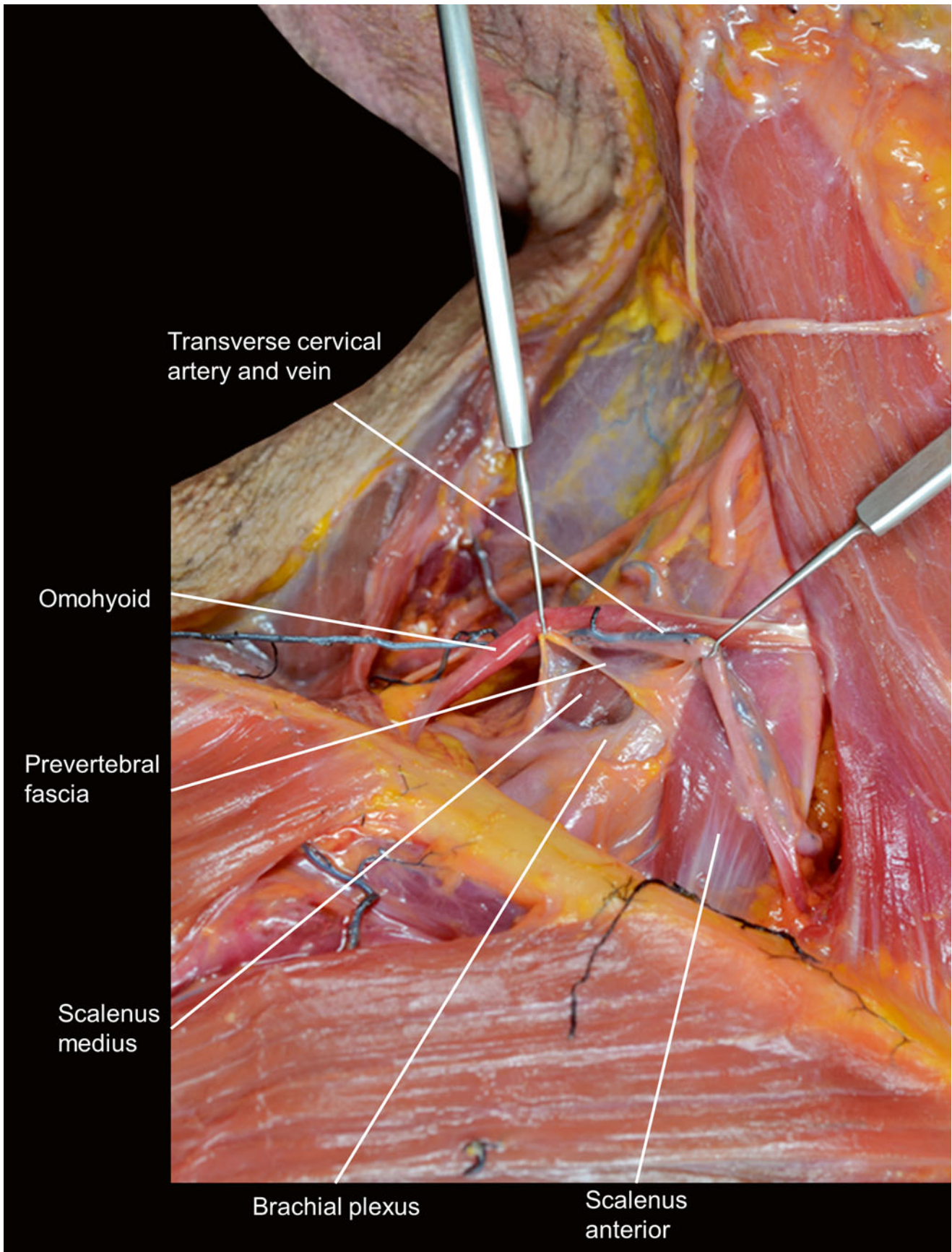


Fig. 7.15 Supraclavicular brachial plexus. All the supraclavicular plexus elements lie beneath the prevertebral (deep cervical) fascia. This fascia forms an anatomic compartment in which an anesthetic agent can flow and bath all the elements contained therein

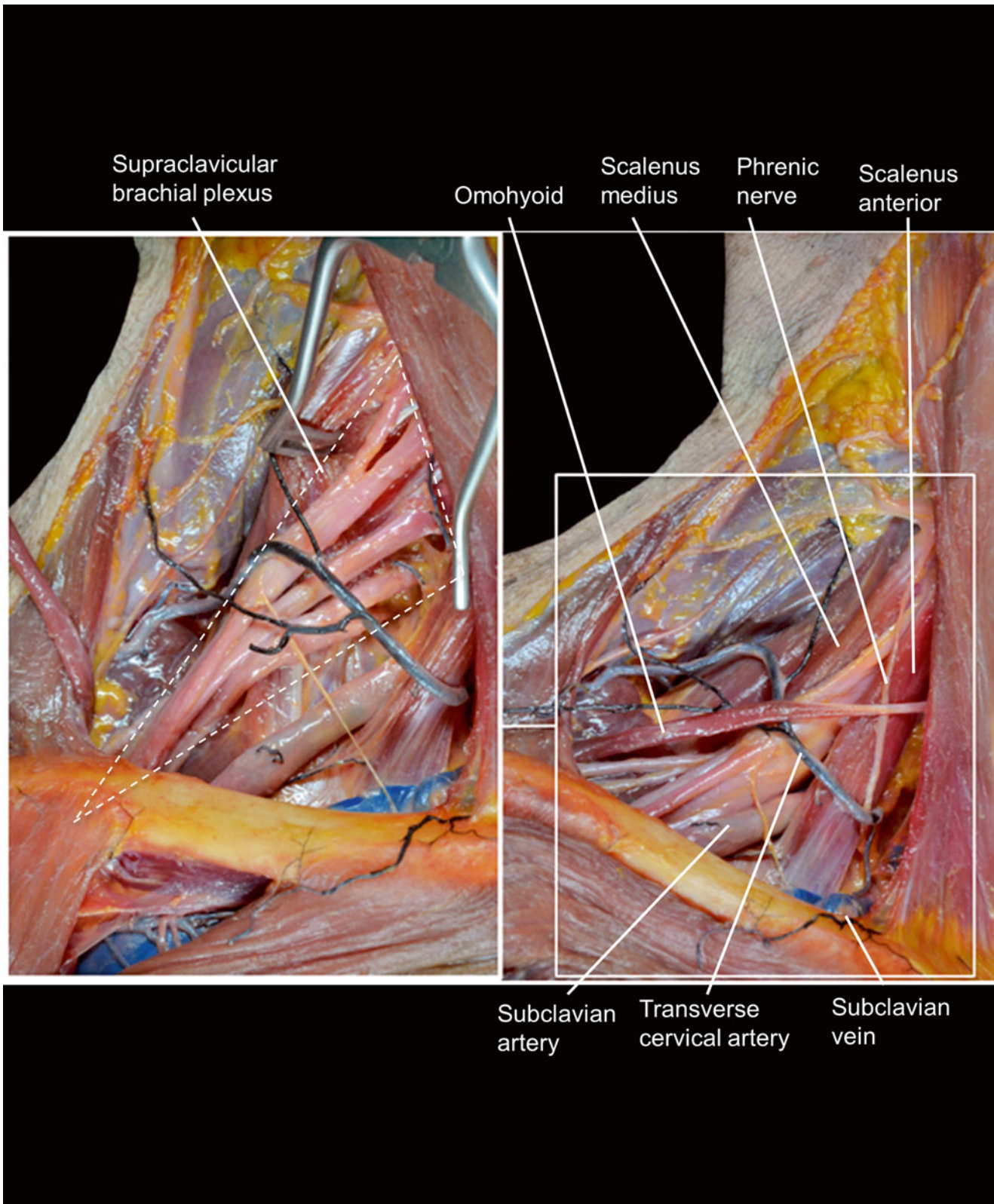


Fig. 7.16 Supraclavicular brachial plexus. The elements of the supraclavicular brachial plexus form a triangular sheet that extends from the cervical paravertebral line to the center of the clavicle. In this lateral region of the neck, the brachial plexus elements exist at two levels. First, the anterior branches of the spinal nerves are found in the cervical

paravertebral line, at the output of their intervertebral foramina, between the muscles of the paravertebral channels. Then, the brachial plexus trunks run through the interscalene space between the anterior and middle scalene muscles

