Total Thyroidectomy

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Introduction

The patient presents with a single thyroid nodule that was positive for malignancy on biopsy, and with positive molecular testing, a total thyroidectomy was planned. The usual steps of this procedure are described, along with the potential pitfalls and key aspects of perioperative care.

The patient is placed supine with adequate anterior neck extension. A transverse incision is used, and the incision is carried through the platysma. Subplatysmal flaps are created, and the median raphe is widely incised. The strap muscles are then dissected off the thyroid lobe. The blood supply to the thyroid lobe is divided between fine ties, and the parathyroid glands are identified to be preserved in situ. The recurrent laryngeal nerve is identified and cleared, with avoidance of electrocautery or other injuries. As dissection progresses, the ligament of Berry is carefully ligated near the insertion of the recurrent laryngeal nerve, and then the thyroid is dissected off the trachea. The same steps are then used on the contralateral lobe, and the specimen is resected. Hemostasis must be ensured prior to the closure of the incision in layers.

Preoperative screening for concurrent primary hyperparathyroidism is routinely done, and vitamin D is repleted preoperatively if identified. We do not routinely use intraoperative nerve monitoring, but vocal cord assessment is performed in several ways. Postoperatively, monitoring for signs of cervical hematoma is important, as is the prevention of hypocalcemia.

Supplementary Information The online version contains supplementary material available at [https://doi.org/10.1007/978-3-030-93673-0_5].

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Case Description

The patient is an otherwise healthy 32-year-old male with a TIRADS 5, 1.7 cm right thyroid nodule without associated lymphadenopathy on cervical ultrasound. The nodule was positive for papillary thyroid cancer on fine-needle aspiration biopsy. After informed consent and under an institutional clinical trial, it was subjected to molecular testing with ThyroSeq® version 3 to determine the extent of initial thyroidectomy. Molecular results were positive for a BRAF V600E mutation, and total thyroidectomy was planned.

Procedure

The patient is positioned supine for the induction of anesthesia by endotracheal intubation. A rolled sheet is placed behind the scapulae, and a modified beach chair position is used to best expose the anterior neck. Care is taken to ensure that the patient has no history or features of cervical disk disease. After prepping and draping, a short transverse incision is marked within a natural skin crease, ideally 1–2 cm inferior to the cricoid cartilage, using concentric lateral hatch marks in case the incision should need to be extended. Here, the incision measured 4.8 cm. Local anesthesia with 0.5% bupivacaine with 1:200,000 epinephrine is infiltrated as a subcuticular wheal in the dermis, the skin is incised with a 15-blade scalpel, and the subcutaneous tissues and platysma are divided with electrocautery, taking care to preserve the anterior jugular veins. A Senn retractor is used to elevate the subplatysmal flaps superiorly and inferiorly using blunt dissection and electrocautery; this step facilitates excellent postoperative cosmesis (Figs. 5.1, 5.2, and 5.3).

The median raphe is then incised up to the thyroid cartilage and down to the sternal notch, and a self-retaining Weitlaner retractor is placed. It is preferable to begin the dissection on the side of the cancer, in this case the right side, but this is not mandatory in every setting. As the strap muscles are dissected off the lobe, care must be taken to widely

A. Shifrin (ed.), *Atlas of Thyroid Surgery*, https://doi.org/10.1007/978-3-030-93673-0_5

Fig. 5.1 Modified beach chair positioning with a rolled sheet as a shoulder roll (solid arrow) for adequate neck extension

