17 Total Thyroidectomy with Comprehensive Central and Lateral Neck Dissection for Differentiated Thyroid Carcinoma

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Introduction

Total thyroidectomy with comprehensive central and lateral neck dissection represents the standard surgical treatment of differentiated thyroid carcinomas (DTCs) with lateral neck lymph node involvement (N1b) [1–7].

Lymph node metastases may negatively affect recurrence rate and survival [1–3] and occur in 30–80% of patients with papillary thyroid carcinoma (PTC) [8, 9] and, rarely (1–8%), in follicular thyroid carcinoma (FTC) patients [10].

Clinical evaluation and preoperative workup are of utmost importance to plan the correct initial surgical procedure, balancing a complete oncological removal of the tumor and nodal disease while minimizing the complication rate.

An accurate ultrasound evaluation, eventually performed by the surgeons, himself/herself [11], is essential in the evaluation of the thyroid tumor and nodal status. The loss of fatty hilum, calcifications, peripheral vascularity, hyperechogenicity, rounded rather than oval shape, cystic changes, and large size are all characteristics of lymph nodes suspicious for nodal metastases at ultrasound [4]. Preoperative fine-needle aspiration cytology confirms in many cases suspicion of nodal involvement. Thyroglobulin measurement in the washing fluid of the fine-needle aspirate can be helpful in the diagnosis of node-positive (N1) DTC, especially in the case of cystic lateral neck masses, where aspiration cytology is often paucicellular [4]. In the cases in which there is no cytologically/histologically proven nodal disease, a frozen section examination of suspiciously enlarged nodes can enable definitive intraoperative diagnosis, reducing the need for further operations for persistent/recurrent disease [11].

Cross-sectional imaging studies (computed tomography – (CT) or magnetic resonance imaging – (MRI)) with intravenous contrast could be sometimes helpful in the identification of nodal involvement, especially in the upper mediastinum and the retropharyngeal and parapharyngeal spaces [1, 4], and in confirming/excluding the invasion of adjacent organs/structures, including the esophagus, trachea, larynx, and vessels in selected cases (bulky tumors, tumors showing an unexpected rapid growth, signs and symptoms of local invasion – i.e., dysphonia, dysphagia, dyspnea, suspicious findings at preoperative ultrasonography). In suspicious cases, esophagogastroduodenoscopy and/or endotracheal endoscopy can be used to preoperatively confirm/exclude local invasion.

The preoperative workup should include the evaluation of inferior laryngeal nerves (ILNs), by means of direct laryngoscopy. Preoperative vocal fold paralysis may indicate gross invasion by tumor and/or lymph node metastasis or surgical injury during previous operations. The affected nerve can be confidently resected in similar situations in order to achieve adequate oncologic resection. On the contrary, if normal vocal fold motility is demonstrated at preoperative workup, any effort should be made to preserve the anatomic integrity and function of the ILN, even in the presence of macroscopic invasion by the tumor itself or by metastatic nodes with an extranodal growth pattern. However, in such challenging settings, every effort should be made to remove all gross diseases, while preserving ILN function. The benefits of preserving a functioning nerve should be always weighed against the risks of leaving structural disease, especially when facing aggressive histopathological variants of follicular-cell-derived tumors, less prone to respond to adjuvant treatment (i.e., radioiodine treatment).

Lymph node neck dissections are challenging operations associated with several possible complications, as many anatomic structures are at risk during the surgical dissection in a

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relatively small operative field. The trachea, esophagus, laryngeal nerves, and parathyroid glands are extensively exposed during central neck dissection (CND). Moreover, when a lateral neck dissection (LND) is performed, the internal jugular vein (IJV); common carotid artery (CCA); vagus, hypoglossal, phrenic, and spinal accessory nerves (SANs); sympathetic trunk; brachial plexus; and thoracic duct could be at risk of injury.

Knowledge of anatomic landmarks, nomenclatures, classifications, and surgical techniques is essential to offer the most appropriate surgery [7, 8].

Neck lymph nodes have been grouped in levels by the Committee for Head and Neck Surgery and Oncology of the American Academy of Otolaryngology-Head and Neck Surgery (AAO-HNS), with the specific aim of standardizing the nomenclature and reporting system of neck dissections. Level I includes submental (Ia) and submandibular nodes (Ib). Level II includes the upper jugular nodes (the SAN, which travels obliquely across this area, is used as a landmark to subdivide this group into IIb, the portion above and behind the nerve, and IIa, the portion that lays antero inferiorly to it). Level III includes the mid jugular nodes, and level IV includes the lower jugular nodes. Level V includes the lymph nodes of the posterior triangle of the neck (this level is further subdivided by a plane passing along the inferior border of the cricoid cartilage into level Va, superiorly, containing the spinal accessory nodes, and level Vb, inferiorly, containing the transverse cervical and supraclavicular nodes) [12, 13]. Level VI–VII nodes include the lymph nodes of the anterior cervical compartment (level VI) and the superior mediastinal nodes that can be reached via a cervical incision (previously reported as level VII), more commonly reported as central compartment. The boundaries of the anterior compartment (level VI) are defined superiorly by the hyoid bone, inferiorly by the sternal notch, and laterally by the medial aspect of the carotid sheath. Superior mediastinal nodes (level VII lymph nodes) that are removable by a trans cervical approach are those associated with the brachiocephalic vein and innominate artery. The boundaries of level VII are the suprasternal notch superiorly, the medial aspect of the carotid sheath laterally, and the innominate artery on the right (at its point of tracheal crossing) and the corresponding axial plane on the left [14].

Regarding the surgical technique, following the initial description by G. Crile in 1906 of a series of patients who successfully underwent radical neck dissection (RND) [15], which implied the removal of level I–V neck nodes *en bloc* with the IJV, sternocleidomastoid muscle (SCM), and SAN, several modifications have been proposed over the last century in order to minimize the unnecessary consequences and mutilation of Crile's procedure. Owing to high morbidity and anatomical deformity due to RND, in 1963, O. Suarez [16, 17] and, subsequently, Bocca and Pignataro [16] and Gavilan et al. [18–20] described a modified RND (MRND) as functional neck dissection [16, 21], in which satisfactory oncologic results could be obtained while preserving key anatomical structures, i.e., SAN, IJV, and SCM, using a technique of dissection, which follows the fascial planes of the neck.

Indeed, the cervical lymph nodes are without exception contained in the spaces delimited by the muscular fasciae and vascular aponeuroses. As a consequence, in the absence of direct muscular, vascular, and/or nervous invasion, neck dissection can be safely achieved by removing the fascial covering *en bloc* with the fibrofatty tissue containing the lymph nodes while preserving muscular, vascular, and nervous structures [16]. Classically four different fascial layers have been described in the neck: the superficial cervical fascia (SCF) and the deep cervical fascia (DCF). The latter further recognizes three more different layers: the superficial (SLDCF), middle (MLDCF), and deep layers of the DCF (DLDCF) [22, 23].

Then the crucial point in CND and LND is the fascial compartmentalization of the neck: the "wrapping cloth" (i.e., the whole aponeurotic system) can be removed in one piece, together with the packing material (i.e., the cellular and fat tissue contained therein), while preserving important and non affected structures [16].

CND and LND should comprehensively remove fibro fatty tissue in the target compartments, ensuring complete oncologic removal of all nodal diseases, while preserving the anatomical integrity and function of non lymphatic structures.

In the case of N1b DTC, to date, CND and selective LND, including levels IIa, III, IV, and Vb, are considered the standard of treatment in the absence of lymph node involvement at levels I, IIb, and Va [1].

In the present chapter, the authors described the technique for comprehensive CND (levels VI and VII) and LND (levels II–VB) using a fascial dissection approach.

Surgical Technique

Lymph node dissection for thyroid carcinoma should include a comprehensive, possibly *en bloc*, removal of all the target nodal basins: prelaryngeal, pretracheal, and paratracheal lymph nodes in CND and levels IIa–Vb in LND. The dissection of additional nodal groups (i.e., retropharyngeal, retroesophageal, level I, level IIb, and level Va) is selectively needed on the basis of the dissemination of nodal disease.

To achieve an adequate and comprehensive clearance of the target basins, it is particularly useful to follow the planes of coalescence of different fascial layers, which are avascular

and allow to remove the target nodes *en bloc* with their investing fascial layers. That is the well-known principle of fascial dissection, theorized for LND by O. Suarez and popularized worldwide by Bocca and Pignataro [16] and Gavilan et al. [18, 20, 24]. Despite this concept having been primarily developed for LND dissection, it is applicable also for CND, owing to the fascial envelopments of the central (anterior) compartment.

When neck dissection is performed at the time of thyroidectomy, the central compartment would be preferably removed *en bloc* with the thyroid gland to respect the principles of oncologic resection. When LND is planned and performed at the same time as thyroidectomy and/or CND, it should be accomplished first to reduce the risk that traction on an empty thyroid bed (central compartment) would cause inadvertent injury to the ILN and/or parathyroid glands, which are no more protected by adjacent structures. For this reason, in the present chapter, the operative technique of LND will be discussed first.

The central and lateral compartments are separated by the carotid sheath. For this reason, *en bloc* resection of the lateral and central compartments is not suitable. Conversely, in the case of RND or extended radical neck dissection for locally advanced tumors, invading structures included in the carotid sheath, *en bloc* resection of the lateral and the central compartments could be feasible and advisable.

Patient's Preparation and Positioning

General anesthesia with orotracheal intubation is needed. Nerve-monitoring endotracheal tube is preferable. The patient is placed in supine position, and the neck is slightly hyperextended with the help of a shoulder roll (Fig. 17.1). After checking the nerve monitoring system, the patient is prepared and draped in the usual way. The trapezoidal operative field should include the chin, the inferior margin of the mandible, and the earlobe cranially, the anterior margin of the trapezius muscle laterally, and the sternal notch and the clavicle caudally (Fig. 17.2a).

In the case of LND, the head of the patient should be rotated on the opposite side to maximize exposure. During such maneuver, it is important to avoid any dislodgment of the orotracheal tube and its electrodes for intraoperative nerve monitoring.

Skin Incision and Flap Elevation

In a conventional procedure, a 4–5-cm collar incision about 2 fingers above the sternal notch, usually in a natural neck crease, is adequate to provide access and good exposure for total thyroidectomy and CND. In the case of LND, the incision should be prolonged on the side(s) of the dissection (Fig. 17.2b). The horizontal skin incision should be prolonged up to the posterior third/posterior margin of the ipsilateral SCM. The extended collar incision can offer adequate exposure for neck dissections required in thyroid carcinoma.

Monopolar cautery is used to elevate the subplatysmal flap (Fig. 17.3), preserving the SLDCF, the external and anterior jugular veins, and the greater auricular nerve. The flap should be extended cranially to expose the hyoid bone in the midline and the submandibular gland laterally if LND is planned. Inferiorly, the flap is elevated to the sternal notch in the midline and the clavicle laterally. The posterior border of

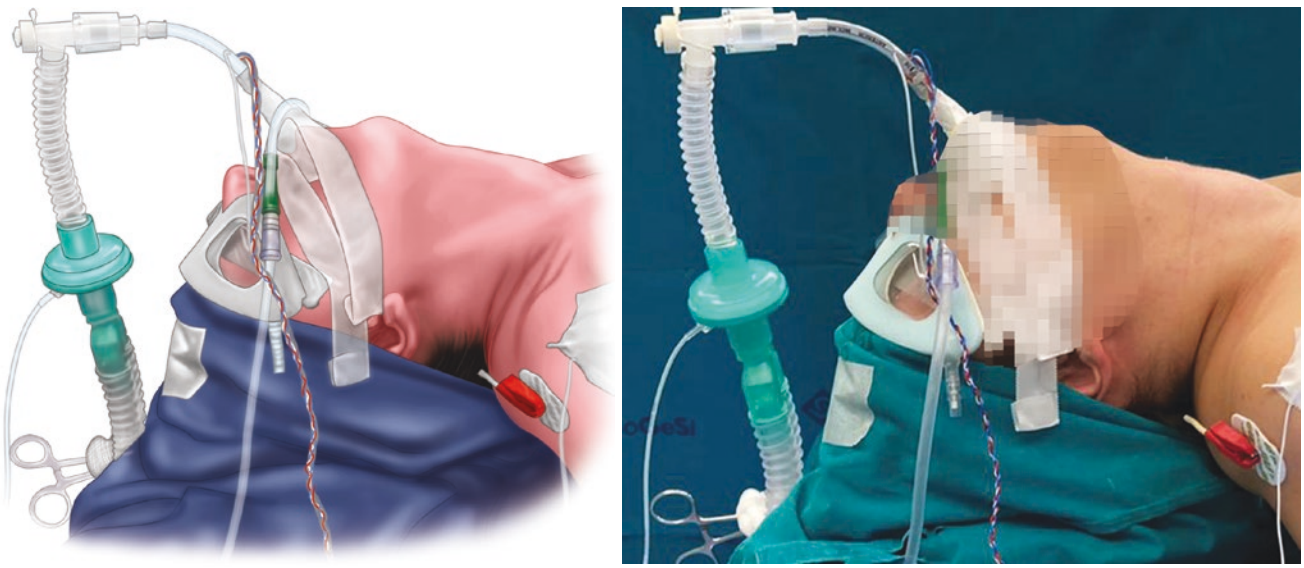

Fig. 17.1 Patient's position. The patient is placed in supine position, and the neck is slightly hyperextended with the help of a shoulder roll. General anesthesia with orotracheal intubation is needed. A nerve-monitoring endotracheal tube is advisable