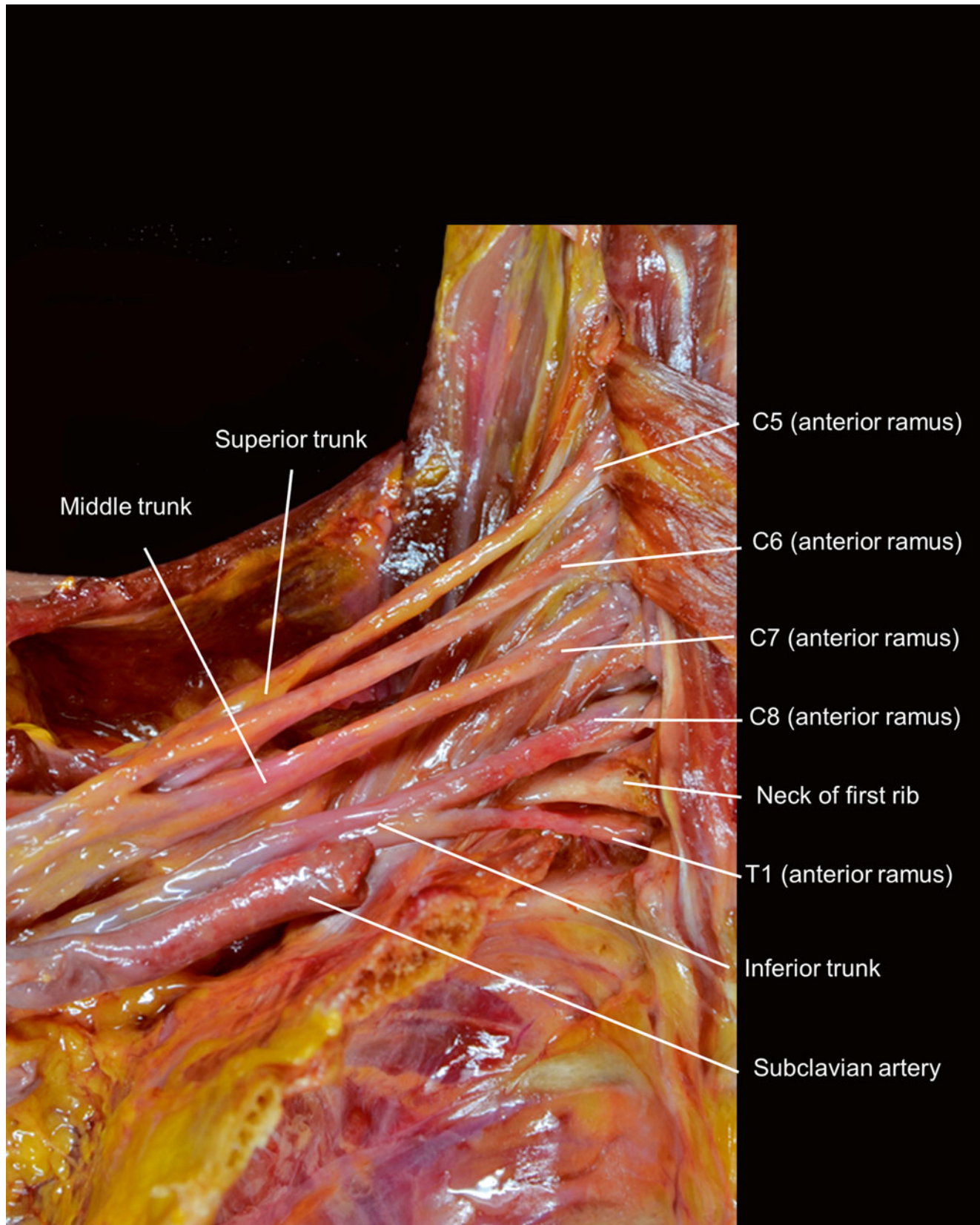


Fig. 7.17 Supraclavicular brachial plexus. The union of the anterior branches of spinal nerves C5, C6, C7, and C8 and most of the ventral branch of spinal nerve T1 forms three trunks. Specifically, the C5 and

C6 anterior branches join to form the upper trunk, C7 remains isolated as the middle trunk, and C8 and T1 bind to constitute the lower trunk

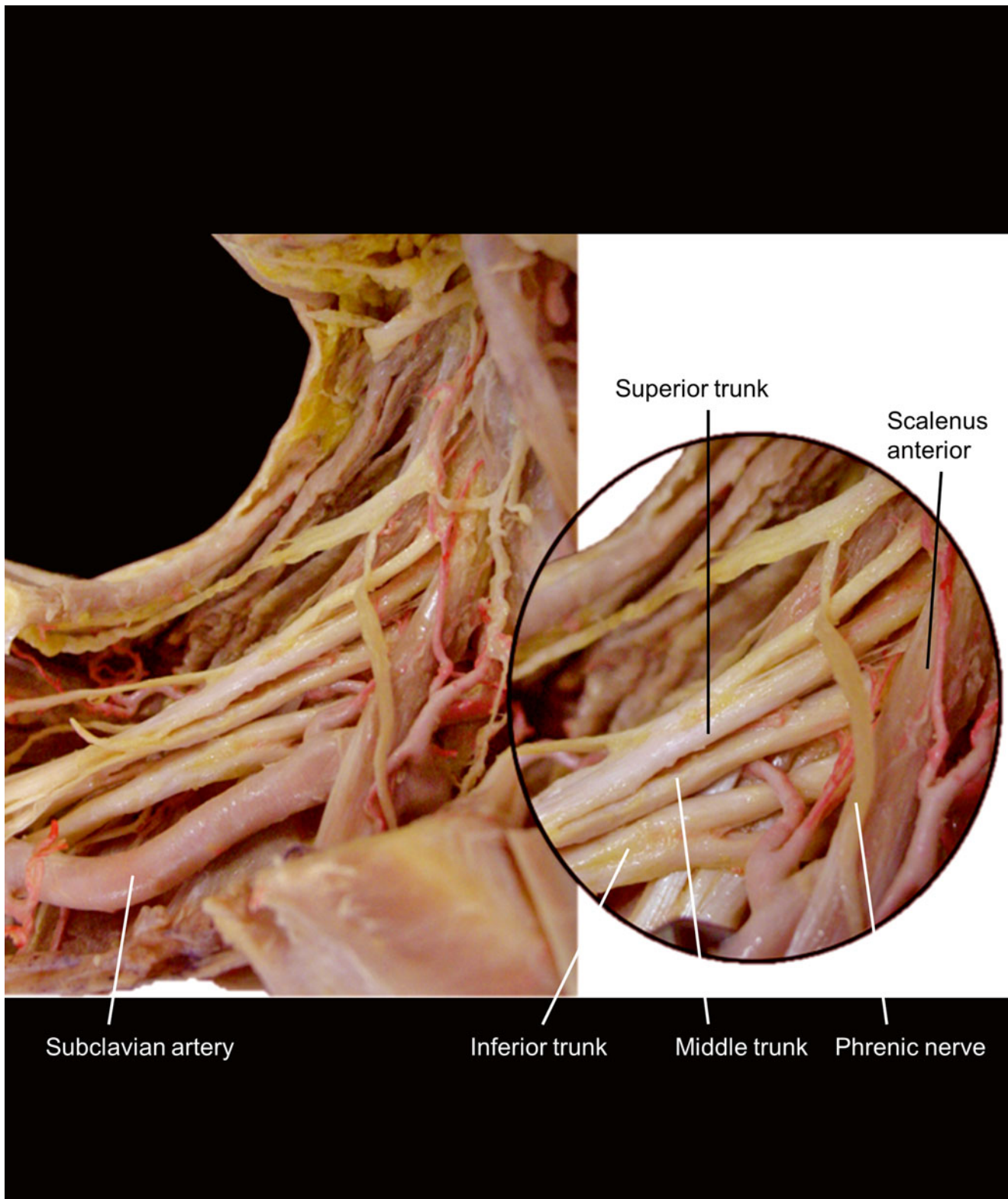


Fig. 7.18 Supraclavicular brachial plexus. The arrangement of the anterior branches of the spinal nerves of the brachial plexus and trunks changes gradually. Whereas the upper trunk and nerve C5 are positioned vertically, the lower trunk adopts a transverse arrangement. The anterior branch of C8 is disposed upward. The close relationship of C8 and the lower trunk with the subclavian artery explains the delayed or

even insufficient anesthesia of these elements that sometimes occurs with supraclavicular brachial plexus block. In the cervical paravertebral area, the vertebral artery rises through the cervical transverse processes anterior to each of these nerves. In this space, one must account for the proximity of the paravertebral sympathetic chain and its interconnections to the elements of the plexus