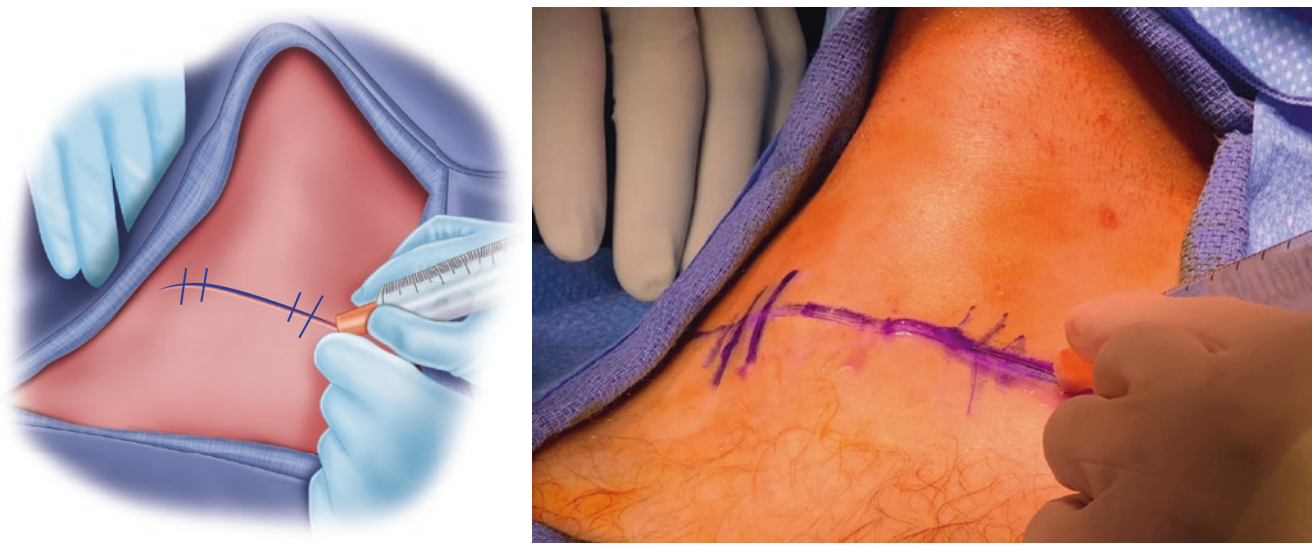

Fig. 5.2 Infiltration of subcuticular local anesthesia

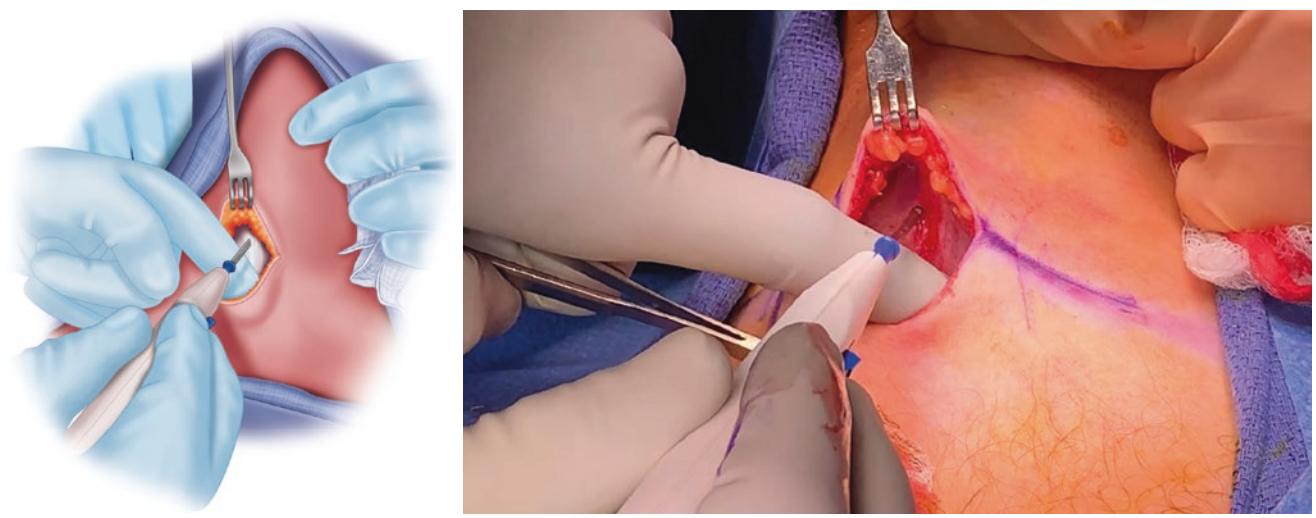

Fig. 5.3 Superior subplatysmal flap elevated with a combination of blunt dissection and electrocautery

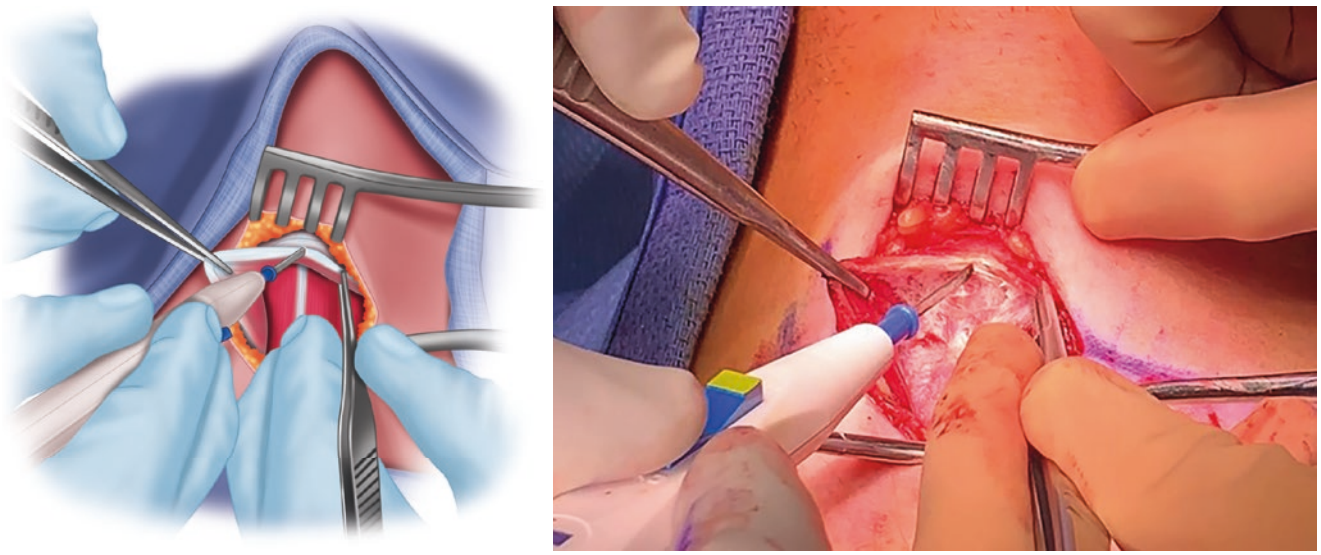

Fig. 5.4 Division of the median raphe superiorly toward the thyroid cartilage

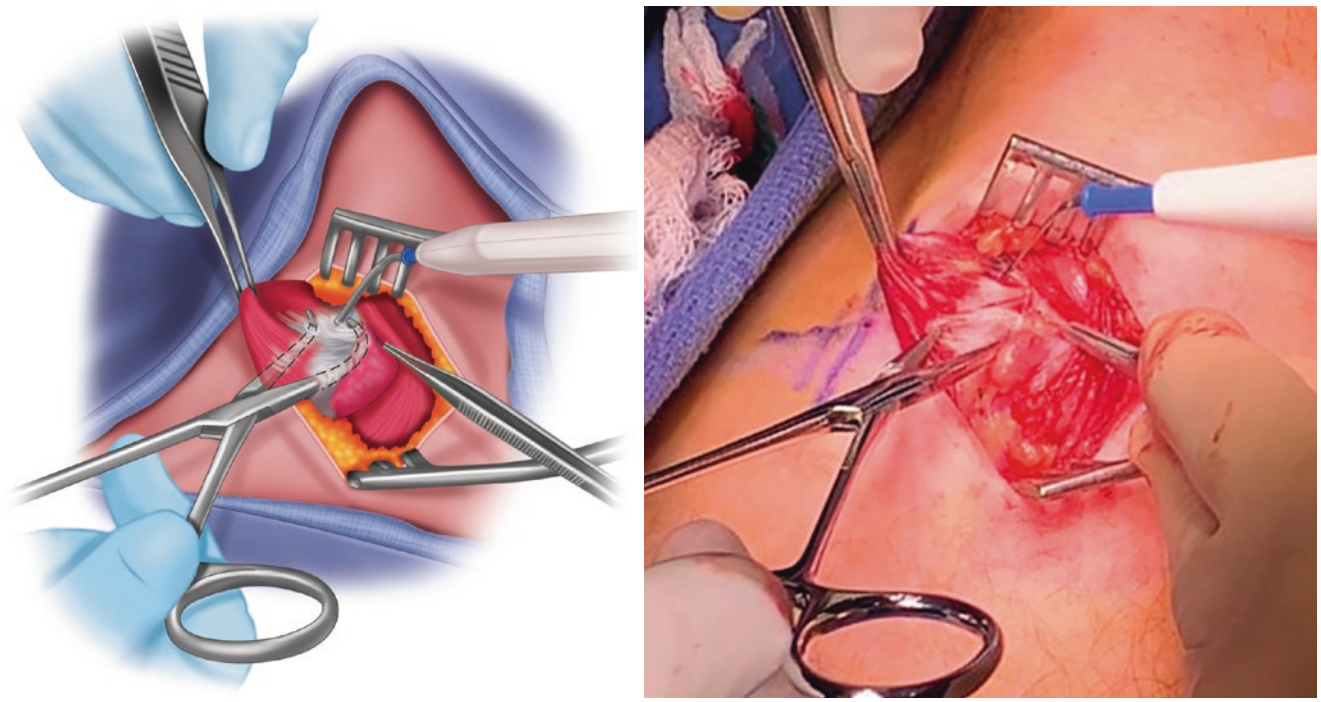

Fig. 5.5 Dissection of the right sternothyroid strap muscle from the thyroid gland

open the dissecting instrument (here a Mixter right-angle forceps) in order to prevent electrocautery arcing, which could potentially lead to thermal injury of the ipsilateral recurrent laryngeal nerve (RLN). When possible, lateral dissection should extend along the lateral strap muscle line to ensure that the surrounding lymphatic tissue remains with the thyroid specimen. This is called "opening the box" (Figs. 5.4 and 5.5).