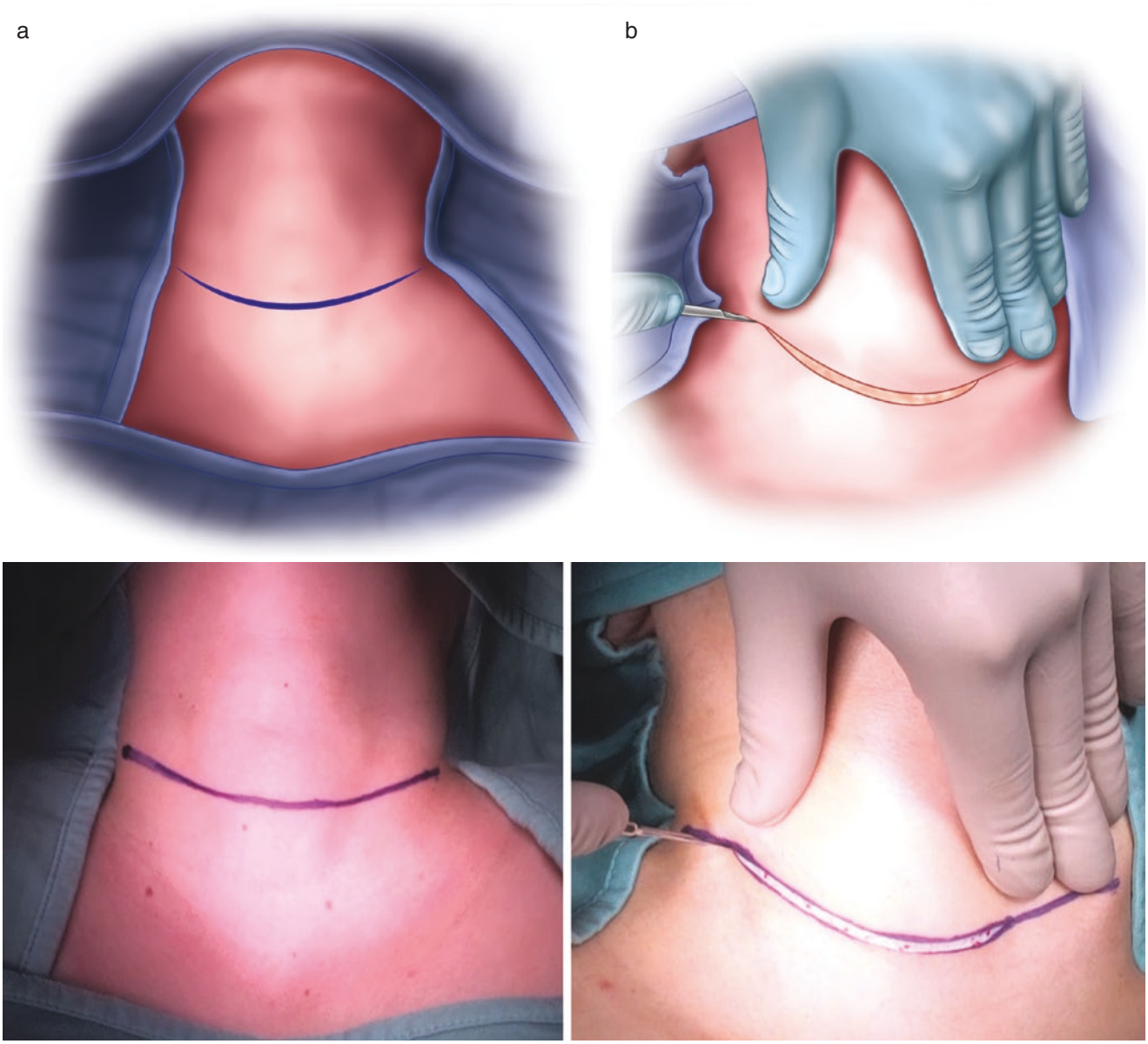

Fig. 17.2 (**a**), Operative field should include the chin, the inferior margin of the mandible and the earlobe cranially, the anterior margin of the trapezius muscle laterally, and the sternal notch and the clavicle caudally. (**b**) Horizontal skin incision is performed about 2 fingers above the sternal notch, ideally in a natural neck crease, and is prolonged laterally on the side of neck dissection until the posterior third/posterior margin of the ipsilateral sternocleidomastoid muscle

the SCM should be exposed as well if LND is planned (Fig. 17.4).

Selective Lateral Neck Dissection: Levels II–Vb

It should be underlined that the sequence of the steps usually reflects the operating surgeon's preference and experience. Usually, a medial to lateral approach is used by general and endocrine surgeons, while a lateral to medial approach is usually preferred by head and neck surgeons. Every approach has its own advantage(s). A combination of both a lateral to medial and a medial to lateral approaches can be useful, depending on the step of the procedure and the individual patients and tumor to be treated.

What is of utmost importance is the comprehensive removal of all the fibrofatty tissue *en bloc* and embedded within the investing fascial planes.

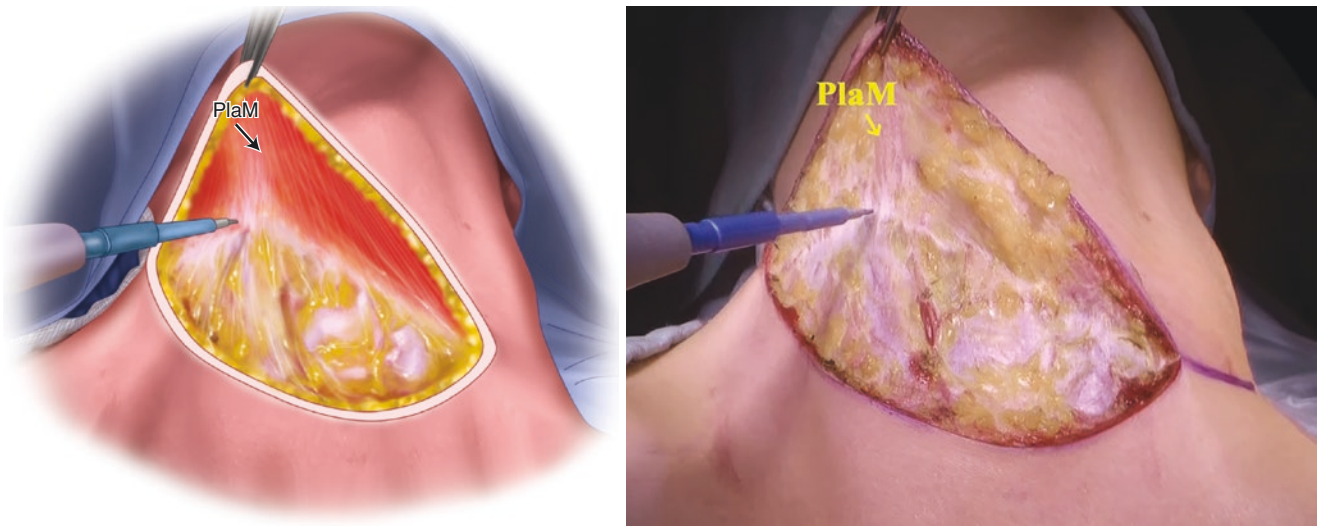

Fig. 17.3 A wide subplatysmal flap is elevated upward, paying attention to preserving the integrity of the superficial layer of the deep cervical fascia (see text). PlaM – platysma muscle

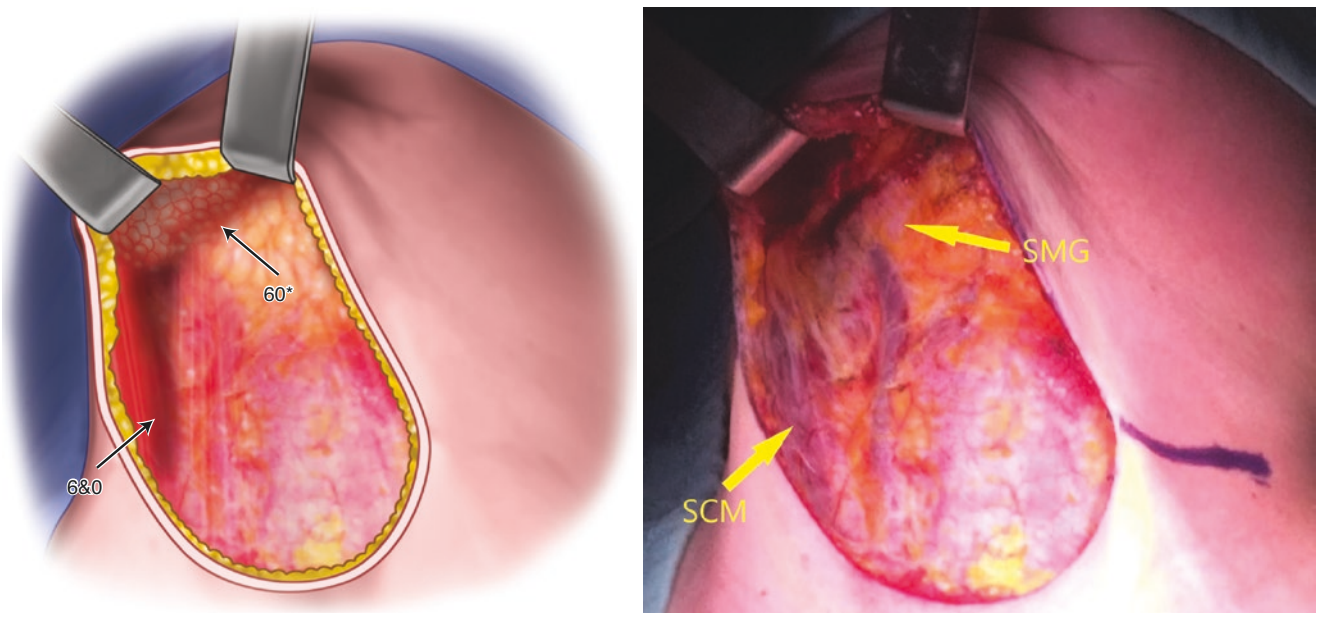

Fig. 17.4 The subplatysmal flap is accomplished, preserving the integrity of the superficial layer of the deep cervical fascia and the anterior jugular veins. It is extended cranially to expose the hyoid bone in the midline and the submandibular gland laterally and caudally to the sternal notch in the midline and the clavicle laterally. The posterior border of the SCM is exposed. SCM – sternocleidomastoid muscle, SMG – submandibular gland

Unwrapping the SMC

The dissection starts with vertical incision of the SLDCF investing the SCM along all the length of the SCM itself. The incision is preferably close to the posterior border of the SCM (Fig. 17.5). At this point, the SCM should be completely enwrapped. Although most surgeons usually prefer to proceed with subfascial dissection toward the anterior margin of the muscle, it could be preferable to prepare the dissection of the subclavicular triangle first, proceeding with a postero lateral direction. The incised fascia is then elevated by means of a pair of forceps and retracted postero laterally at the level of the distal third of the SCM. Dissection is achieved by means of monopolar electrocautery or bipolar scissors to avoid any minimal bleeding.