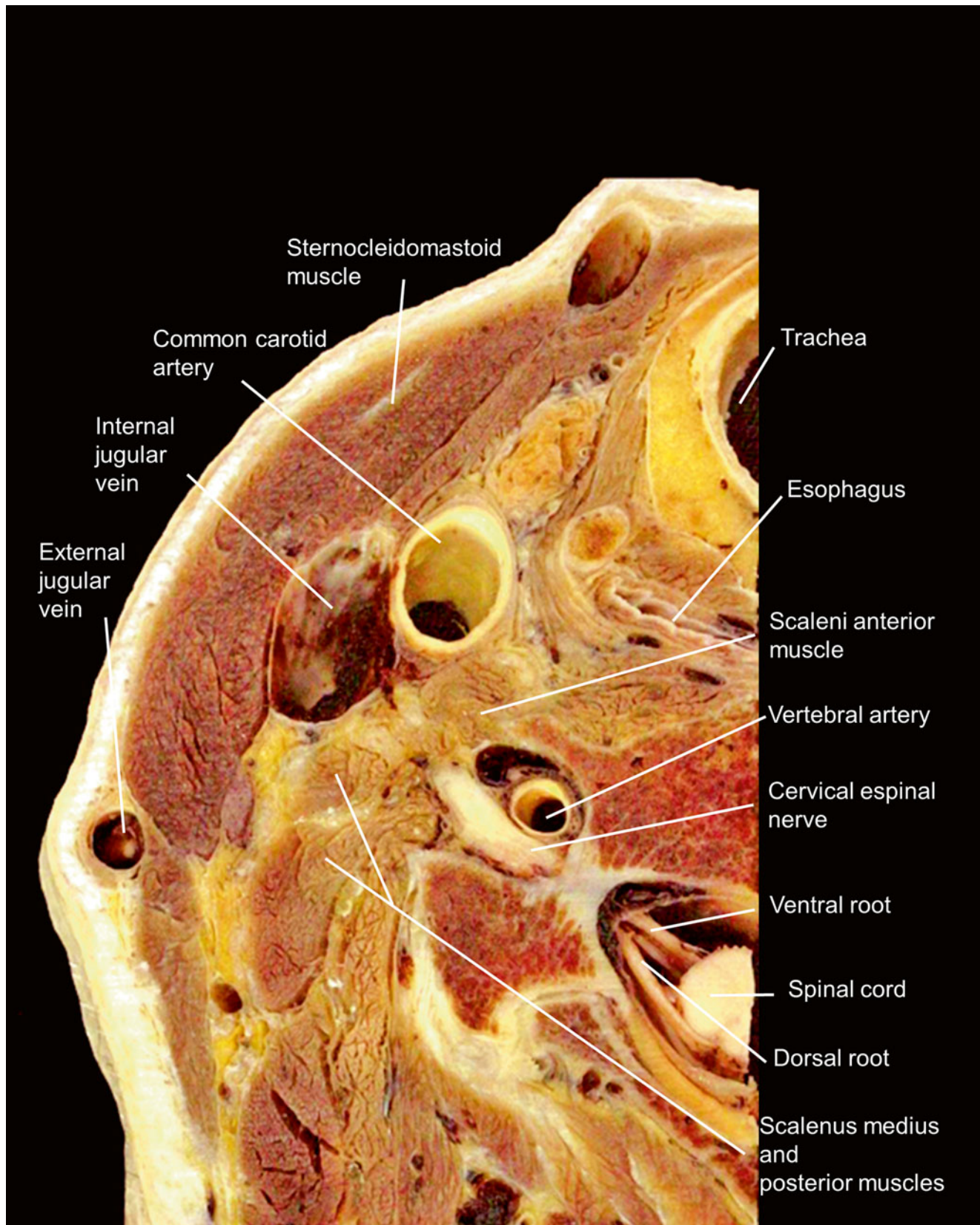


Fig. 7.19 Supraclavicular brachial plexus. This cross-section of a cervical transverse process shows the characteristic arrangement of the spinal nerve anterior branch, between the anterior and posterior tuber-

cles of the transverse process. The relationship between the nerve root and the vertebral artery and vein also may be seen

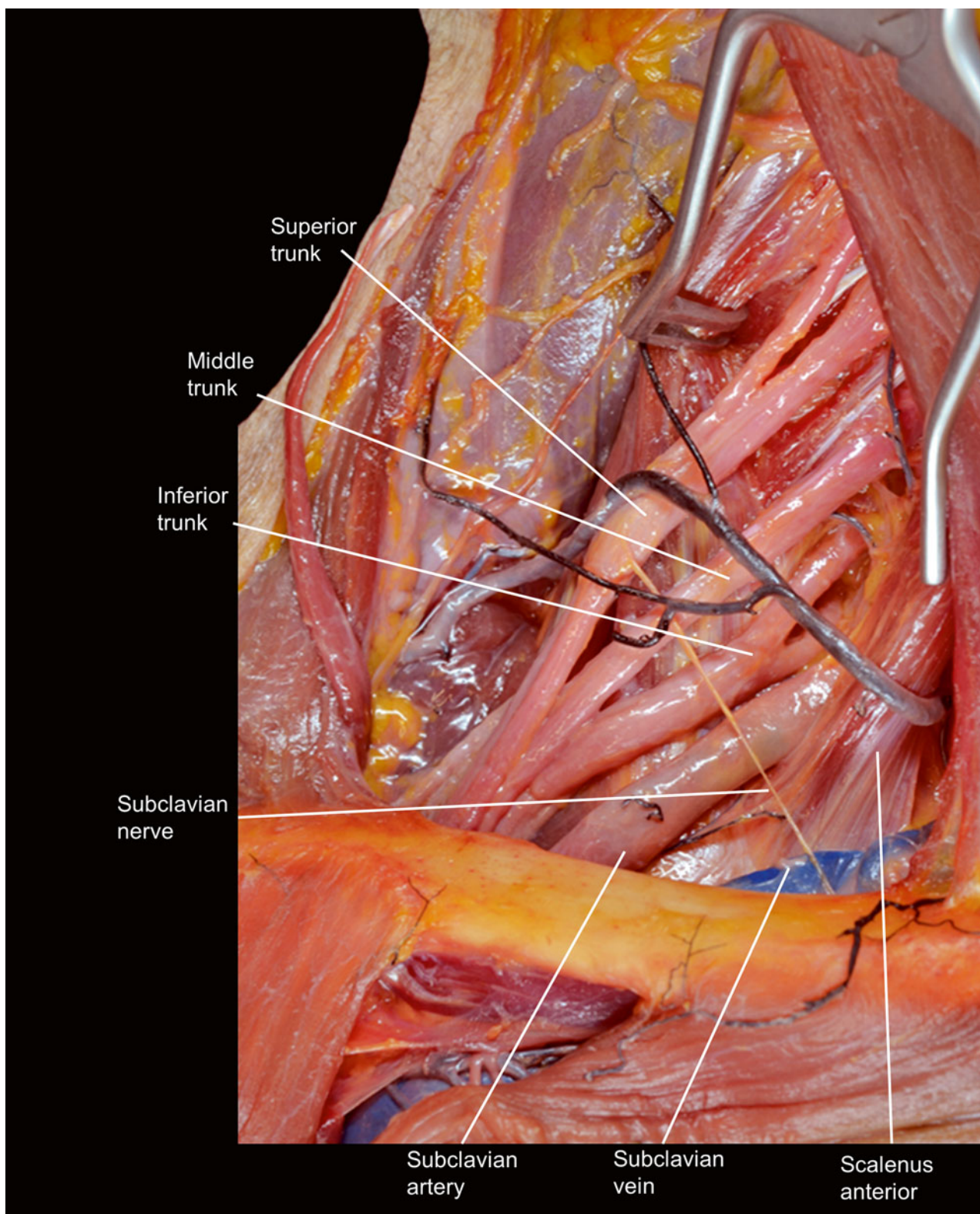


Fig. 7.20 Supraclavicular brachial plexus. The elements of the brachial plexus in the interscalene space are the upper, middle, and lower trunks. Their names refer to the orderly arrangement from cranial to caudal, coinciding with the arrangement of the anterior branches of the spinal nerves at which they originate. The transverse cervical artery runs superficial to the trunks. Caudally, the trunks of the brachial plexus

tend to cluster, forming a nerve cord that passes under the clavicle. In the interscalene space, the subclavian artery is in front of the trunks as it passes over the first rib. The subclavian vein is in front of the anterior scalene muscle insertion. It is related to the phrenic nerve, which characteristically is in the anterior face of this muscle



Fig. 7.21 Supraclavicular brachial plexus. This sagittal section through the interscalene space shows how the trunks of the brachial plexus, the subclavian artery, and the subclavian vein are arranged cranial to caudal and posterior to anterior. The trunks of the brachial plexus

and the subclavian artery are positioned at the interscalene space, whereas the subclavian vein passes in front of the anterior scalene muscle



Fig. 7.22 Supraclavicular brachial plexus. Several collateral nerves originate from the supraclavicular brachial plexus. The dorsal scapular nerve arises from the back side of nerve C5. The long thoracic nerve roots originate on the back side of nerves C5, C6, and C7; the supra-scapular nerve emerges from the posterior face of the upper trunk.