During initial exposure of the lobe, (1) a manual Richardson retractor is placed laterally, (2) two Allis clamps are applied in parallel to facilitate medial rotation of the lobe while avoiding capsular disruption, and (3) the bed is tilted slightly to best bring the field into the light (i.e., the table is rotated slightly toward the contralateral lobe). As seen later in this video, with their nondominant hand, the assistant gradually everts the lobe while applying manual medial

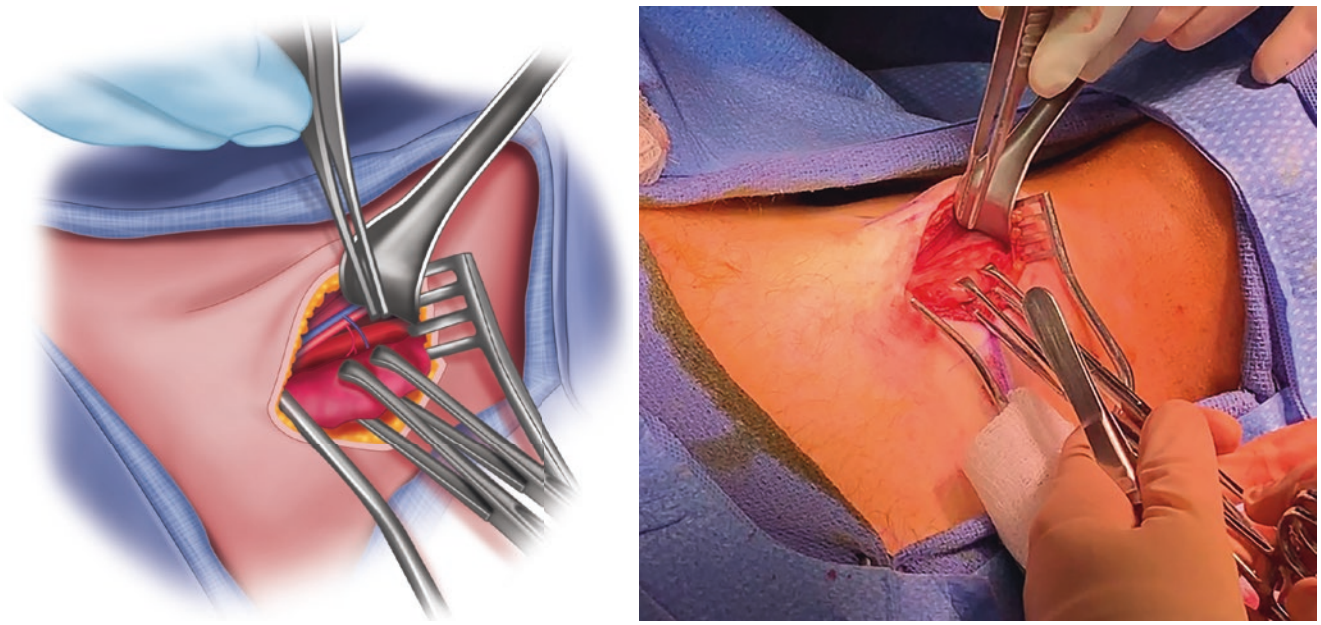

Fig. 5.6 Exposure of the right thyroid lobe with a lateral retraction of the strap muscle, medial retraction of the thyroid lobe, and tilt of the operating room table toward the left

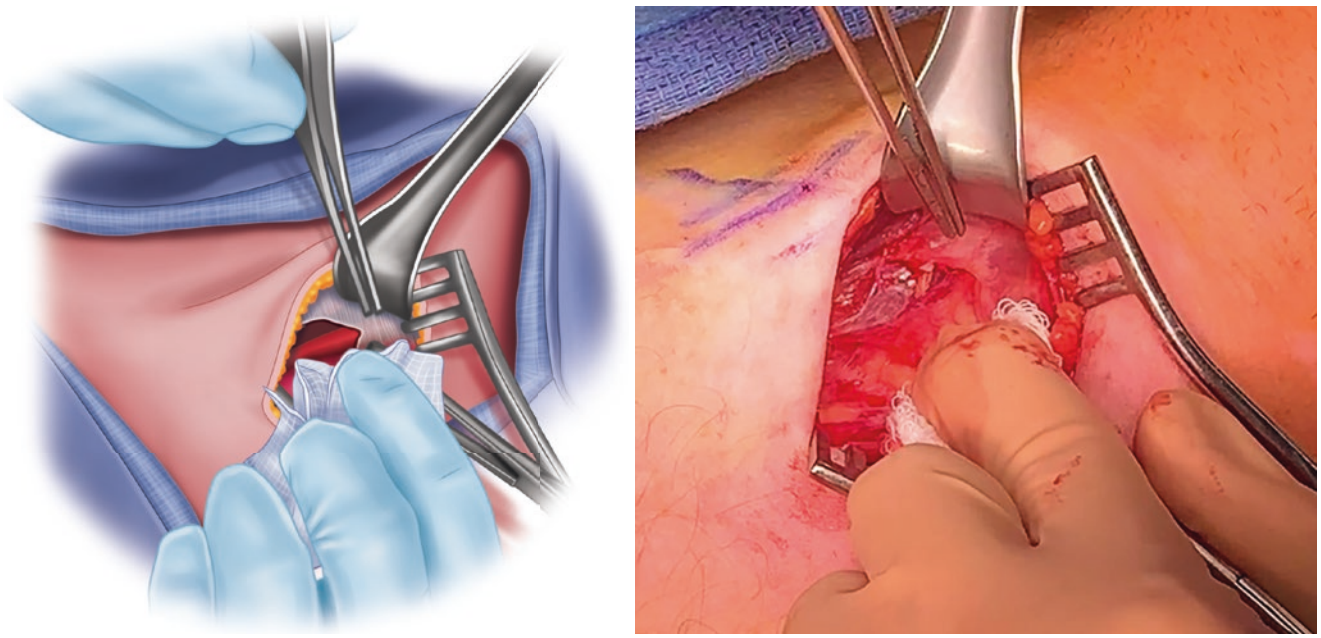

Fig. 5.7 Manual compression and eversion of the right thyroid lobe

compression, which works to improve both visualization and hemostasis (Figs. 5.6 and 5.7).