The SLDCF is detached from its infero anterior attachments at the level of the sternum and the medial third of the clavicle. Once the posterior border of the SCM is reached, dissection of the fascia proceeds anteriorly along the poste-

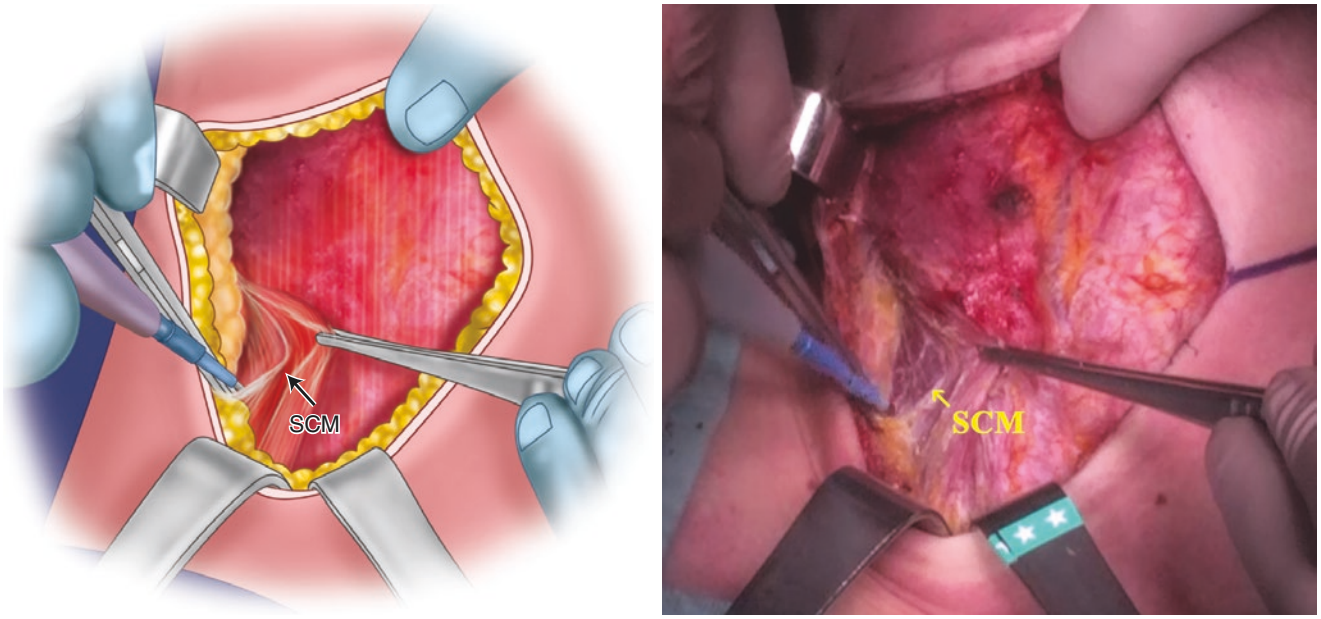

Fig. 17.5 Unwrapping the sternocleidomastoid muscle. The superficial layer of the deep cervical fascia is incised vertically along the sternocleidomastoid muscle, close to its posterior border, and subfascial dissection is accomplished using monopolar cautery. In the distal thirds of the sternocleidomastoid muscle, dissection proceeds first posteriorly along the posterior border and the inferior aspect of the sternocleidomastoid muscle (supraclavicular triangle). SCM – sternocleidomastoid muscle

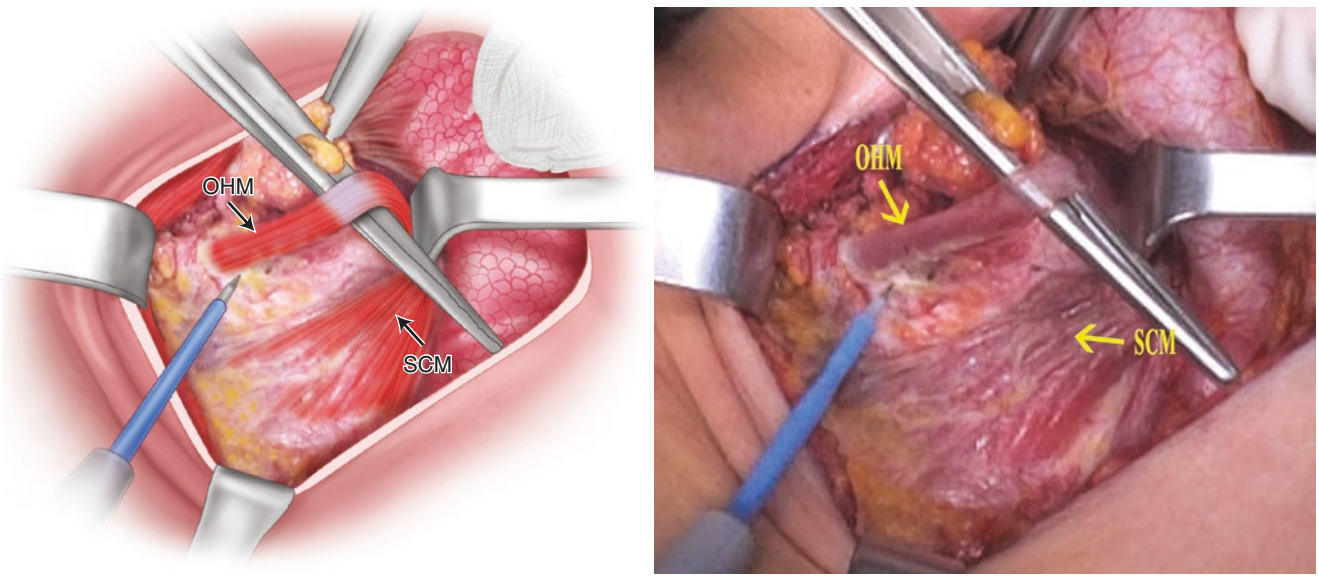

Fig. 17.6 Superficial dissection of the supraclavicular triangle. The inferior belly of the omohyoid muscle is identified and unwrapped of the investing middle layer of deep cervical fascia, from the intermediate tendon to the point where it crosses the trapezius muscle. OHM – omohyoid muscle, SCM – sternocleidomastoid muscle

rior aspect of the distal third of the muscle, which is retracted antero medially, allowing a progressive dissection of the fascial covering (Fig. 17.5). The posterior belly of the omohyoid muscle is then identified and unwrapped of its fascial coating from the intermediate tendon to its crossing with the trapezius muscle (Fig. 17.6). Unwrapping the omohyoid muscle will be continued anteriorly during the anterior dissection. It is essential to preserve the muscle and obtain adequate exposure, especially during supraclavicular triangle dissection. In addition, it should be underlined that omohy-

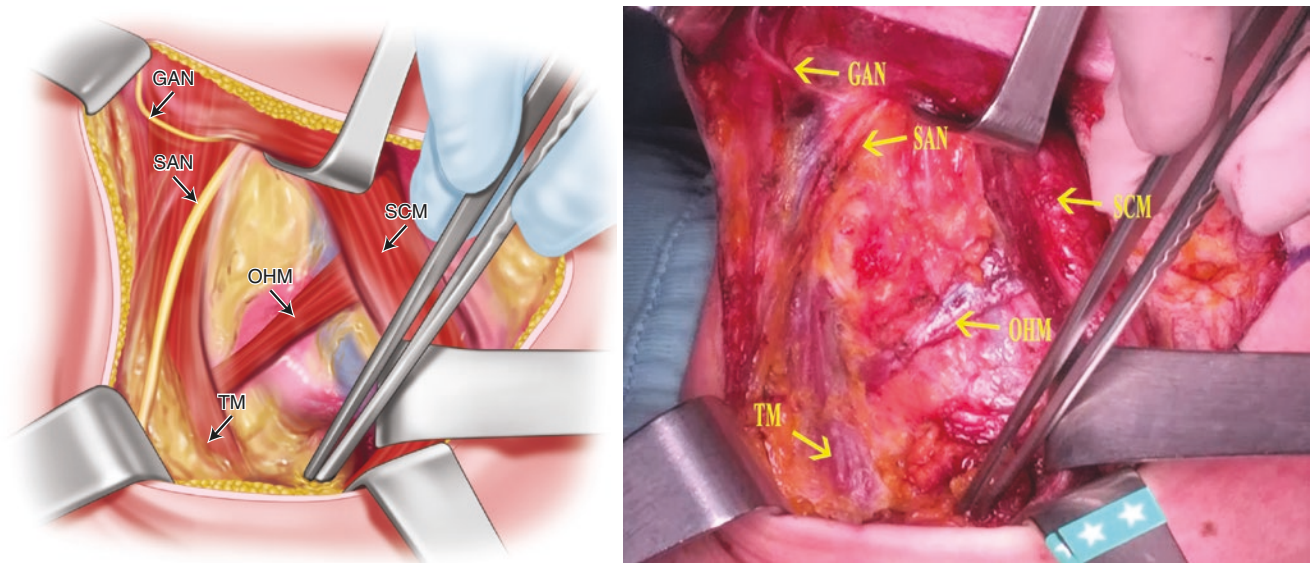

Fig. 17.7 Superficial dissection of the supraclavicular triangle completed. GAN – greater auricular nerve, OHM – omohyoid muscle, SAN – spinal accessory nerve, SCM – sternocleidomastoid muscle, TM – trapezius muscle

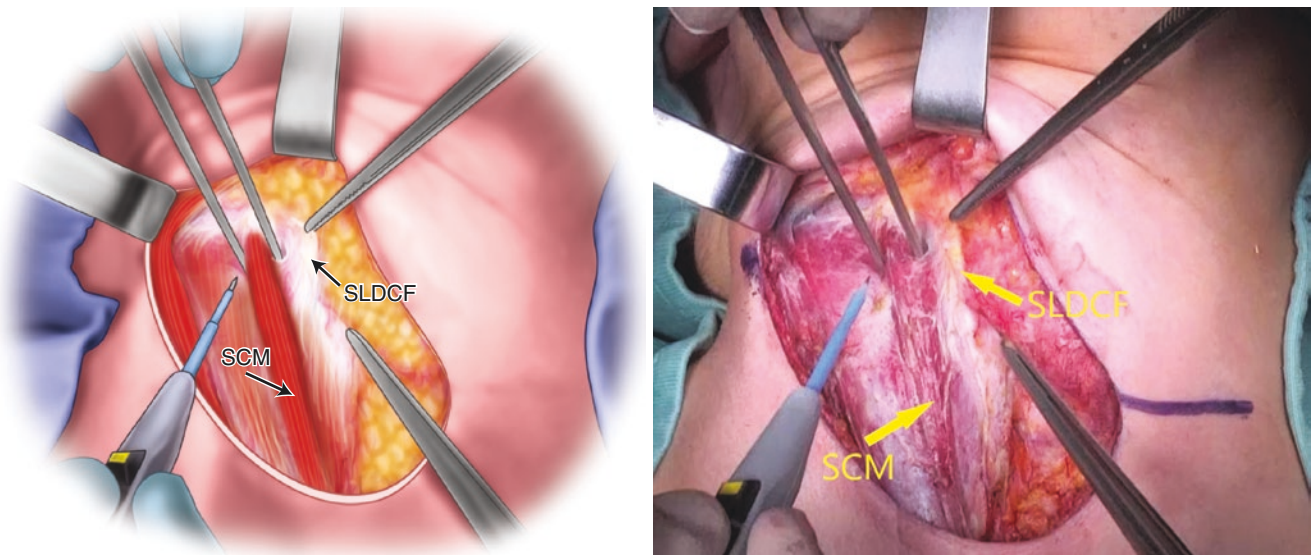

Fig. 17.8 Dissection of the superficial layer of the deep cervical fascia is continued along the anterior aspect of the sternocleidomastoid muscle and its anterior margin. The fascial layer is elevated with two forceps and dissection performed using monopolar cautery. SLDCF – superficial layer of the deep cervical fascia, SCM – sternocleidomastoid muscle

oid muscle is enveloped by the MLDCF that should be removed *en bloc* to ensure adequate clearance.

Once the achieved dissection of the posterior belly of the omohyoid muscle is achieved, the SLDCF is detached inferiorly from the clavicle and posteriorly from the trapezius muscle. The clavicle and the trapezius muscle are exposed. Dissection is then continued upward along the anterior margin of the trapezius muscle until exposure of the external jugular vein, which can be ligated or preserved (Fig. 17.7). If preservation of the external jugular vein is chosen, it should be freed from investing in fibrofatty tissue. At this point, the superficial dissection of the supraclavicular triangle is completed. A small gauze may be left at this level.