Another collateral branch, the subclavian muscle nerve, arises from the anterior face of the upper trunk. Besides these collateral branches, the supraclavicular plexus begins the innervation of the scalene muscles, longus colli muscle, and connections between the anterior branch of nerve C5 and the phrenic nerve

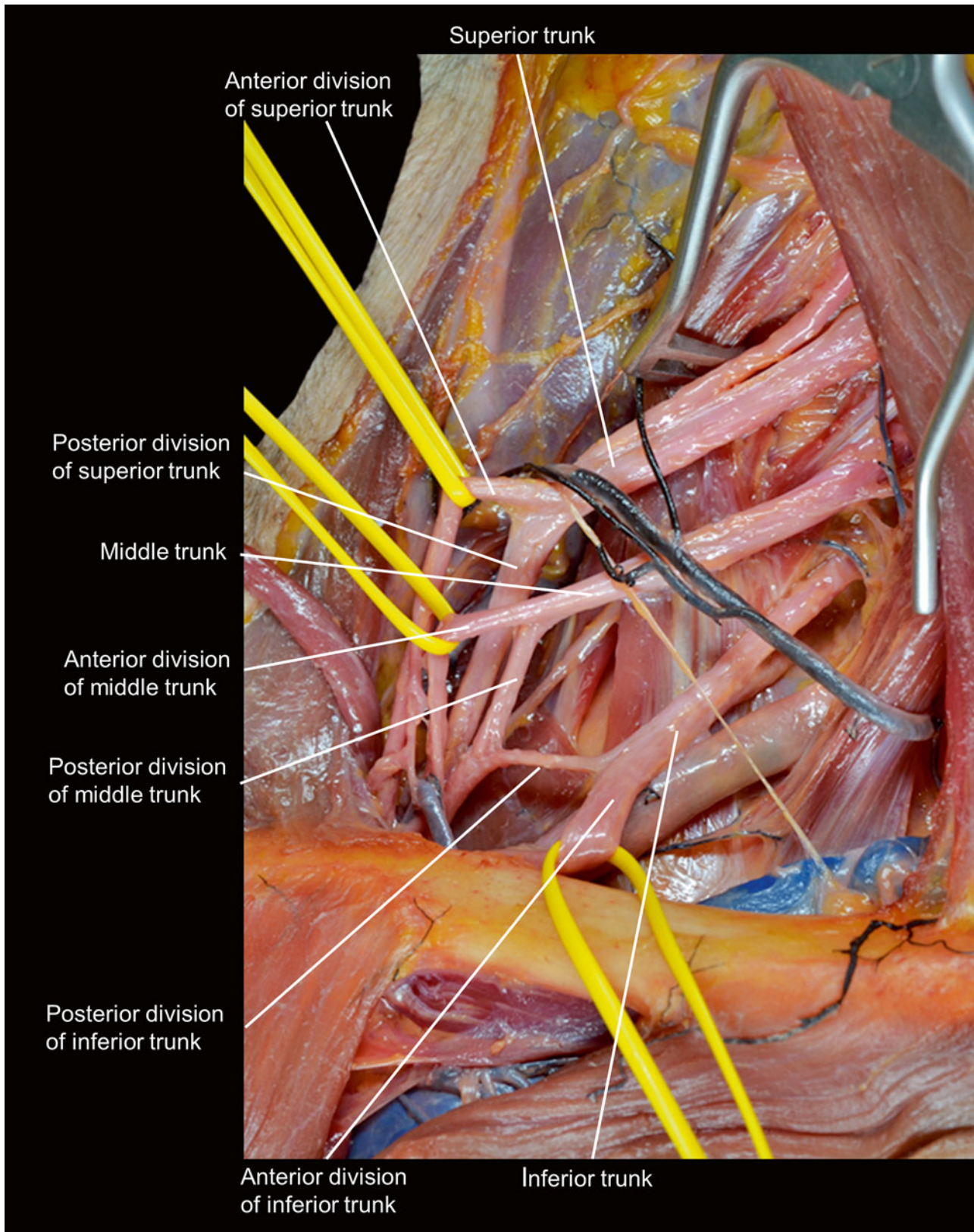


Fig. 7.23 Supraclavicular brachial plexus. Near the costoclavicular corridor, each trunk of the brachial plexus divides into an anterior and a posterior segment. These divisions constitute a functional organization of the plexus. The anterior divisions give rise to nerves distributed on

the front face of the upper extremity; therefore, they have a major functional flexor component. Meanwhile, the posterior divisions give rise to nerves toward the posterior face of the limb, with an extensor main functional component

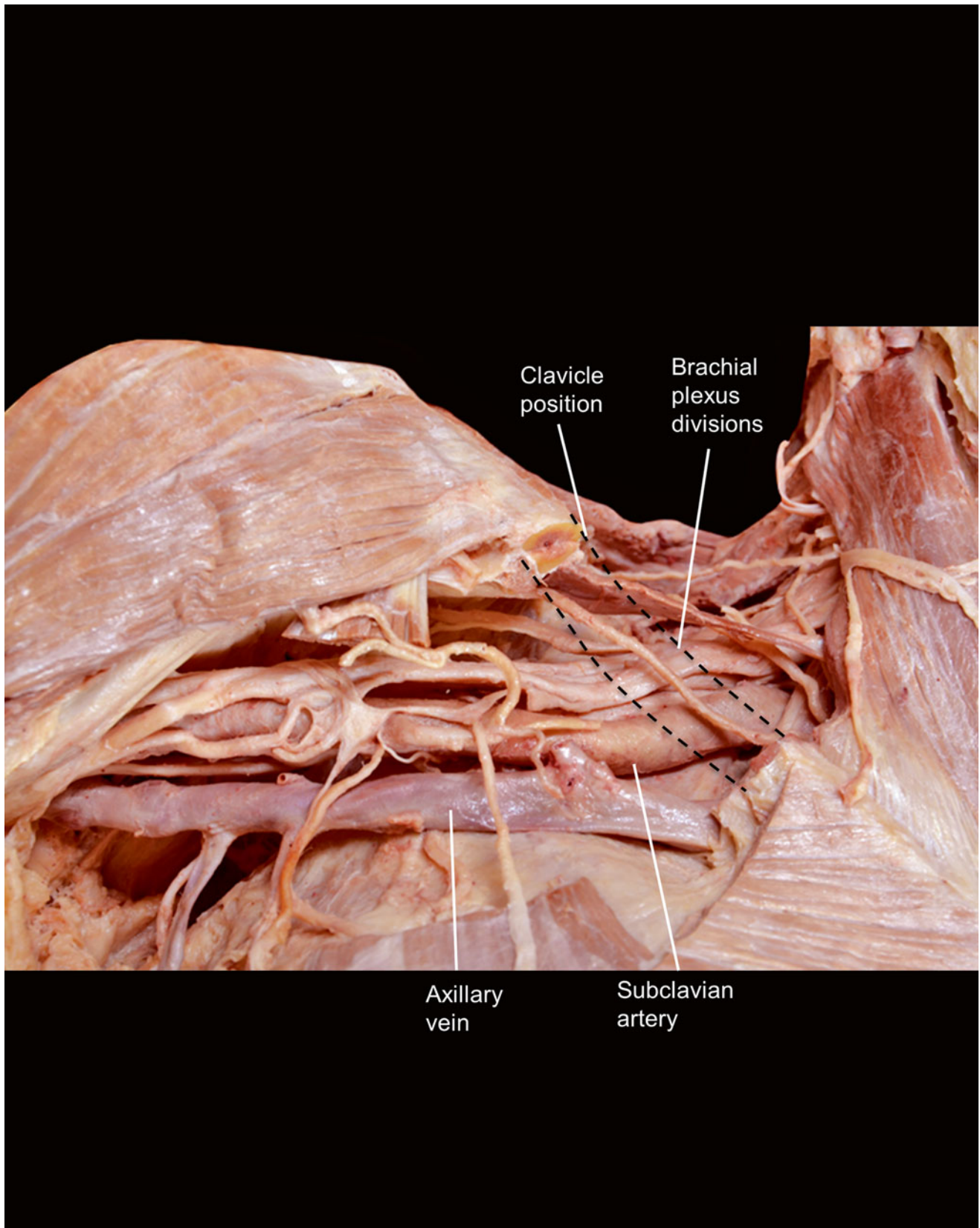


Fig. 7.24 Supraclavicular brachial plexus. Although the brachial plexus is divided into six parts (three anterior and three posterior), these divisions are grouped together to form a single nerve cord positioned at

the junction between the lateral third and the two medial thirds of the clavicle, posterior and lateral to the subclavian artery. Thus, the plexus minimizes its size to pass under the clavicle to access the armpit