In general, as dissection progresses, the blood supply to the lobe is sequentially divided between fine ties, while the recurrent laryngeal nerve is delicately identified and cleared, and the ipsilateral parathyroid glands are recognized and preserved viably in situ. However, the specific thyroid lobe anatomy very much determines the order and conduct of these next steps—which can thus vary greatly. Often, the specific anatomy prompts early ligation of the middle thyroid vein between 4 and 0 absorbable ties, as seen here. The superior and inferior vascular pedicles are also early targets for division between ligatures. During dissection, manually thinning out the tissue helps the surgeon determine that a bite is safe to take. Electrocautery and energy devices should not be used within 1 cm of the course of the RLN. We do not use an

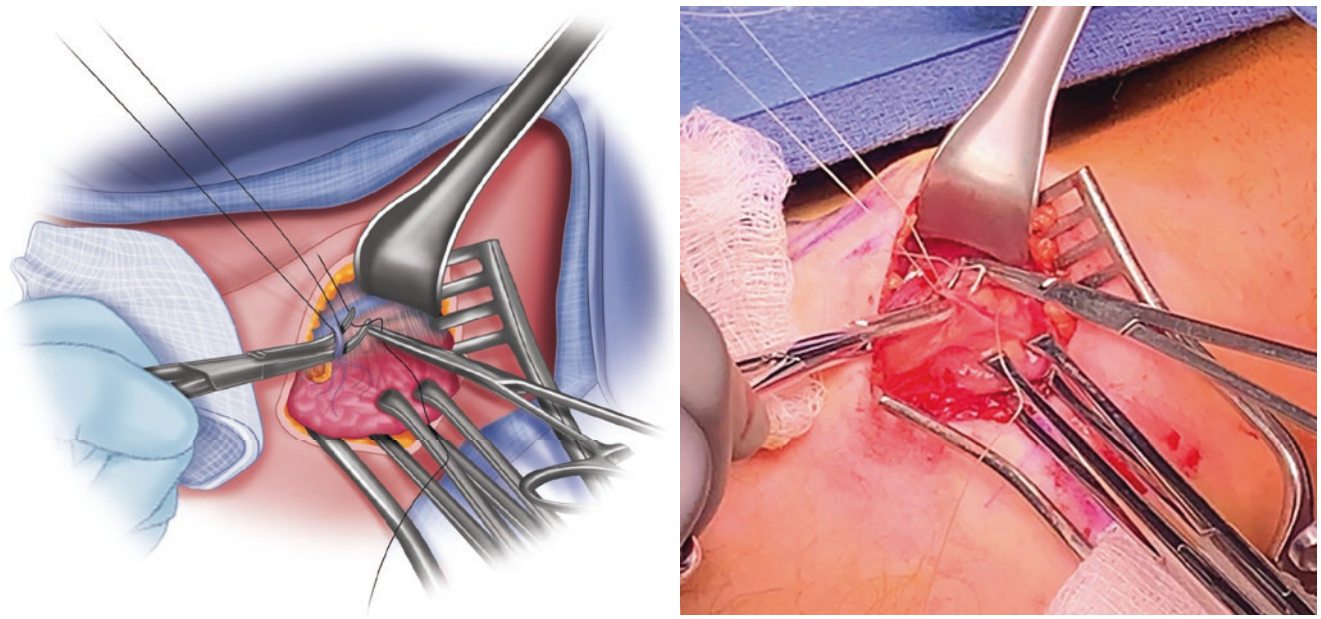

Fig. 5.8 Ligation of the middle thyroid vein between fine ties

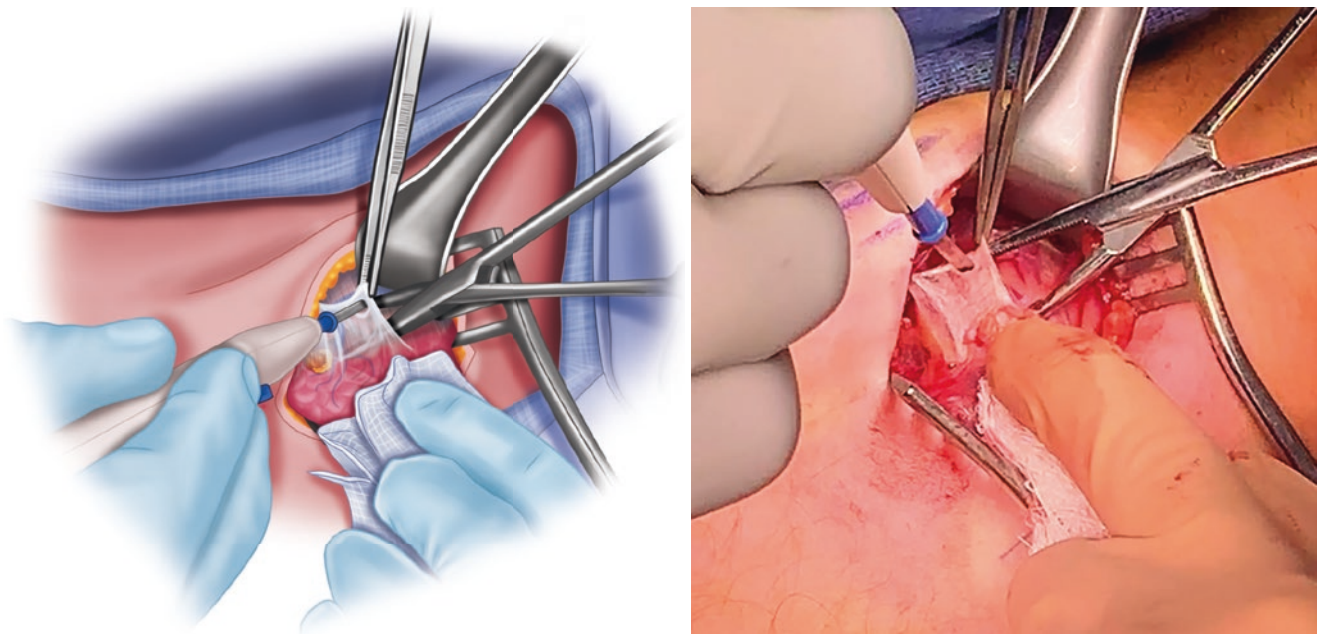

Fig. 5.9 Division of lateral attachments with electrocautery with a widely open dissector instrument to avoid thermal injury to nearby structures

energy device because of concerns of bleeding and iatrogenic injury, and we find that it does not save time as our average operative duration for a thyroid lobectomy is about 45 minutes (Figs. 5.8 and 5.9).