Dissection is then directed anteriorly. The SLDCF is detached along the anterior aspect of the SMC. When dissection reaches the anterior border of the SCM, the muscle is retracted posteriorly to continue dissection underneath, over its medial aspect, starting from the caudal portion upward, aiming to free the fascial covering from the posterior border of the SCM (Fig. 17.8). Inferiorly, the dissection reaches the

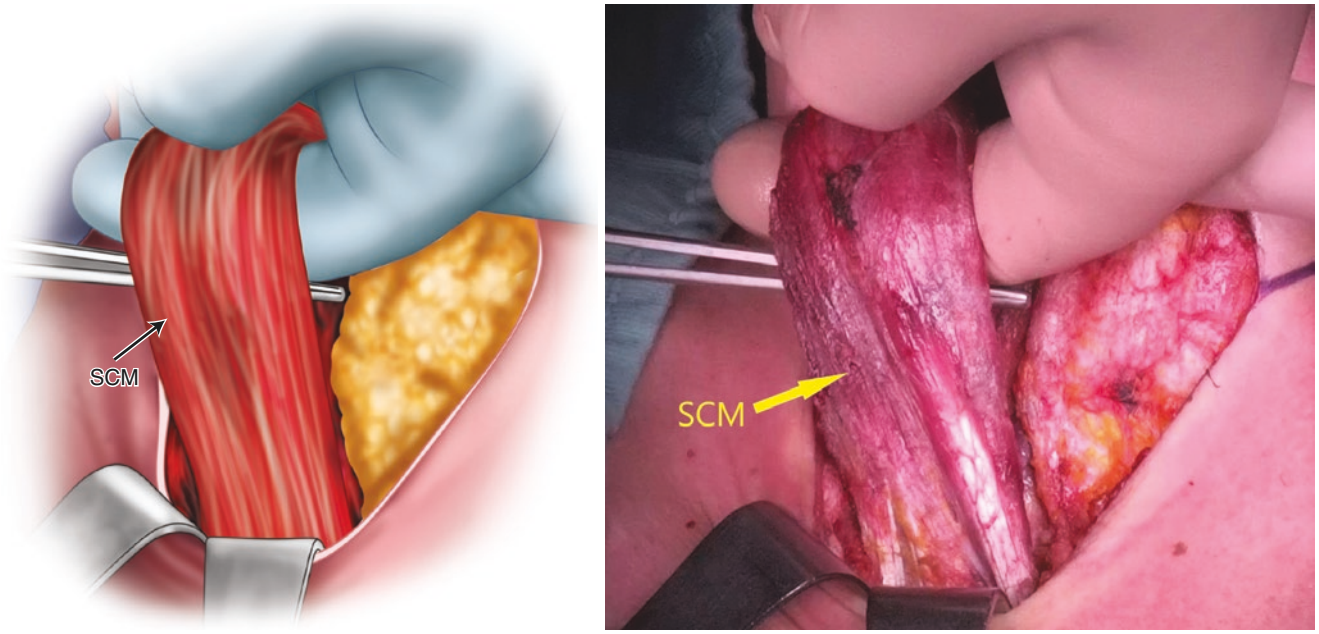

Fig. 17.9 The sternocleidomastoid muscle is completely unwrapped of its investing fascial layer, belonging to the superficial layer of the deep cervical fascia. That allows complete mobilization of the sternocleidomastoid muscle itself. SCM – sternocleidomastoid muscle

previously dissected supraclavicular triangle, as evidenced by the identification of the gauze left at that level.

Dissection over the medial surface of the SCM is then continued, allowing complete mobilization of the SCM (Fig. 17.9). When dissection reaches the cranial third of the muscle, special attention should be paid to the SAN that enters the muscle, approximately at the junction of its upper and middle thirds. To minimize the risk of SAN injury, it may be preferable to stop posterior dissection before reaching such a dangerous area. Dissection can be more safely accomplished after the dissection of the submandibular triangle and the identification of the SAN in its proximal tract below the posterior belly of the digastric muscle.

In summary, the first step of the procedure consists in the complete unwrapping of the SCM (Fig. 17.9) and of the inferior belly of the omohyoid muscle and the dissection of the SLDCF from its clavicular and sternal attachments and from the anterior border of the trapezius muscle. Below Erb's point, dissection is accomplished posterior to the SCM; in the upper two thirds, dissection is accomplished anterior to the SCM.

Preparing the Submandibular Triangle

At this point, the SLDCF is incised along the inferior margin of the submandibular gland (Fig. 17.10a). The gland is then retracted upward to expose the cranial boundary of the dissection represented by the posterior belly of the digastric muscle and the stylohyoid muscle. In the SND for thyroid carcinoma, the section of the facial vein is not required. However, it should be preferably unwrapped of the investing fascial layer, since small lymph nodes may be missed along its posterior aspect, below the inferior margin of the submandibular gland.

Dissecting the Medial Boundary

At this point, the dissection of the SLDCF is continued along the lateral margin of the sternohyoid muscle by preserving the anterior jugular veins. The SLDCF is dissected away from the antero lateral aspect of the sternohyoid muscle. This allows exposing the medial border of the LND, which is represented by the coalescence of the fascia covering the lateral border of the sternothyroid muscle with the carotid sheath (Fig. 17.11). Proceeding in a postero lateral direction, the superior belly of the omohyoid muscle is identified and completely unwrapped of its investing fascia (Fig. 17.12). This allows for complete mobilization of the muscle, very useful in the text steps of the dissection process and for complete exposure of the carotid sheath and the neurovascular bundle of the neck. By retracting postero laterally the medial border of the dissected SLDCF, the neurovascular bundle is unwrapped, caudal to cranial, until reaching the sagittal aponeurosis, posterior to the neurovascular bundle, and, consequently, the coalescence of the avascular plane with the DLDCF (Fig. 17.13). An effort should be made to preserve the descending branch of the *ansa cervicalis*, which should be followed upward till its travels along with the hypoglossal nerve. Moreover, during the most posterior part of the dissection, its ascending branch should be preserved as well since it represents an important landmark for the deepest plan of dissection (Fig. 17.13). During this step of the dissection, it is usually unnecessary to ligate

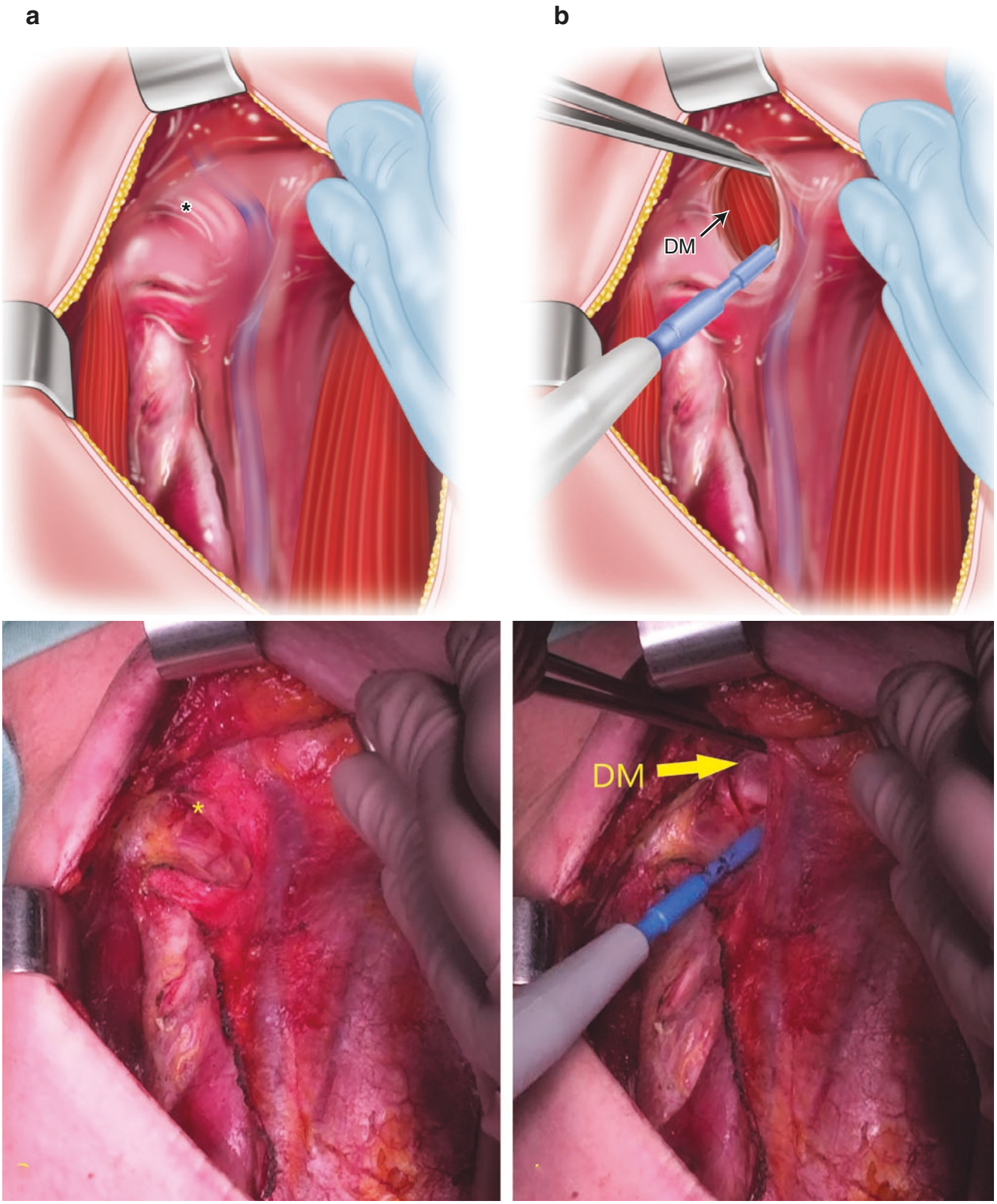

Fig. 17.10 Preparing the submandibular triangle. (**a**) The superficial layer of the deep cervical fascia (*) is incised along the inferior border of the submandibular gland. (**b**) The submandibular gland is retracted medially and upward to expose the cranial boundary of the dissection, represented by the posterior belly of the digastric muscle (DM) and the stylohyoid muscle

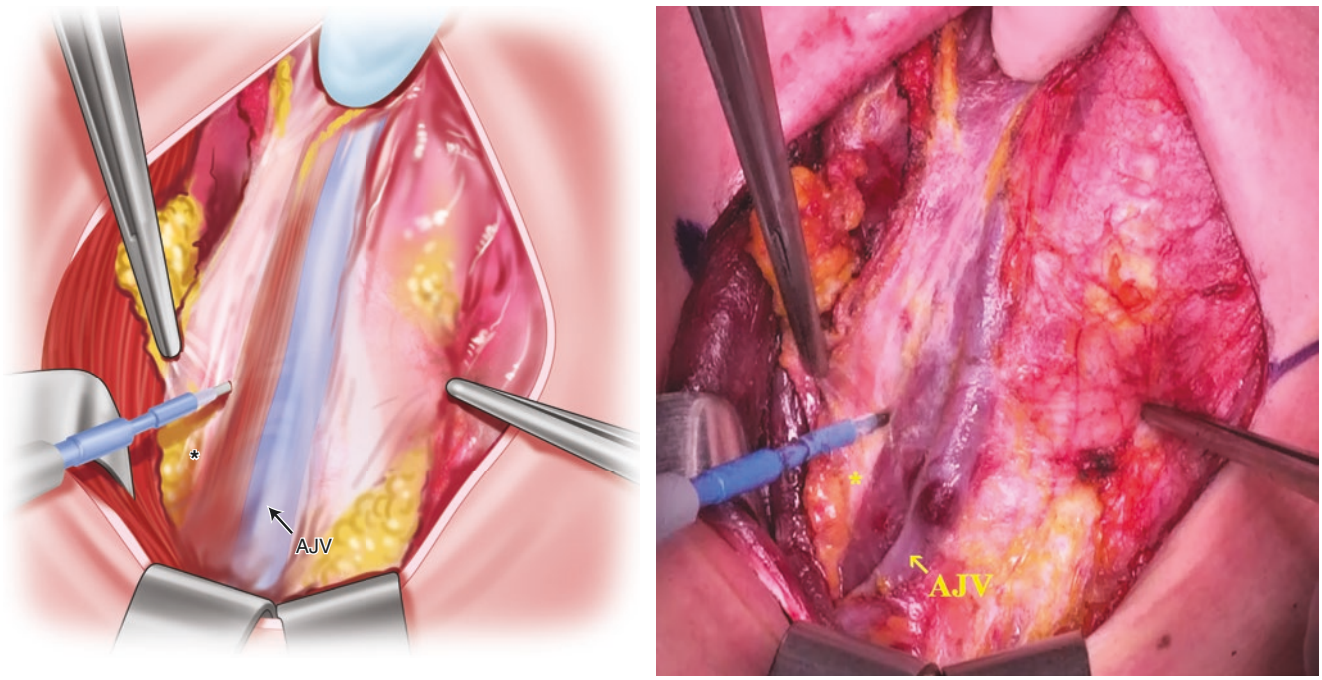

Fig. 17.11 The medial boundary of the lateral neck dissection is dissected: it is represented by the coalescence of the fascia investing the sternothyroid muscle and the carotid sheath (*). AJV – anterior jugular vein