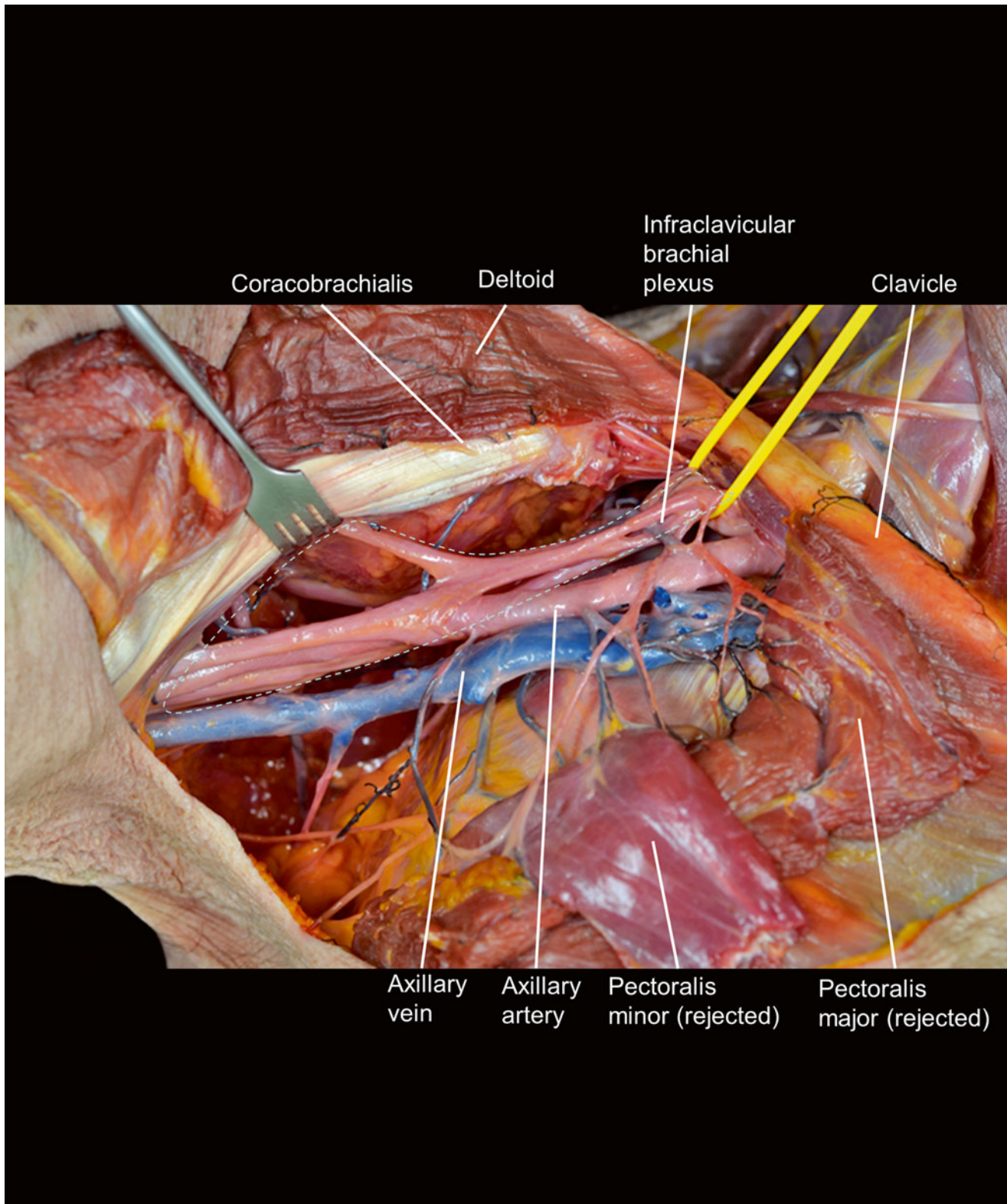


Fig. 7.25 Infraclavicular brachial plexus. The infraclavicular brachial plexus is located in the axillary cavity and consists of cords and terminal nerves. Overall, this portion of the brachial plexus is cone shaped. At its apex, at the entrance of the axillary cavity from the retroclavicular space, its constituent elements remain grouped. Distally, the plexus expands, coinciding with the origin of its terminal branches, which are arranged

around the axillary artery. In anatomic position, the infraclavicular brachial plexus has an oblique downward, lateral, and slightly posterior disposition. However, clinically it must be remembered that when the arm is abducted for an anesthetic procedure, this anatomic positions becomes horizontal and the plexus is placed now closer to the skin surface

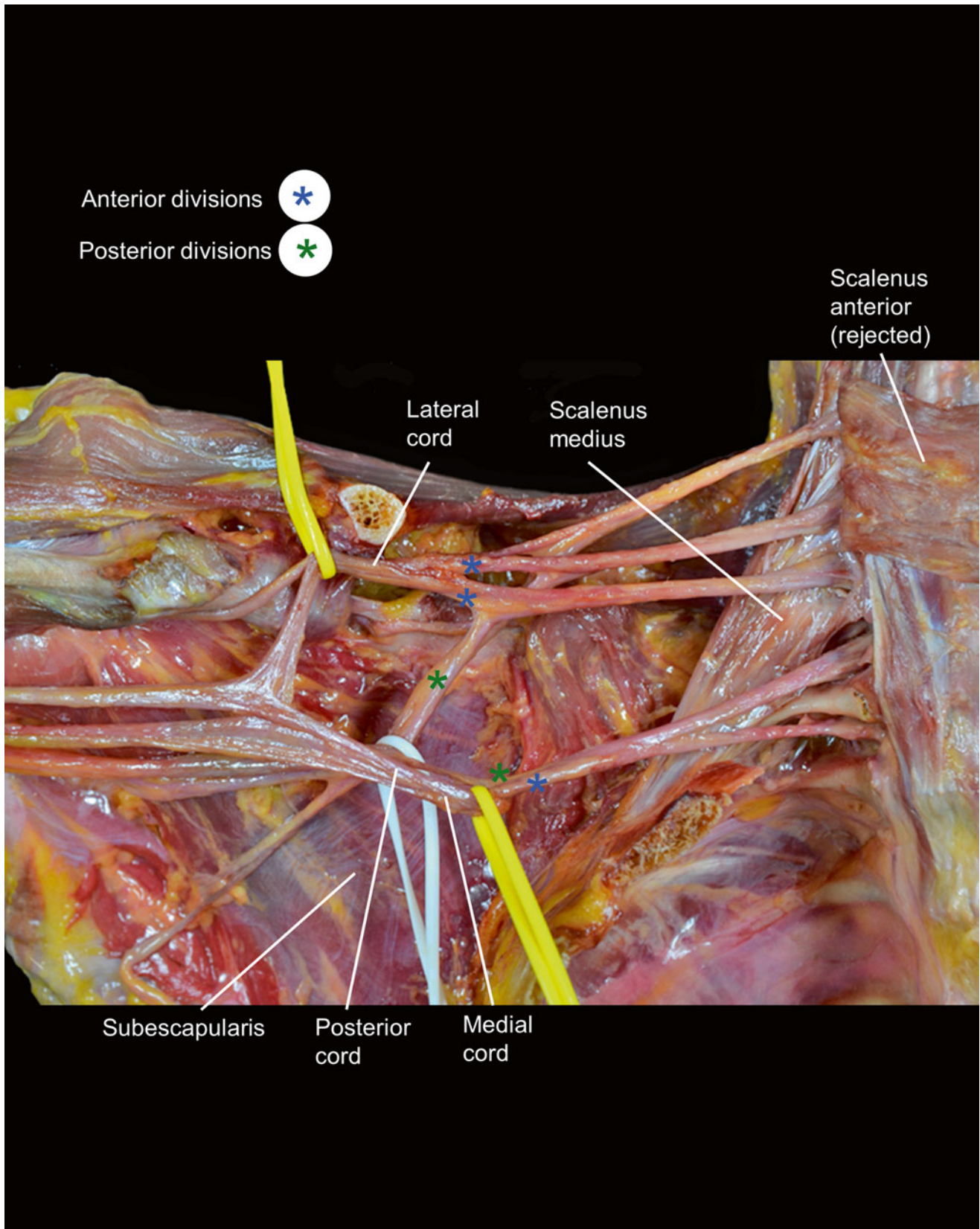


Fig. 7.26 Infraclavicular brachial plexus. In the infraclavicular brachial plexus segment, the anterior and posterior trunk divisions are combined, resulting in cords that give rise to the terminal branches of

the plexus. Specifically, the anterior divisions of the upper and middle trunks result in the lateral cord, the anterior division of the lower trunk in the medial cord, and the three posterior divisions in the posterior cord