In this patient, the normal right inferior parathyroid gland is identified within the surrounding fat and preserved, while it was also marked with a titanium clip. This patient also has a superior thyroid pole that extends very cranially, almost to the angle of the mandible. The preservation of the external branch of the superior laryngeal nerve is routinely facilitated by dividing the superior vascular pedicle (and/or its arborizing branches) on the anterior surface of the superior thyroid pole. The estimated injury rate of the external branch of the superior laryngeal nerve is <4%. This patient also has a prominent tubercle of Zuckerkandl, which when present must be resected in full if safely possible. Here, the tubercle was rolled medially with finger traction to aid in mobilization (Figs. 5.10 and 5.11).

We can clearly see the two normal ipsilateral parathyroid glands, which are preserved and appear viable with

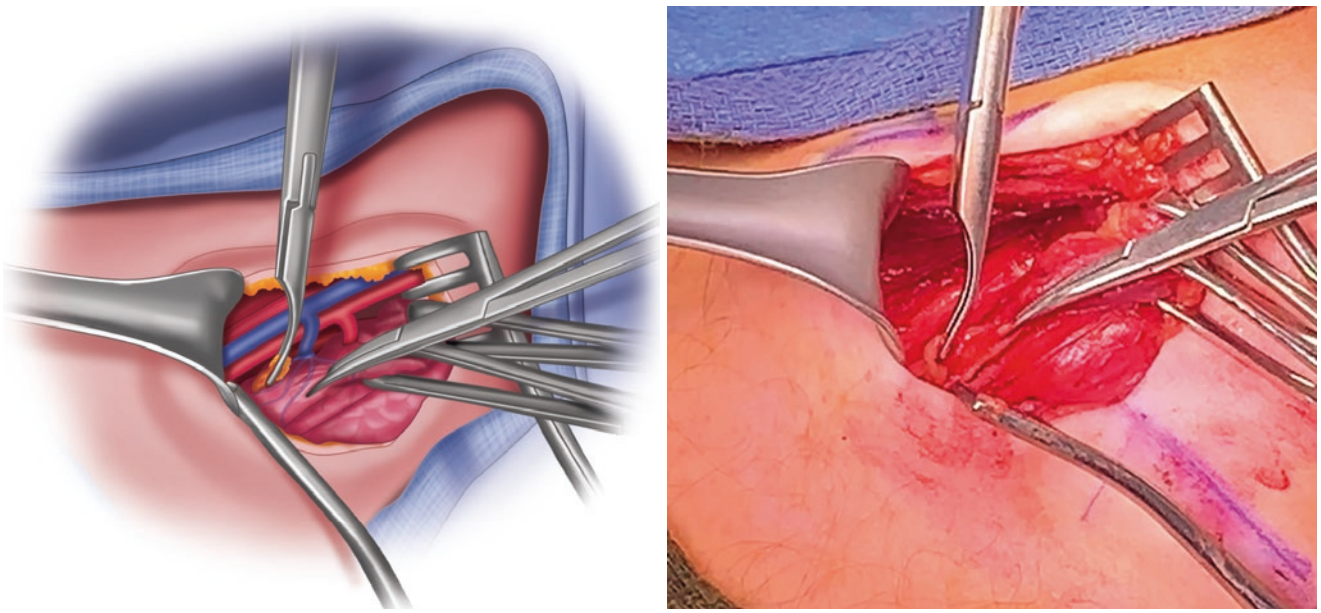

Fig. 5.10 The right inferior parathyroid gland is marked with a titanium clip

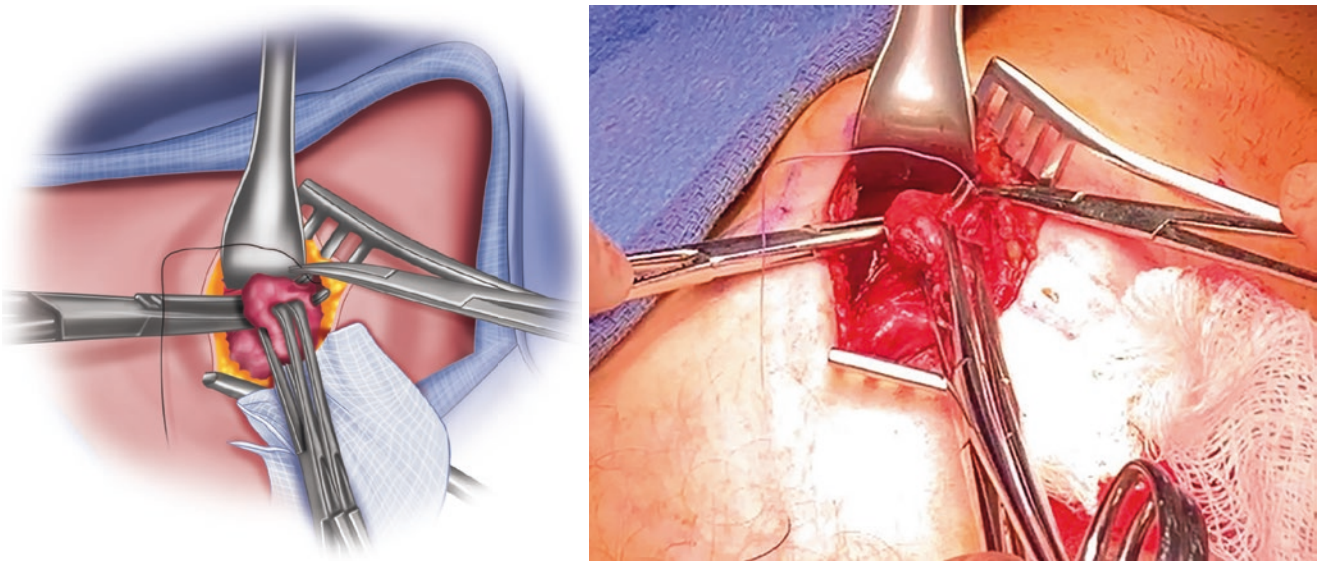

Fig. 5.11 A prominent tubercle of Zuckerkandl is carefully resected with the thyroid lobe

subtle differences in color and texture from the surrounding fat and lymph nodes. A normal parathyroid gland weighs about 20–50 mg. In general, an embryologic inferior gland is more anteriorly situated, often near the tip of the cervical thymus, while the superior parathyroid resides in a deeper plane and is often in or near the tracheoesophageal groove. If for any reason a normal parathyroid appears ischemic, it should be promptly harvested and minced sterilely into 1-mm fragments, with one fragment sent for frozen section to confirm tissue identity and the remainder autotransplanted into the ipsilateral strap or sternocleidomastoid muscle, marking that site with a permanent stitch. The likelihood of this being required in this program is <5%. The likelihood of permanent hypoparathyroidism with total thyroidectomy in this program is about 1 in 300 (Figs. 5.12, 5.13, 5.14, and 5.15).