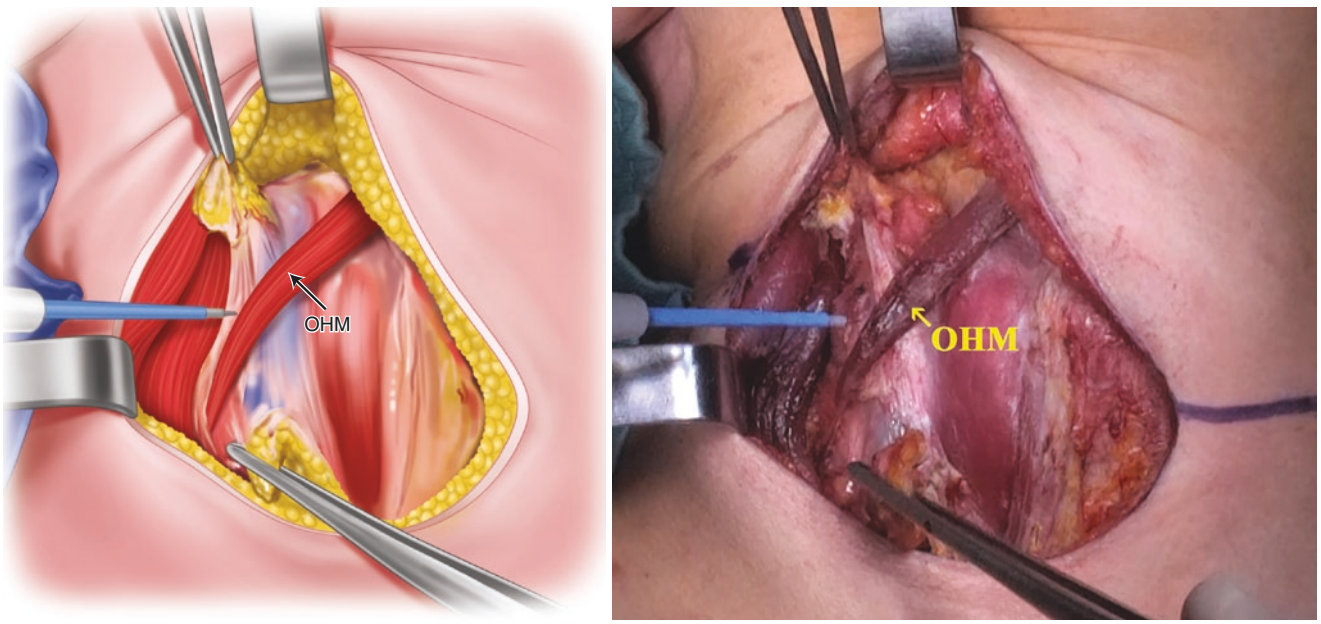

Fig. 17.12 The superior belly of the omohyoid muscle (OHM) is identified and completely unwrapped of the investing middle layer of the deep cervical fascia

the facial, lingual, and thyroid artery and veins, but they should be completely freed from the investing fascia.

In the caudal portion of the field, the IJV should be prepared till its confluence with the subclavian vein (Pirogoff's trunk), eventually preserving also the external and anterior jugular veins. At this level, attention should be paid to avoid injury to the thoracic duct on the left and the right lymphatic duct (if present) at their confluence on the Pirogoff's trunk.

During the dissection of the posterior aspect of the neuro vascular bundle, special attention should be paid to avoid inadvertent injury to the sympathetic chain, which can result in Horner's syndrome.

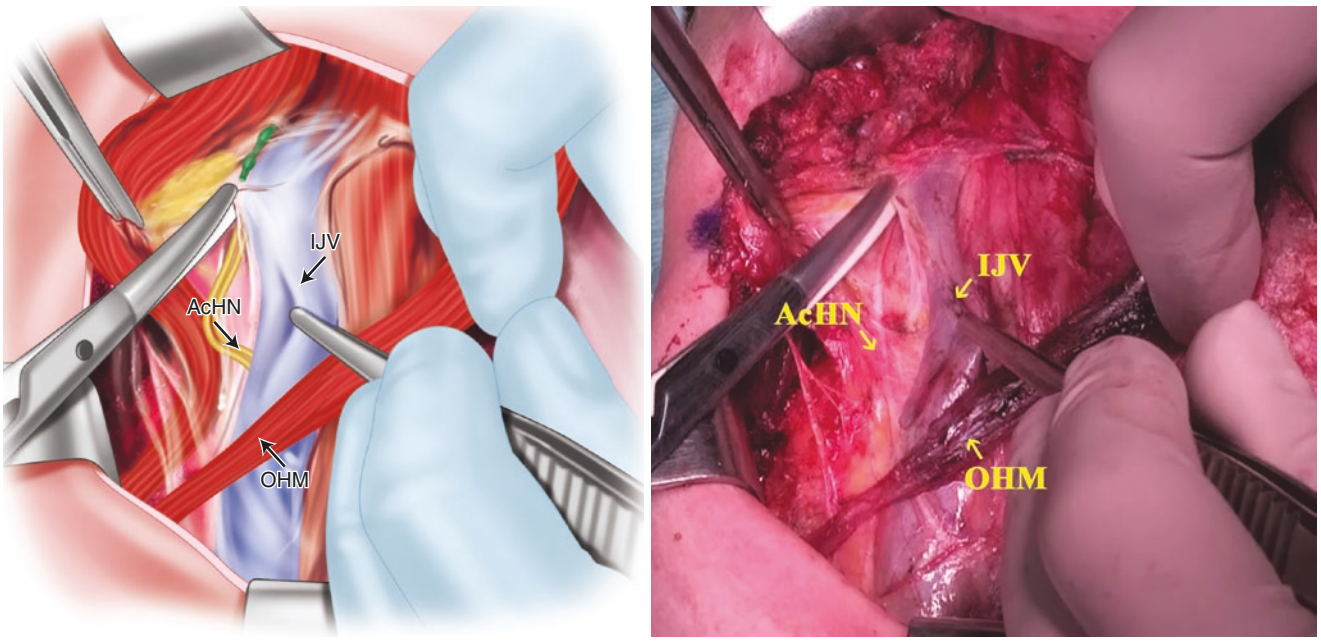

Fig. 17.13 The sagittal fascia posterior to the carotid sheet is incised, and the plane of coalescence of the superficial and deep cervical fascia layers is exposed. Dissection is continued along that avascular plane. The ascending branch of the *ansa cervicalis* is identified and preserved. AcHN – ascending branch of the *ansa cervicalis* of the hypoglossal nerve, IJV – internal jugular vein, OHM – omohyoid muscle

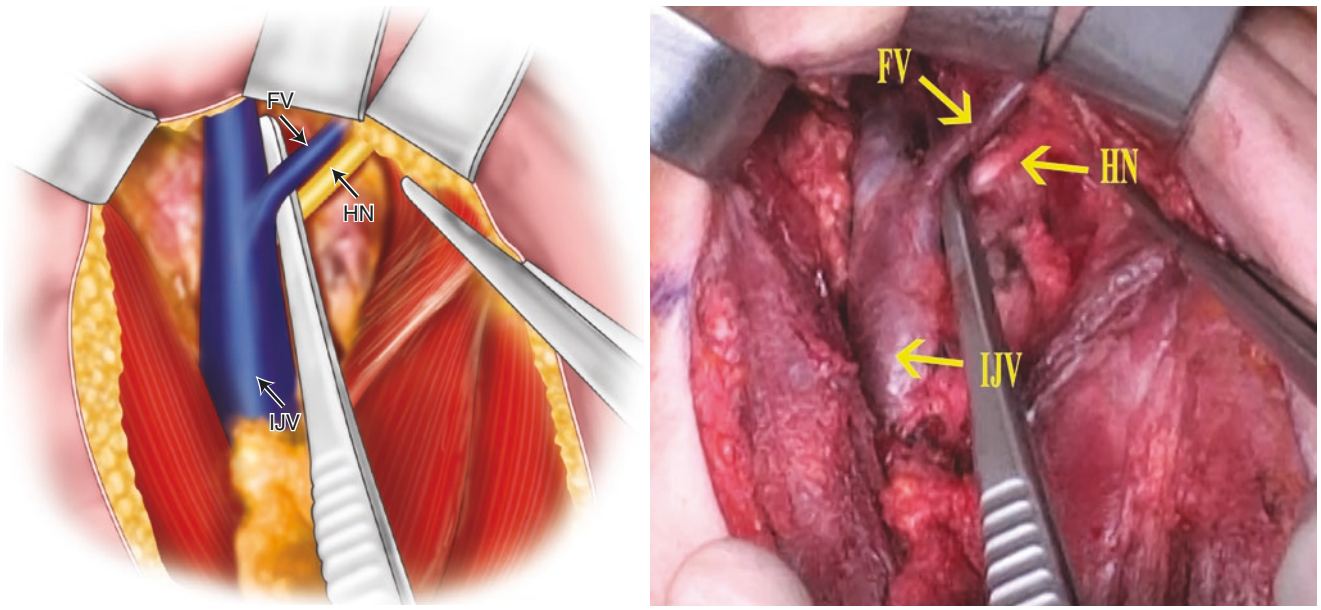

Fig. 17.14 Dissection of level II – submandibular triangle – the facial vein is unwrapped, and the hypoglossal nerve is identified. FV – facial vein, HN – hypoglossal nerve, IJV – internal jugular vein

Dissecting Level II

Proceeding upward, the fascia is incised along the posterior belly of the digastric muscle. Countertraction by the assistant over the uppermost portion of CCA facilitates the identification of the hypoglossal nerve (Fig. 17.14), following the descending branch of the *ansa cervicalis*. Dissection over the fascial plane is then continued laterally to complete the dissection of the anterior and lateral aspects of the IJV. At this point, the supero medial retraction of the posterior belly of the digastric muscle and the latero inferior retraction of the SCM muscle allow adequate exposition of the SAN between the SCM and IJV. The SAN has then to be completely dissected from its surrounding tissue since it crosses the intrafascial tissue, and it is completely embed-

ded with lymph nodes containing fibrofatty tissue. In the absence of a gross involvement of such lymph nodes, it would be enough to dissect the tissue anterior to the nerve (IIa dissection). In the case that a level IIb dissection is needed, the SAN must be gently displaced to dissect the cranial and posterior fibrofatty tissue. Then the dissected IIb tissue has to be passed behind the nerve to be removed *en bloc* with the remaining specimen. Thus, in level IIb dissection, the splenius capitis and the levator scapulae muscles represent the most posterior aspect of the dissection in the cranial part of the operative field (Fig. 17.15).

Level III and IV Dissection

At this point, while the SCM is retracted laterally and the vascular bundle medially, the downward retraction of the specimen allows completing the dissection of the posterior boundary along the plane of coalescence of the SLDCF and DLDCF (Fig. 17.16) by preserving the roots of the

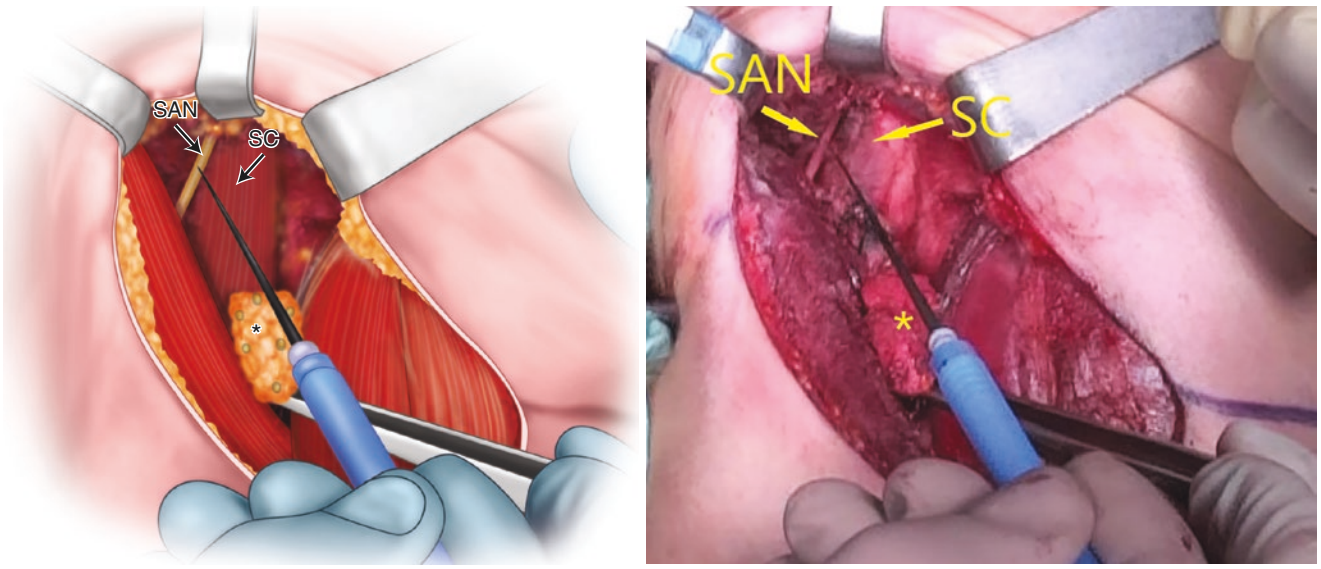

Fig. 17.15 Dissection of level II – the spinal accessory nerve has to be completely dissected from its surrounding tissue since it does not follow a fascial plane, but it crosses the intrafascial tissue and it is completely embedded with lymph nodes containing fibrofatty tissue. In case level IIb dissection is required, the splenius capitis and the levator scapulae muscles represent most of the posterior aspect of the dissection in the cranial part of the operative field. SAN – spinal accessory nerve, SC – splenius capitis, * – lymph nodes retracted downward