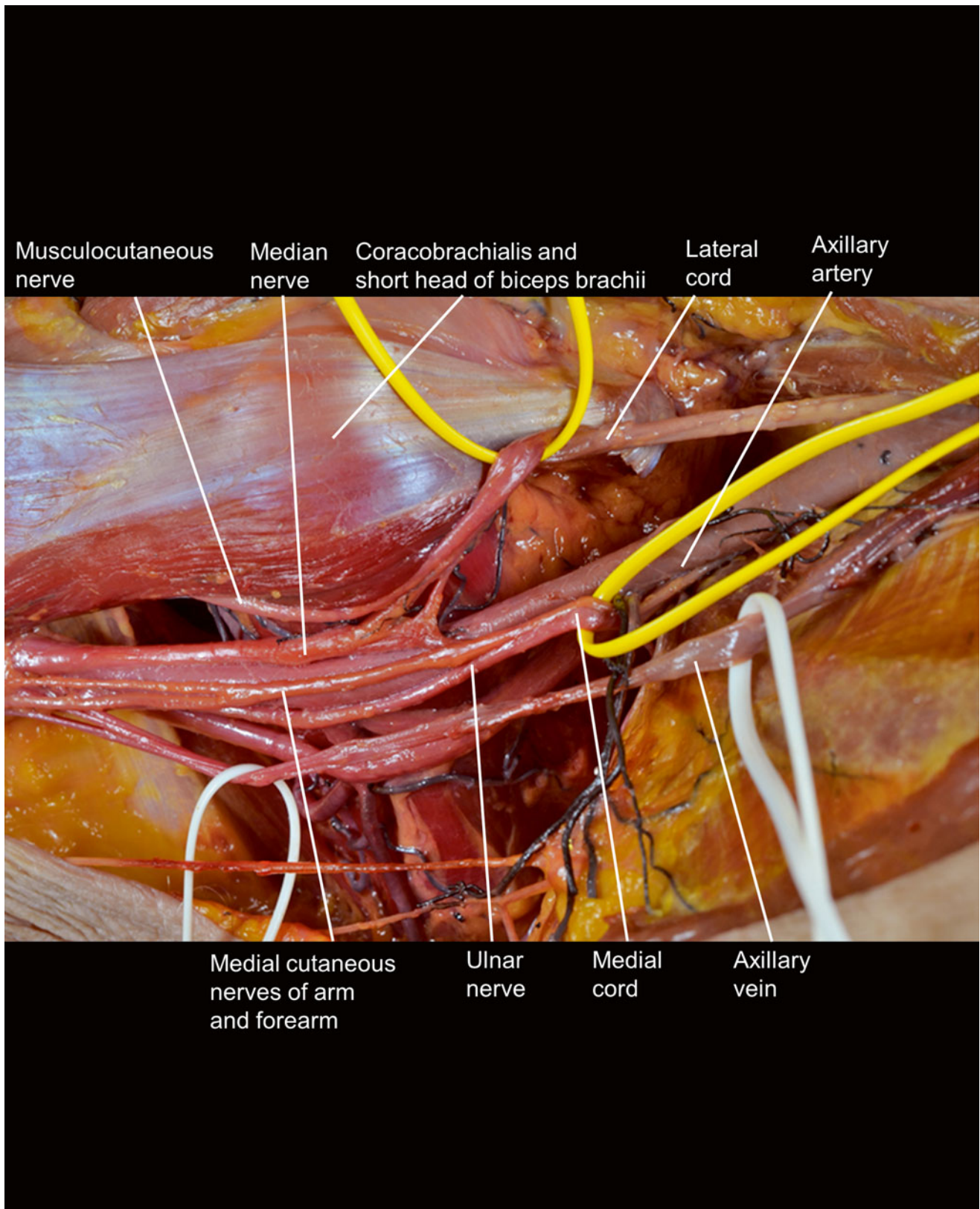


Fig. 7.27 Infraclavicular brachial plexus. The brachial plexus terminal nerves correspond to five mixed nerves—the musculocutaneous, median, ulnar, axillary, and radial nerves—and two exclusively sensory nerves—the medial brachial cutaneous and medial antebrachial

cutaneous nerves. From the lateral cord, the musculocutaneous nerve and the lateral root of the median nerve arise; the medial cord divides into the medial root of the median nerve, the ulnar nerve, and the medial brachial and antebrachial cutaneous nerves

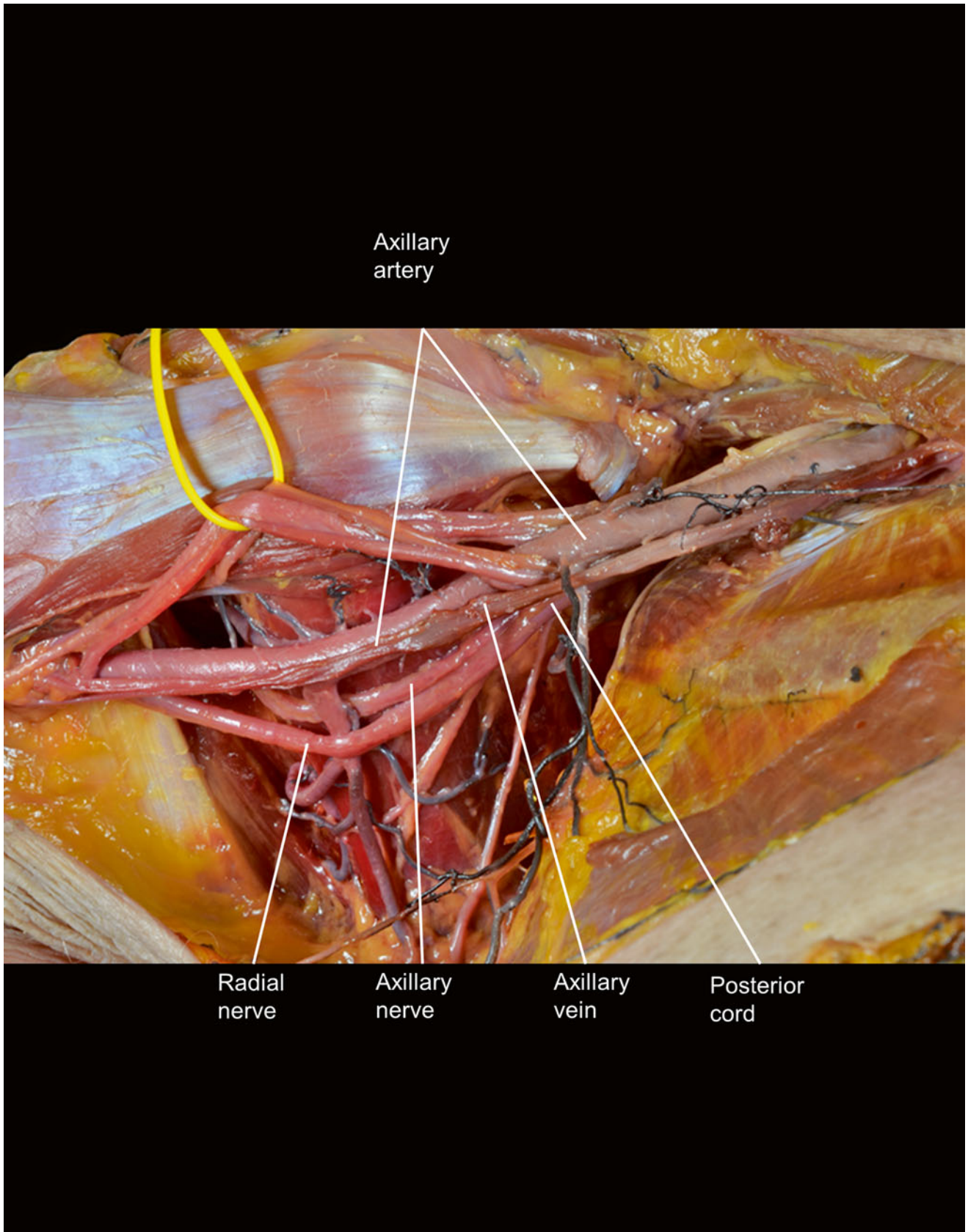


Fig. 7.28 Infraclavicular brachial plexus. The axillary and radial nerves arise from the posterior cord

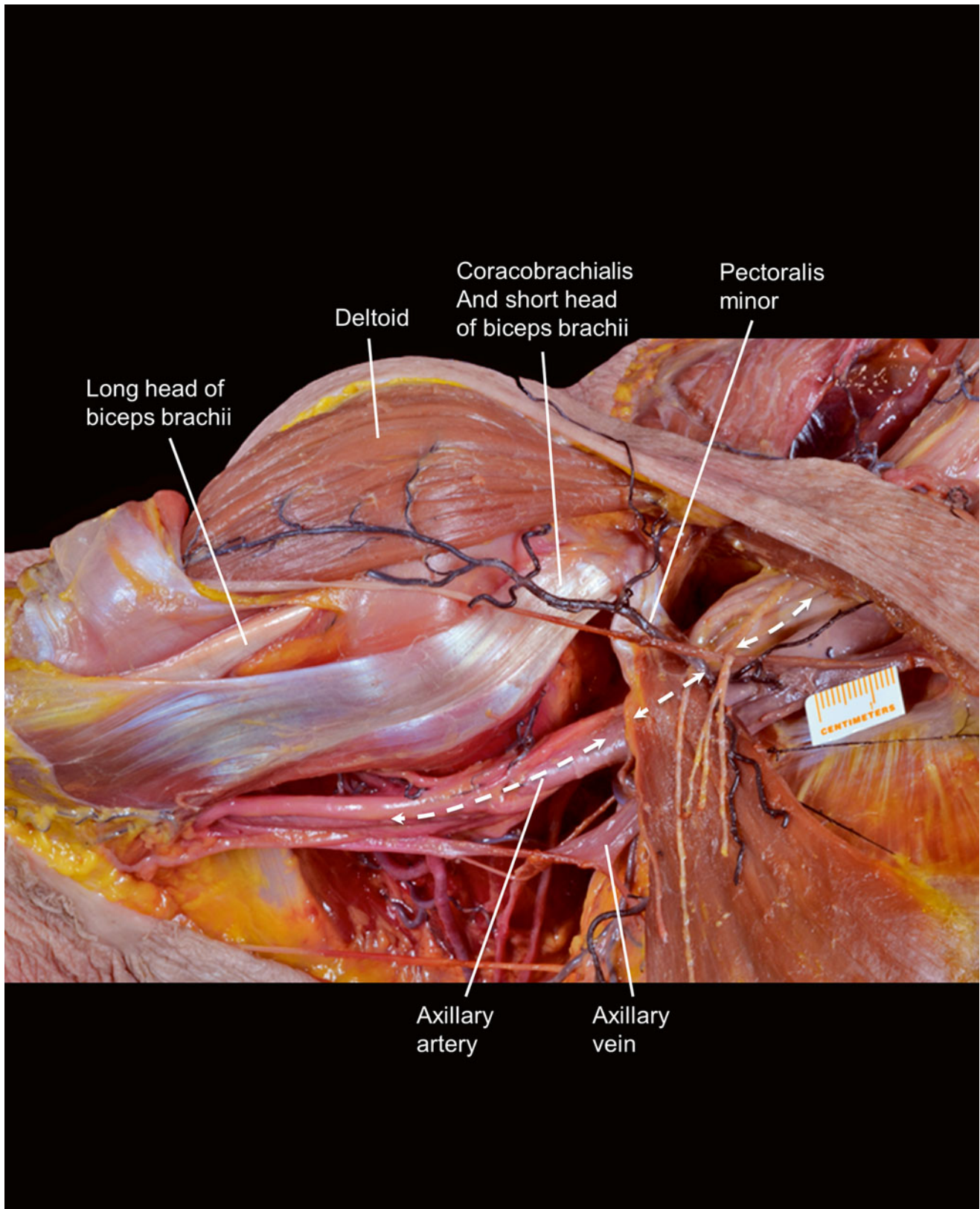


Fig. 7.29 Infraclavicular brachial plexus. In the anterior wall of the axilla, and by using the insertion of the pectoralis minor muscle on the coracoid process of the scapula as a reference, the elements constituting the infraclavicular plexus can be organized. Three regions can be

distinguished: a region between the clavicle and the upper margin of the pectoralis minor muscle, a region posterior to this muscle, and a region between the lower edge of the pectoralis muscle and the base of the axilla