As dissection progresses, atraumatic preservation of the RLN is facilitated by tracing its course from near the thoracic inlet into the larynx at the ligament of Berry. Here, we can see that the nerve has anterior and posterior branches. Studies have documented that it is the anterior branch that has a motor function; thus, it is imperative to preserve both branches

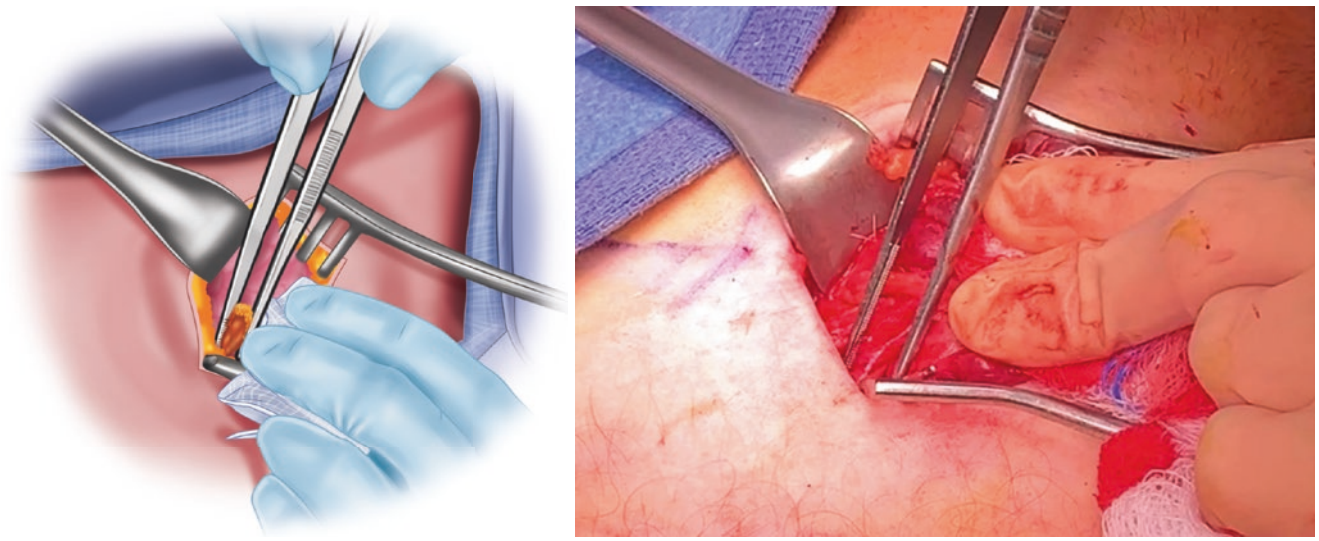

Fig. 5.12 Identification of the right inferior parathyroid gland

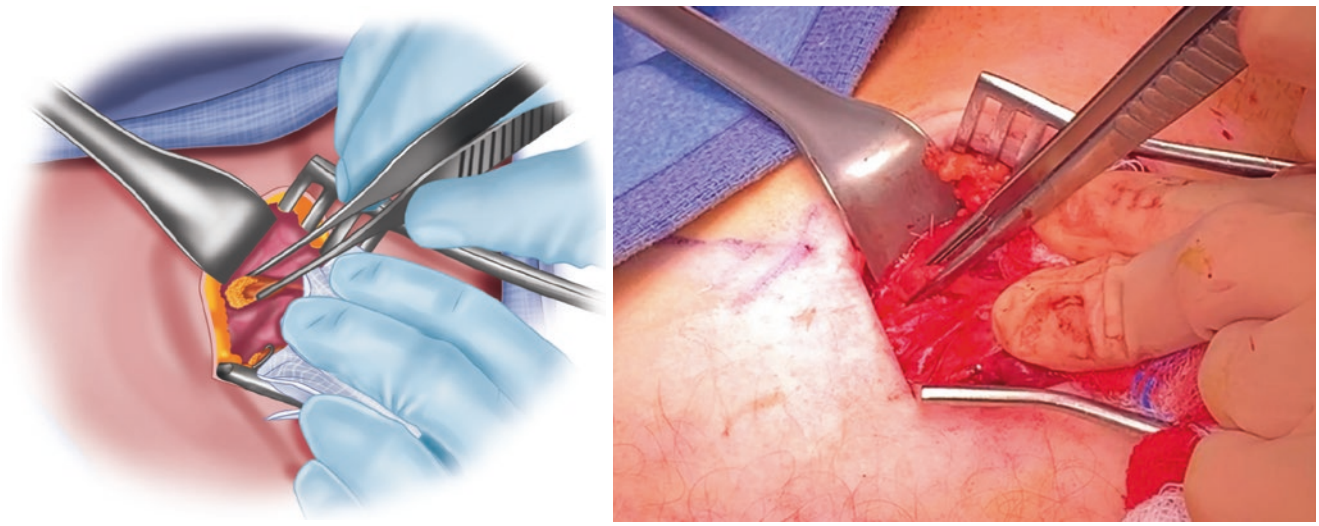

Fig. 5.13 Identification of the right superior parathyroid gland

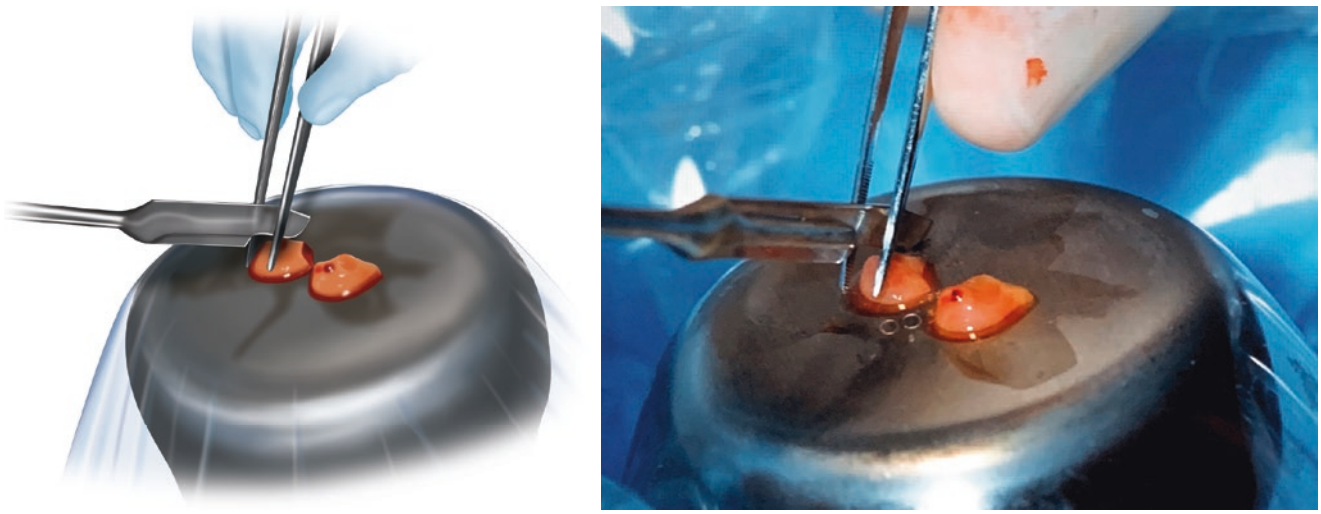

Fig. 5.14 A harvested parathyroid gland, with one fragment sent to pathology to confirm identity