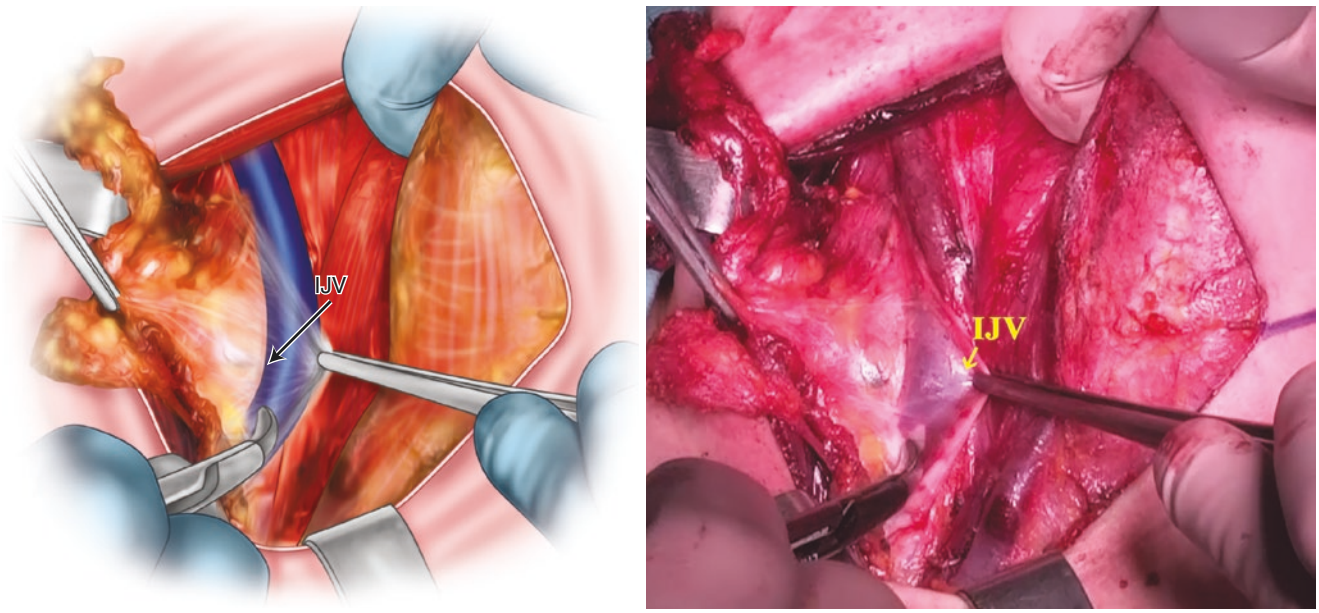

Fig. 17.16 Dissection of levels III and IV – the dissection of the posterior boundary is accomplished along the plane of coalescence of the superficial and deep layers of the deep cervical fascia, while the neurovascular bundle is retracted medially. IJV – internal jugular vein

cervical plexus (level III) (Fig. 17.17). The specimen is then passed behind the omohyoid muscle, and dissection is continued downward (level IV). Following the fascial plane allows preserving the integrity of the phrenic nerve and thyrocervical trunk. However, infrascalenic nodes can be safely removed *en bloc* after identifying the phrenic nerve. Small vascular branches arising from the thyrocervical trunk have to be ligated. Preserving the thyrocervical trunk is of utmost importance to reduce the risk of postoperative hypoparathyroidism.

In summary, during this step, since both the lateral and medial borders have been already prepared, it is possible to safely dissect the posterior aspect along the DLDCF, which should not be violated; Should be performed in an avascular plane, and the injury to the phrenic nerve should be avoided (Fig. 17.18).

Completing Level Vb Dissection (Supraclavicular Triangle)

At this point in time, the SCM is retracted medially, and the specimen is passed behind and transposed postero laterally

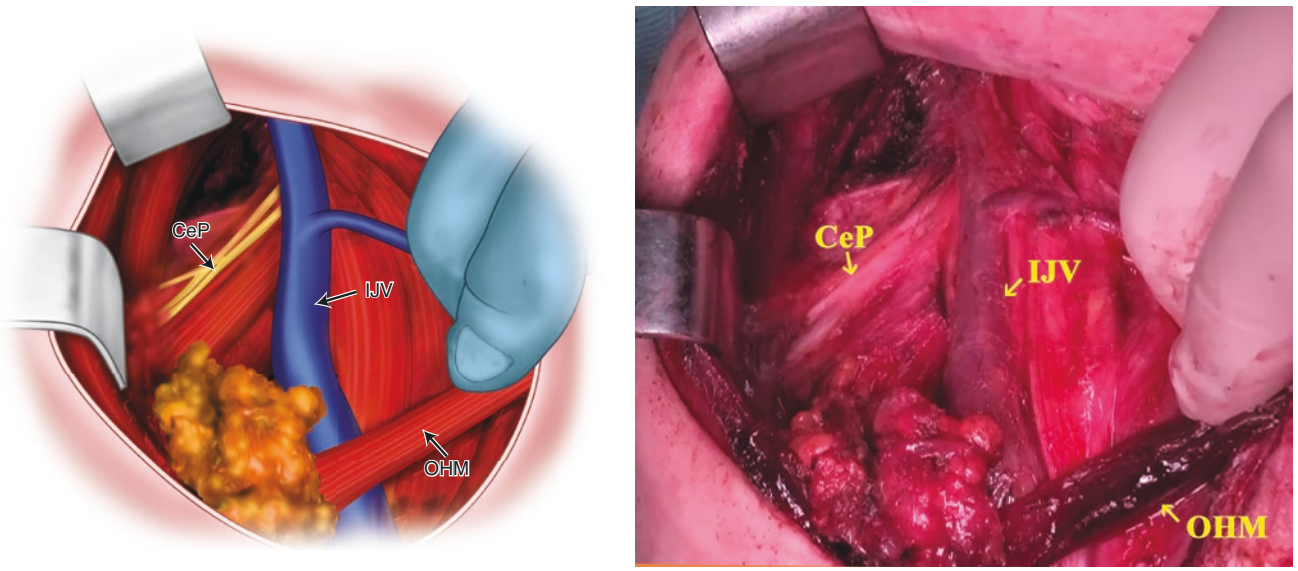

Fig. 17.17 Dissection of level III – dissecting along the fascial plane allows to preserving the roots of the cervical plexus. CeP – cervical plexus, IJV – internal jugular vein, OHM – omohyoid muscle

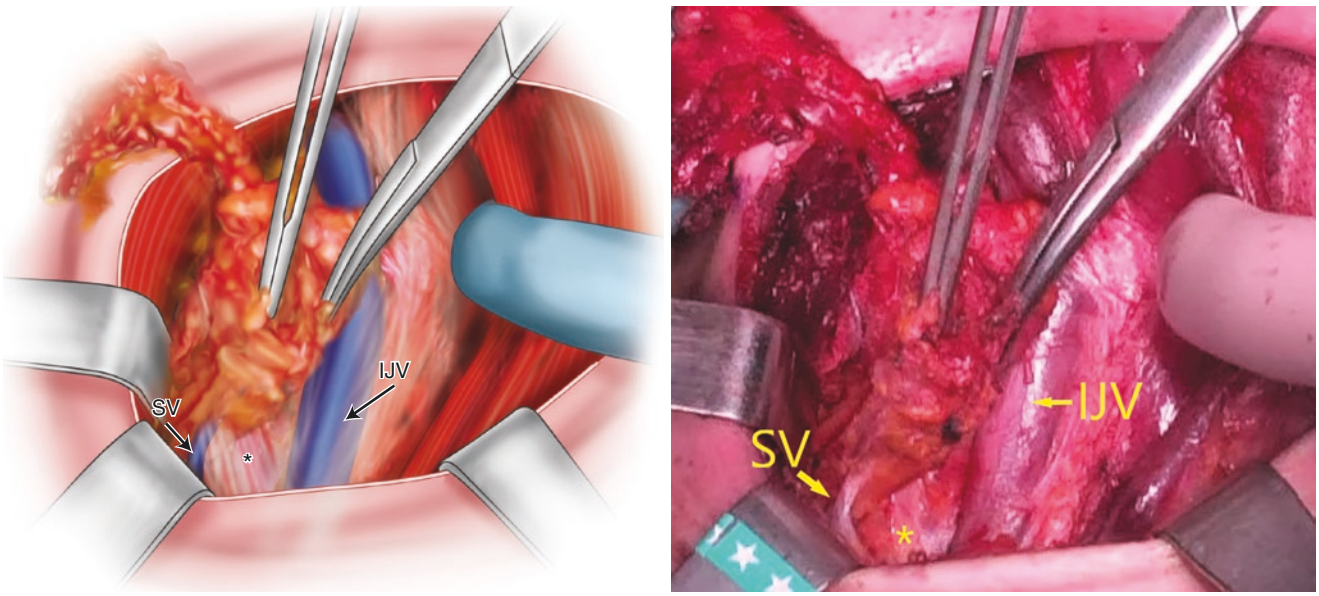

Fig. 17.18 Level IV dissection is completed along the superior aspect of the subclavian vein. IJV – internal jugular vein, SV – subclavian vein, * deep layer of the deep cervical fascia (prevertebral fascia)

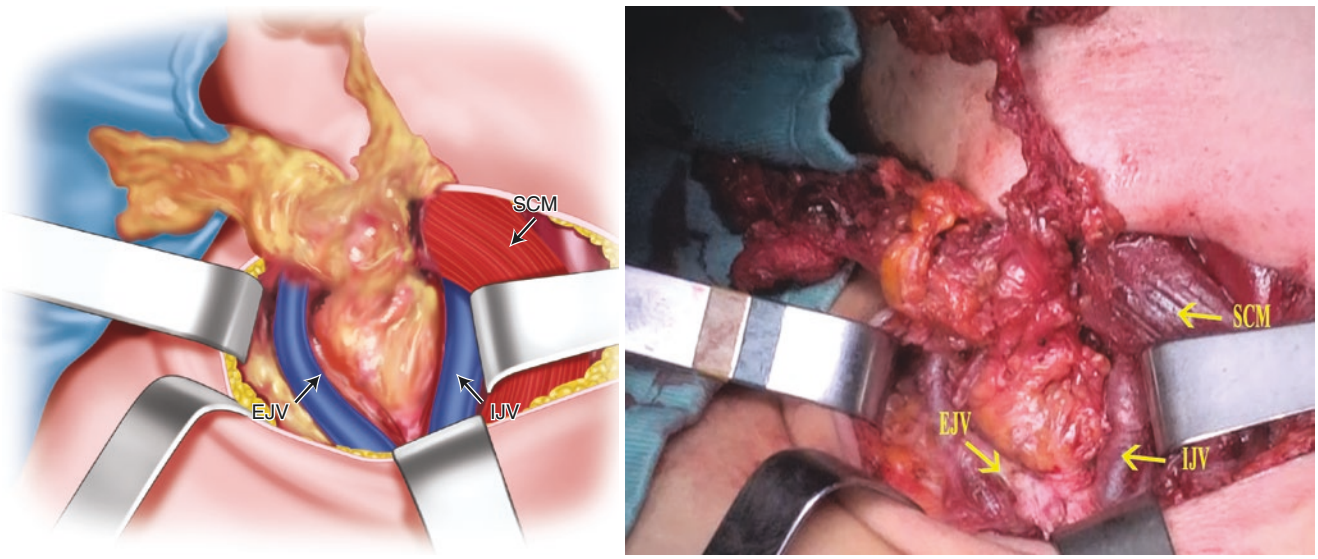

Fig. 17.19 Completing level IV–Vb dissection (supraclavicular triangle) – the sternocleidomastoid muscle is retracted medially and the specimen passed behind and transposed postero laterally. SCM – sternocleidomastoid muscle, EJV – external jugular vein, IJV – internal jugular vein