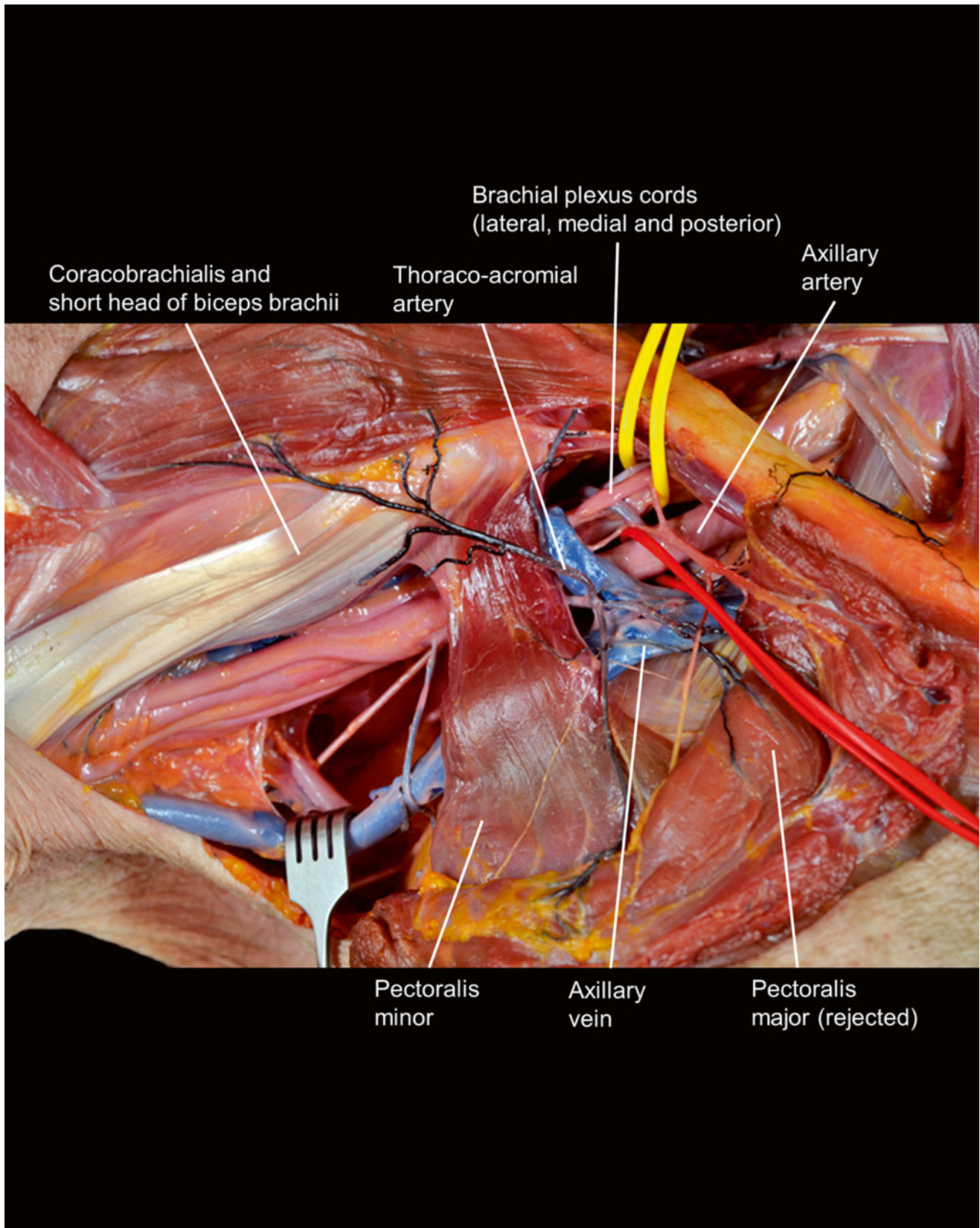


Fig. 7.30 Infraclavicular brachial plexus. Between the clavicle and the upper margin of the pectoralis minor muscle, infraclavicular plexus cords are grouped into a nerve cord located posterolateral to the axillary

artery. The axillary vein, meanwhile, is the most medial and anterior element of the axillary neurovascular bundle

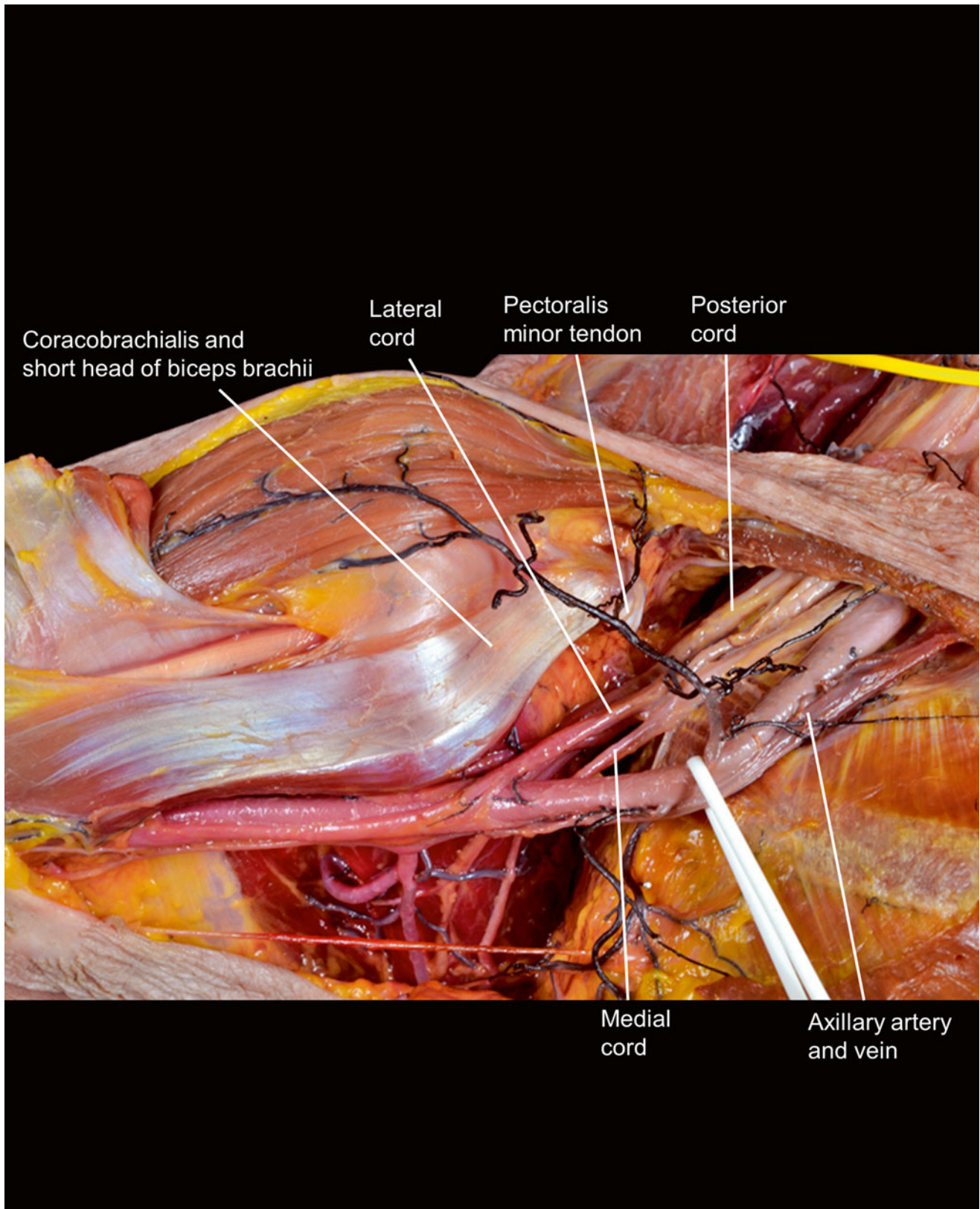


Fig. 7.31 Infraclavicular brachial plexus. Under the pectoralis minor tendon, the brachial plexus cords surround the axillary artery in positions that, in fact, form the underlying nomenclature. Specifically, the lateral cord descends to lie anterolateral to the artery, whereas the

medial cord lies obliquely behind the axillary artery and above the posterior cord to a position between the axillary artery and vein, which is the most medial element in this area. The posterior cord then is located behind the artery