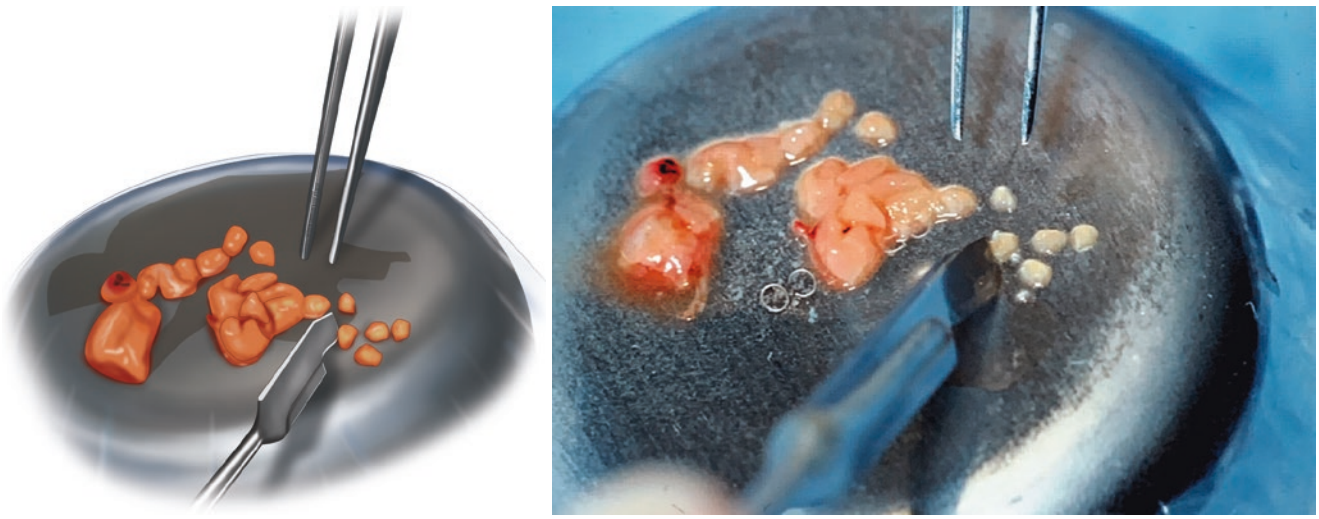

Fig. 5.15 The minced parathyroid gland prior to reimplantation

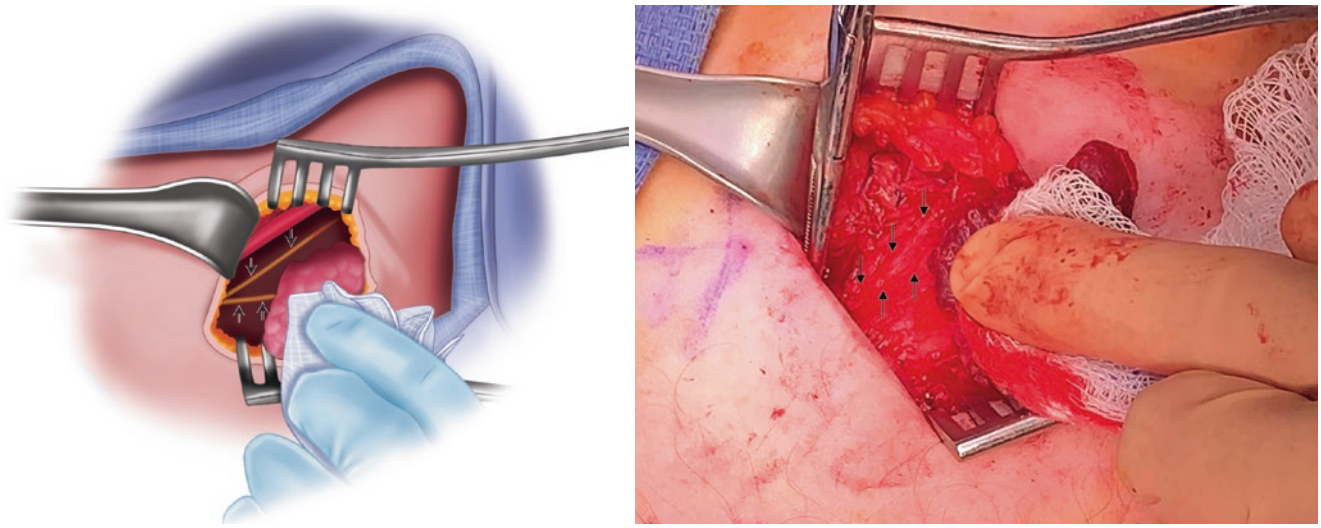

Fig. 5.16 The right recurrent laryngeal nerve is identified, and its two branches are traced (black arrows)

when branching is present. When dividing the ligament of Berry, the Mixter is directed toward the feet to avoid the cricoid membrane and to remain parallel to the course of the RLN. Once ligated, the ligament of Berry is often divided sharply for precision (Figs. 5.16, 5.17, and 5.18).

The thyroid isthmus is then dissected off the trachea in the avascular plane. If a pyramidal lobe is present (which is often bilobed and can even be trilobed), this tissue is resected entirely and in continuity with the isthmus; a pyramidal lobe typically has paired vascular pedicles that should be individually managed. Once mobilization is well away from the RLN, one can return to using electrocautery. Any thyroidea ima vessels near the isthmus are ligated and divided. When performing lobectomy, the junction of the isthmus and contralateral thyroid lobe represents the surgical margin and is transected and oversewn. At this point, a review of the exposed anatomy shows the inferior parathyroid gland, the recurrent laryngeal nerve, and the superior parathyroid gland, and the thyroid cancer can be seen near the inferior pole (Figs. 5.19, 5.20, 5.21, and 5.22).