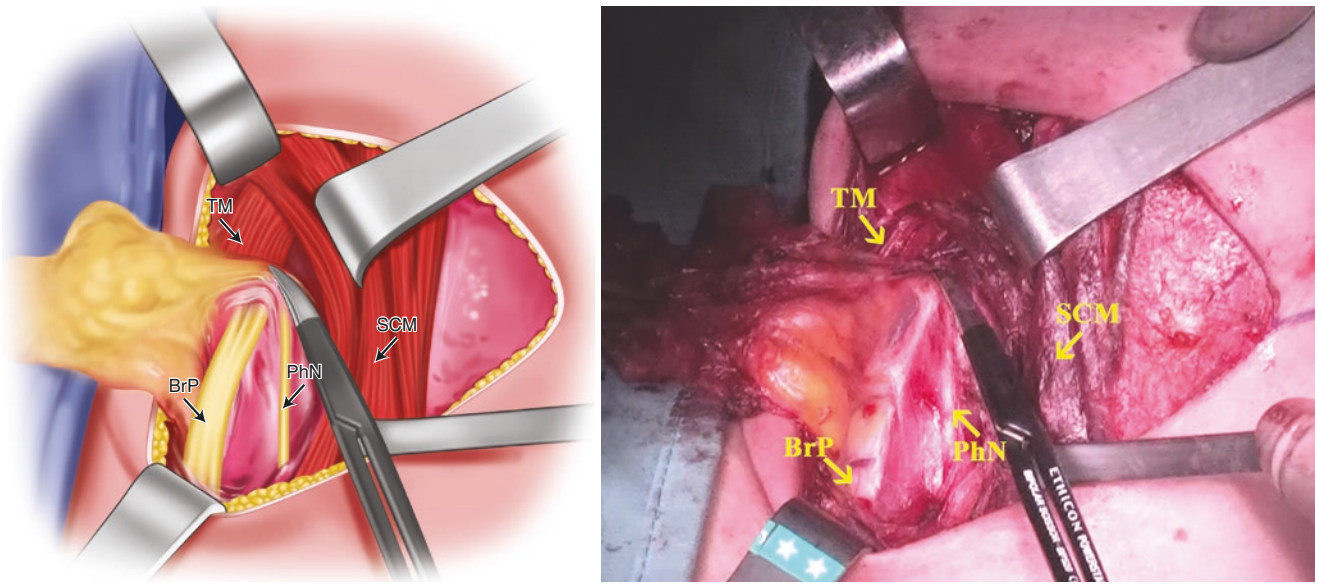

Fig. 17.20 Completing level IV–Vb dissection (supraclavicular triangle) – the brachial plexus is exposed posteriorly, the dissection is completed along the anterior margin of the trapezius muscle, and the specimen of the lateral neck dissection is removed. BrP – brachial plexus, PhN – phrenic nerve, SCM – sternocleidomastoid muscle, TM – trapezius muscle

(Fig. 17.19). The dissection continues along the superior aspect of the subclavian vein, exposing posteriorly the brachial plexus. Then the dissection is completed along the anterior margin of the trapezius muscle, and the specimen is removed (Fig. 17.20).

Central Neck Dissection (Levels VI–VII)

Strap Muscle Dissection

The strap muscles are separated along the midline as extensively as possible from the hyoid bone to the sternal notch. In the case of large infiltrating tumors and/or bulky lymph node metastases, *en bloc* resection of the sternothyroid muscles can be advisable since it ensures adequate exposure and clearance. In such cases, a complete mobilization of the sternohyoid muscle is reached by dissecting its posterior aspect from the anterior aspect of the ipsilateral sternothyroid and thyrohyoid muscles. After that, the sternothyroid muscle is sectioned at its proximal (thyroid cartilage) and distal (sternal) insertions (Fig. 17.21). If needed or preferred, the SLDCF, in its anterior portion, covering the strap muscles, can be removed *en bloc* with the central compartment. It is sectioned cranially at the level of the hyoid bone

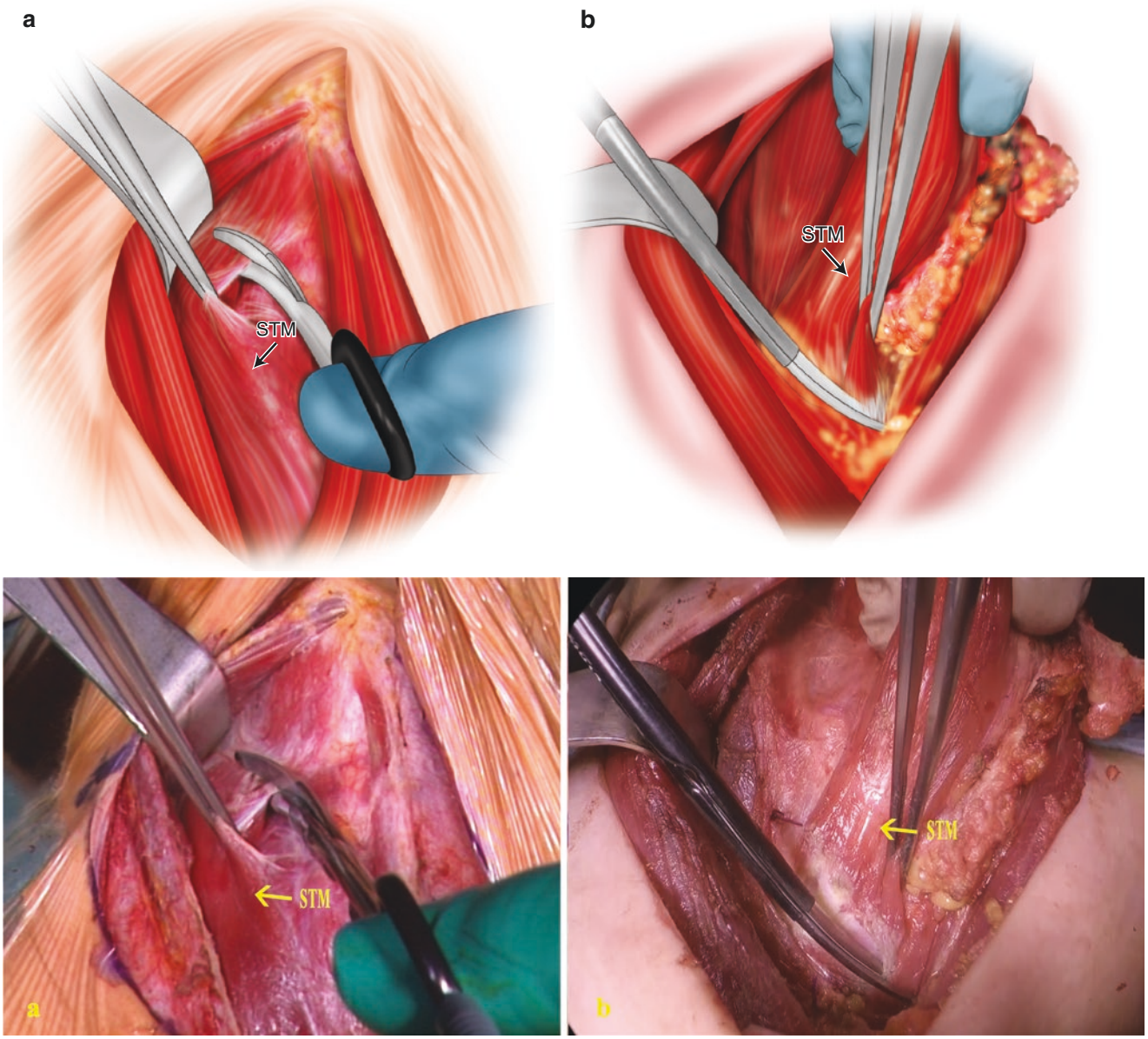

Fig. 17.21 Central compartment dissection. Once the sternohyoid muscle is freed from the ipsilateral sternothyroid and thyrohyoid muscles, the right sternothyroid muscle is sectioned at its proximal (**a**) and distal (**b**) insertions. STM – sternothyroid muscle

and caudally at the level of the sternal notch. Then the sternohyoid muscles are unwrapped from lateral to medial. When the dissection reaches the medial border of the sternohyoid muscles on each side, it changes direction, and the posterior aspect of the sternohyoid muscles is dissected as described above, leaving the fascial envelopment connected along the median raphe with the sternothyroid muscles and the "content" of the central compartment.

Dissection of the Lateral Boundary (Exposure of the CCA)

The dissection, using monopolar and/or bipolar cautery, follows the lateral margin of the sternothyroid muscle, along the carotid sheath (Fig. 17.22). Complete exposure should be obtained from the thyroid cartilage to the innominate trunk on the right side and as low as possible on the left side, depending on the patient's morphometric characteristics, but at least to the plane corresponding to the level where the innominate trunk crosses the trachea on the right side.

Identification of the ILN and Paratracheal Dissection

After the identification of the external branch of the superior laryngeal nerve and the selective dissection of the upper thyroid pedicle, the thyroid lobe is retracted medially to expose the tracheoesophageal groove. The ILN nerve is identified where it crosses the inferior thyroid artery or its branches, possibly using intraoperative nerve monitoring to confirm

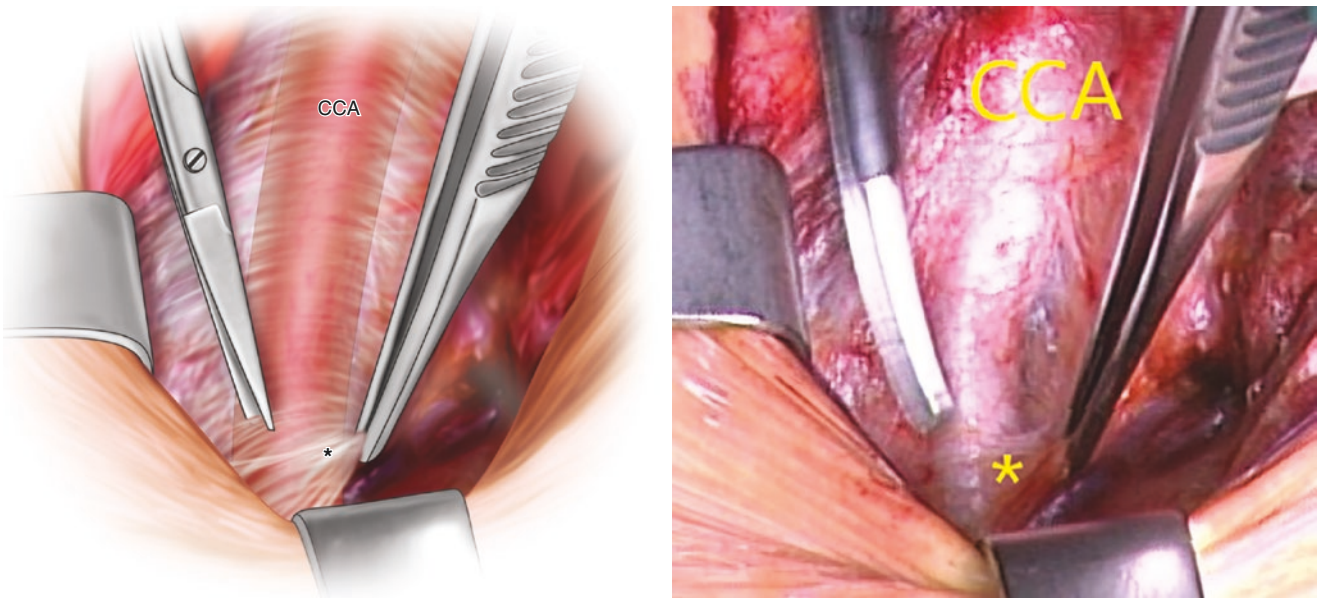

Fig. 17.22 Dissection of the lateral boundary of the central compartment (exposure of the common carotid artery). CCA – common carotid artery, *middle layer of the deep cervical fascia, investing the sternothyroid muscle at the conjunction with the carotid sheet