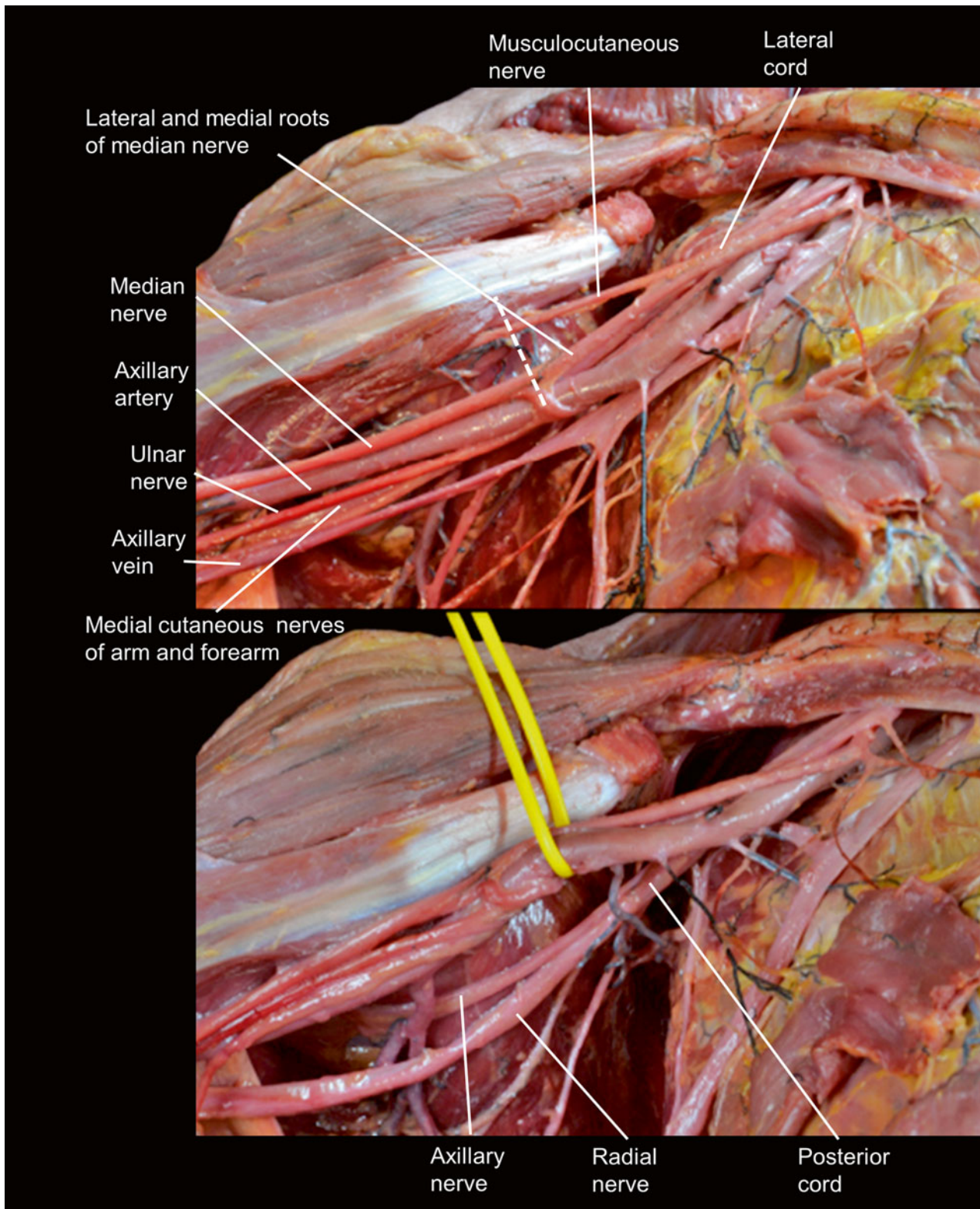


Fig. 7.32 Infraclavicular brachial plexus. At the lower edge of the pectoralis minor muscle, the cords of the brachial plexus become terminal nerves. Given their origin, these nerves are arranged around the axillary artery, occupying a position very similar to that of the cords from which they originated. Thus, the musculocutaneous nerve from the lateral cord is anterolateral to the axillary artery. The median nerve, formed by

the union of two components from the lateral and medial cords, is located on the front side of the axillary artery. The ulnar nerve, the medial antebrachial cutaneous nerve, and the medial brachial cutaneous nerve arising from the medial cord lie anteromedial to the artery. Finally, the nerves formed from the posterior cord (the axillary nerve and the radial nerve) are located on the back side of the artery

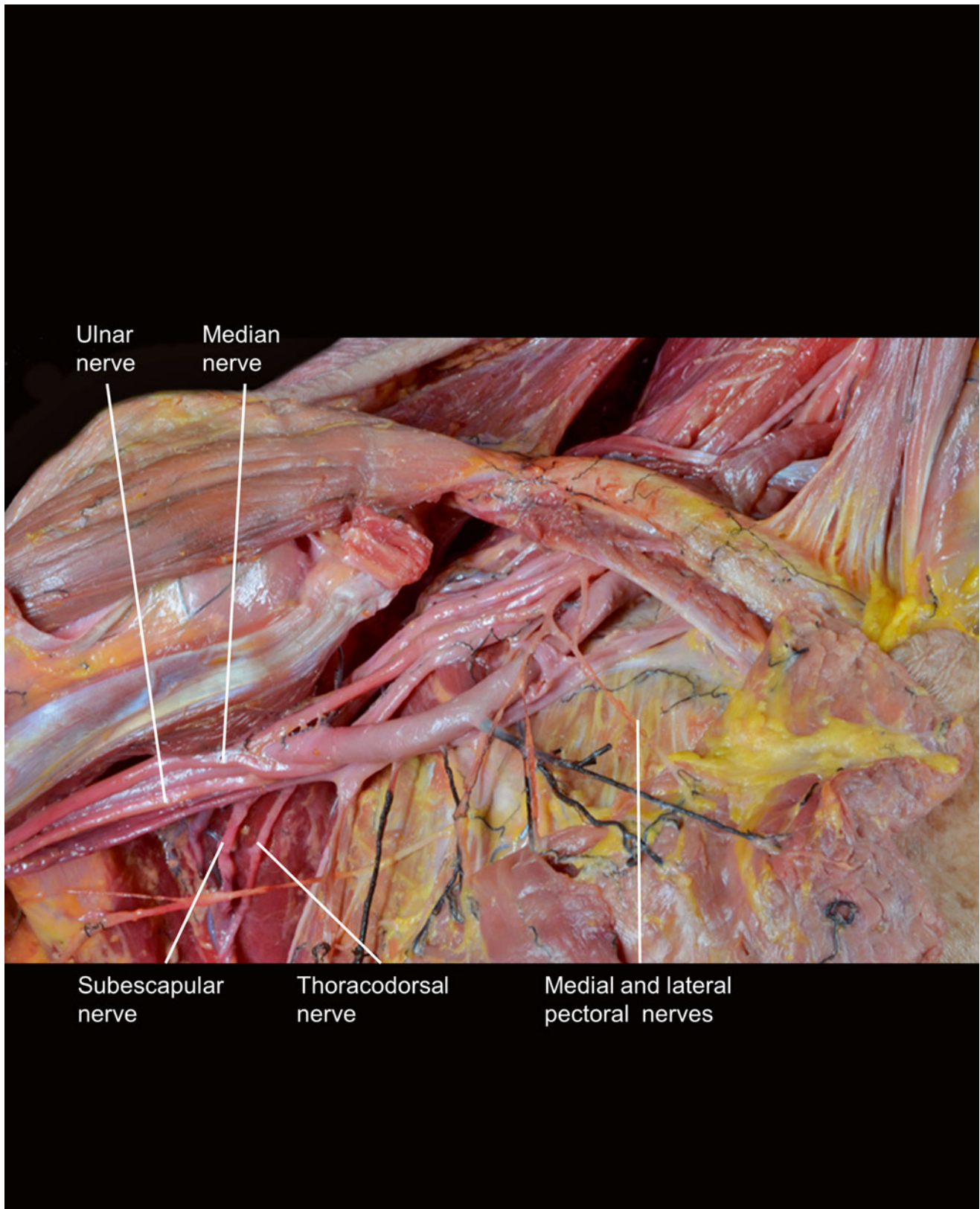


Fig. 7.33 Infraclavicular brachial plexus. Besides the seven terminal nerves already mentioned, the infraclavicular segment of the brachial plexus also gives rise to some collateral nerves. These are the lateral and medial pectoral nerves that arise from the anterior aspect of the

lateral and medial cords, respectively, and the upper subscapular, thoracodorsal, and lower subscapular nerves that emerge from the back of the posterior cord, craniocaudally in that order