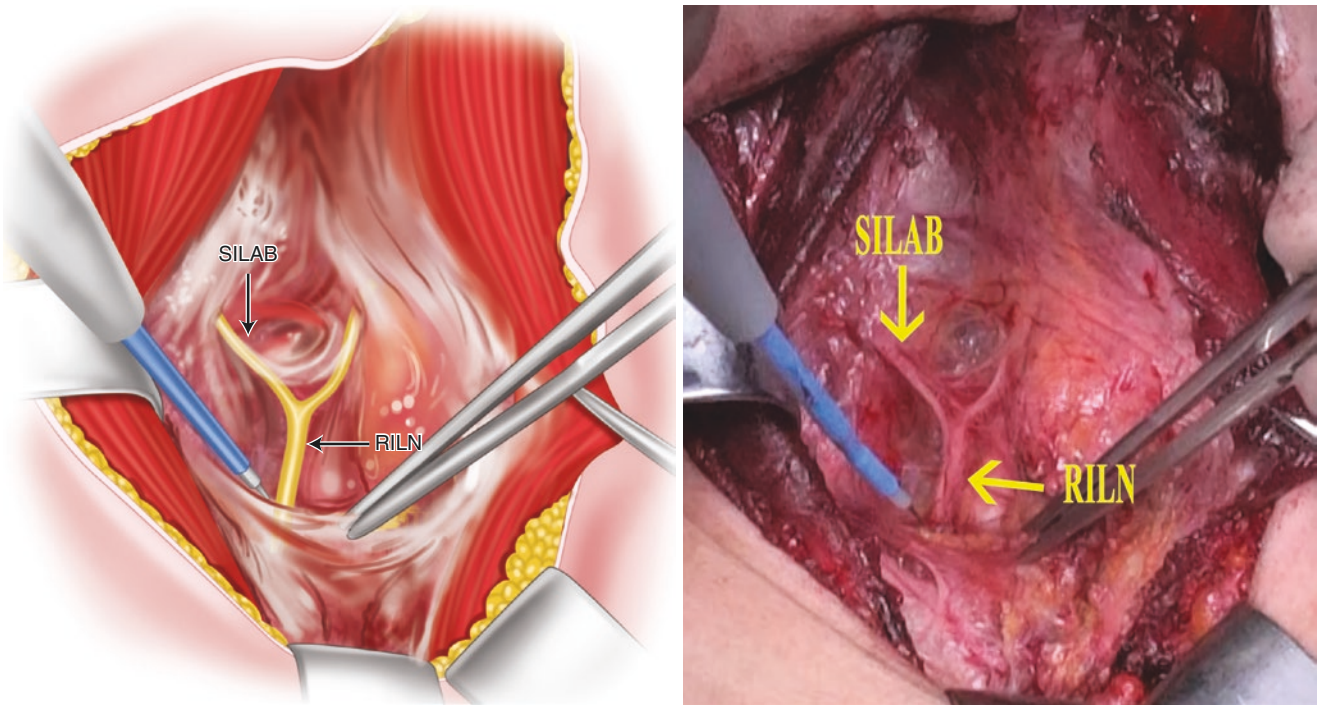

Fig. 17.23 After identifying the inferior laryngeal nerve, the sagittal aponeurosis is incised and the posterolateral fibrofatty tissue dissected from lateral to medial along the lateral aspect of the inferior laryngeal nerve, preserving its anastomotic branches with the sympathetic chain. RILN – right inferior laryngeal nerve, SILAB – sympathetic inferior laryngeal anastomotic branch

correct identification. Intraoperative nerve monitoring can also help in the identification of ILN. On the right side, the nerve should be dissected from the surrounding fibrofatty tissue along its entire cervical course from its origin behind the subclavian artery to its entrance into the larynx (Fig. 17.23). At this point, the sagittal aponeurosis posterior to the carotid sheath should be incised and the posterolateral fibrofatty tissue dissected with a lateral-to-medial direction along the lateral aspect of the ILN, preserving the small sympathetic-inferior laryngeal nerve connecting the branches (Fig. 17.23) [25]. Then the posterior aspect of the nerve is freed from the fibrofatty tissue. The ILN is cau-

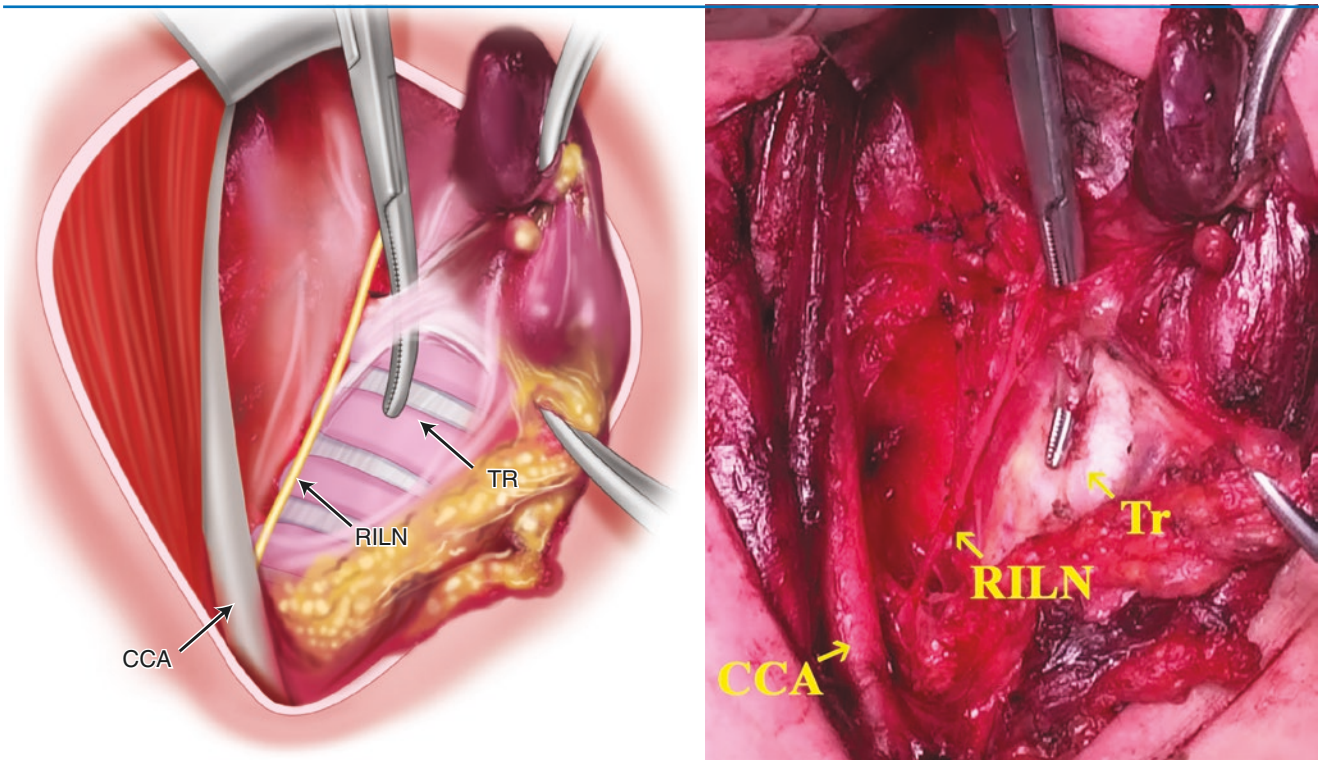

Fig. 17.24 Paratracheal dissection and thyroidectomy – the right inferior laryngeal nerve is dissected from the surrounding fibrofatty tissue all along its cervical course, and the right thyroid lobectomy is completed. CCA – common carotid artery, RILN – right inferior laryngeal nerve, Tr – trachea

tiously antero laterally displaced, and the posterolateral portion of the paratracheal nodes is transposed behind it medially (Fig. 17.24). The dissection is then continued in the antero medial portion of the paratracheal nodes, exposing the antero lateral aspect of the esophagus and the lateral aspect of the trachea. In most cases, the infero lateral part of the dissected field may expose the apex of the ipsilateral lung. On the left side, the nerve is identified where it crosses the inferior thyroid artery and followed in a caudal direction as deep as possible in the upper mediastinum. At this point, the sagittal aponeurosis is incised behind the carotid sheet. By lateral to antero medial retraction, the lymph node containing fibrofatty tissue is completely freed along the antero lateral aspect of the ILN, exposing the esophagus and the lateral margin of the trachea. Any effort should be done to preserve the superior parathyroid glands. First of all, a bloodless surgical field is essential since any bleeding could determine an alteration of the colors, which is essential for parathyroid identification. Once identified, the parathyroid glands should be preserved with their vascular pedicles as far as possible. This implies a very gentle, cautious, and sometimes time-consuming dissection.

Pretracheal Dissection

Just below the sternothyroid muscle, it is possible to identify the thymus. It should be explored for the identification of intrathymic parathyroid glands, which are often encountered or used as a landmark for the identification of inferior parathyroid glands embedded in the thyrothymic tract. The thymus, and the eventually identified inferior parathyroid gland, in the absence of overt involvement by the tumor or nodal disease, should be preserved since it lies in an anatomical plane anterior to the pretracheal nodes in order to preserve the viability of the inferior parathyroid glands. After that, the most inferior portion of the central compartment (upper mediastinal nodes) is dissected from the antero superior aspect of the innominate trunk, exposing the right brachiocephalic vein. Dissection is continued upward, dissecting the fibrofatty tissue embedded in the visceral portion of the MLDCF from the tracheal fascia (Fig. 17.24).

Prelaryngeal (Delphian) Nodes

Dissection then continues, en bloc with the thyroid gland and/or the resected sternothyroid muscles, in the prelaryngeal compartment, paying attention to avoid injury to the cricothyroid muscle, cricothyroid membrane, and thyroid cartilage, along with the pyramidal lobe in the case of synchronous thyroidectomy. Dissection should be continued extensively upward in order to expose the hyoid bone.

Wound Closure

After checking hemostasis and lymphatic leak (Fig. 17.25), the sternohyoid muscles are reapproximated along the mid-

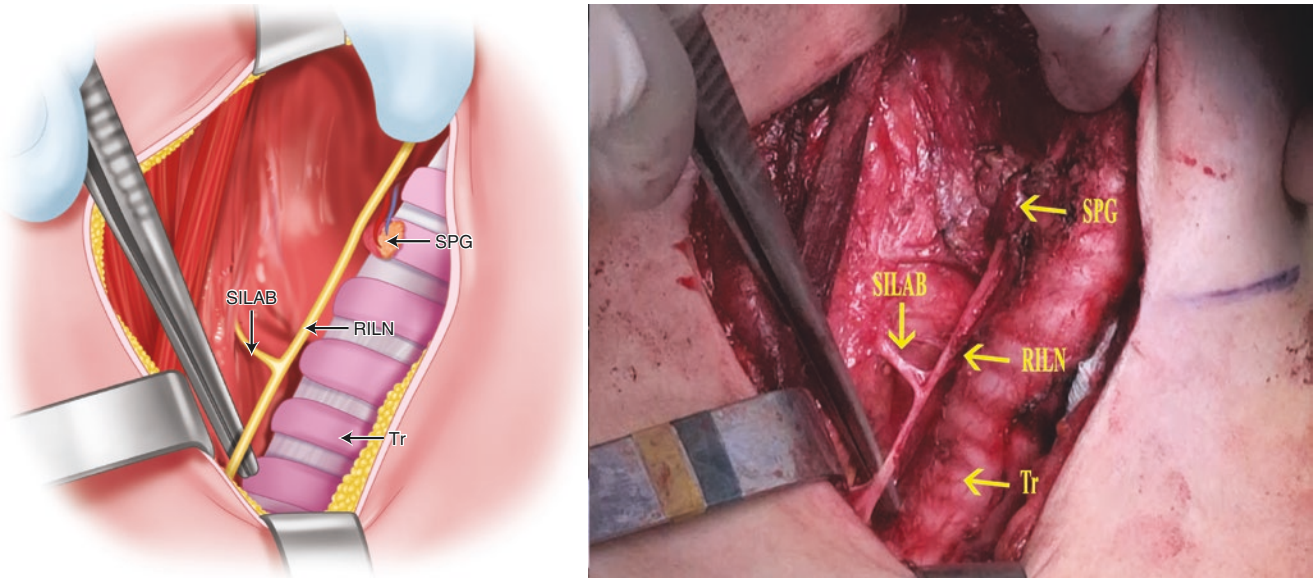

Fig. 17.25 Final view of the operative field. Checking hemostasis after thyroidectomy and central neck dissection is completed. RILN – right inferior laryngeal nerve, SILAB – sympathetic inferior laryngeal anastomotic branch, SPG – superior parathyroid gland, Tr – trachea

line. The wound is closed with subcuticular running sutures. Suction drains may be left inside.

Conclusion

Neck dissection is one of the most complicated surgeries of the human body since several nervous, muscular, and vascular structures are at risk during dissection. Thus, in patients with differentiated thyroid cancers, comprehensive central and lateral neck dissections should be performed only with a therapeutic intent (i.e., in the presence of proven lymph node metastases). Accurate knowledge of applied anatomy and embryology is essential to achieving a radical resection while minimizing the risk of complications. Since fibrofatty tissue containing lymph nodes is enveloped by the deep cervical fascia, to achieve an adequate and comprehensive clearance of the target basins it is particularly useful to follow the planes of coalescence of different fascial layers, which are avascular and allow to remove the target nodes en bloc with their investing fascial layers. Those layers are avascular and allow the surgeon to remove the target nodes *en bloc* along with their investing fascial layers. The technique of fascial dissection for both central and lateral compartments has been described in the present chapter.

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