For total thyroidectomy, attention is next turned to the contralateral lobe, and the same steps are used to expose, mobilize, and resect it. On the left side in this patient, a tiny but often present vascular bundle (termed here the "vein of doom") tethers the recurrent laryngeal nerve to the ligament of Berry, requiring delicate division to protect the nerve (Figs. 5.23, 5.24, and 5.25).

Once the specimen is resected, it must be inspected to assess for any attached parathyroid glands and oriented for pathology. At all layers of depth, the field is repeatedly

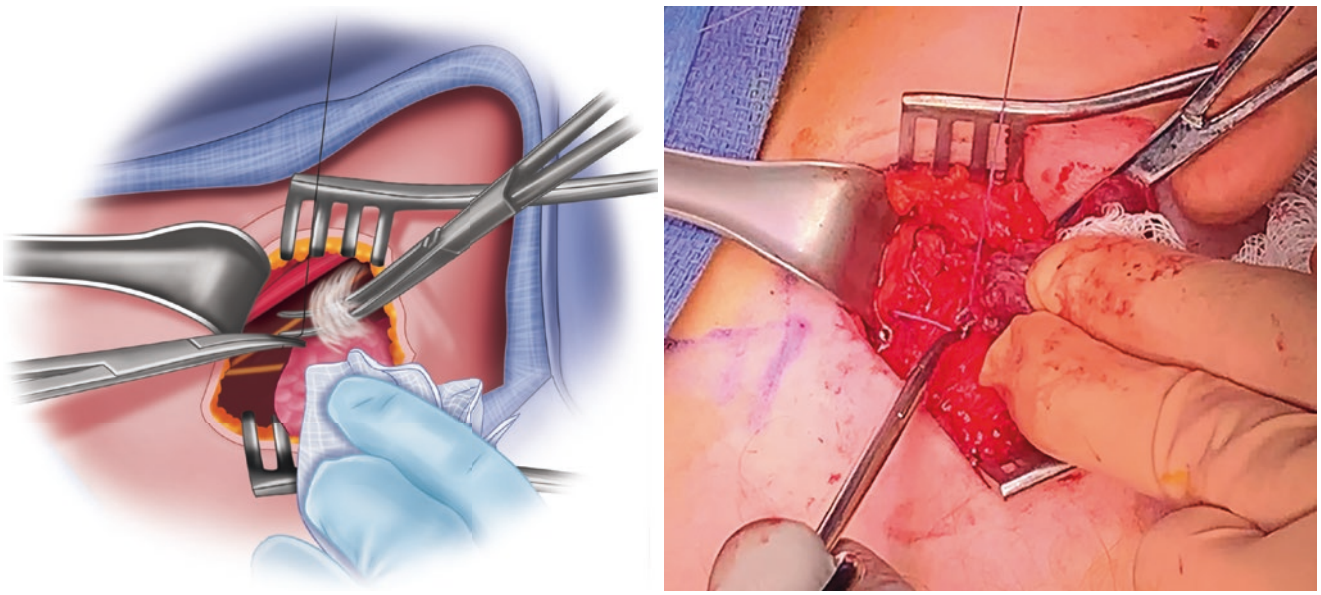

Fig. 5.17 Dissection of the ligament of Berry parallel and medial to the recurrent laryngeal nerve

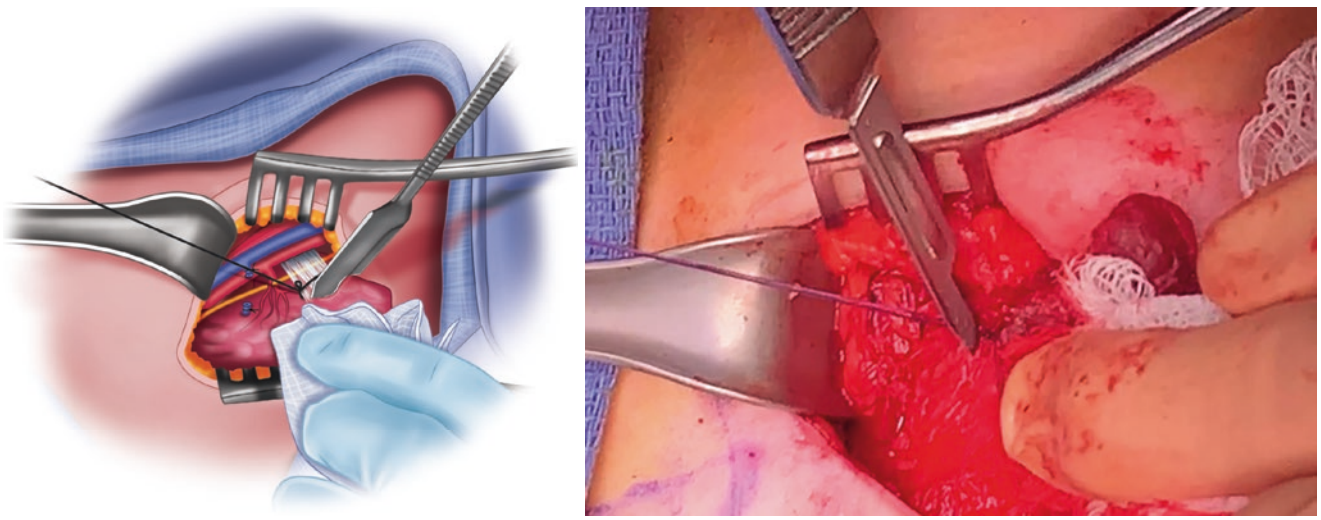

Fig. 5.18 Sharp division of the ligament of Berry

inspected to identify and manage any oozing and ensure meticulous hemostasis. Hemostatic agents are not routinely used. Closure is accomplished in three layers using running 3-0 absorbable suture to close the median raphe in the midline, inverted interrupted 3-0 absorbable to close the platysma, and subcuticular 5-0 absorbable monofilament for the skin. As incisions often stretch out during surgery, they often measure larger at the conclusion of the operation as this incision now measures 5.5 cm. We then place wound closure strips or topical skin adhesive over the incision (Figs. 5.26, 5.27, 5.28, 5.29, and 5.30).

At this high-volume thyroid center, we routinely screen for concurrent primary hyperparathyroidism, which is present in ~5% of patients and can greatly alter the conduct or extent of surgery. This patient had normal calcium, parathormone (PTH), and vitamin D levels preoperatively; vitamin D deficiency is quite common in our region, and vitamin D is routinely repleted preoperatively, which greatly reduces the likelihood and severity of postoperative hypocalcemia and paresthesias. This program also does not routinely use intraoperative nerve monitoring during initial surgery as multiple studies have not been able to demonstrate a benefit; however, we employ this adjunct for selected high-risk patients and often use it in reoperative thyroidectomy. This program does not use direct laryngoscopy for the initial surgery of patients who are assessed by the surgeon to have

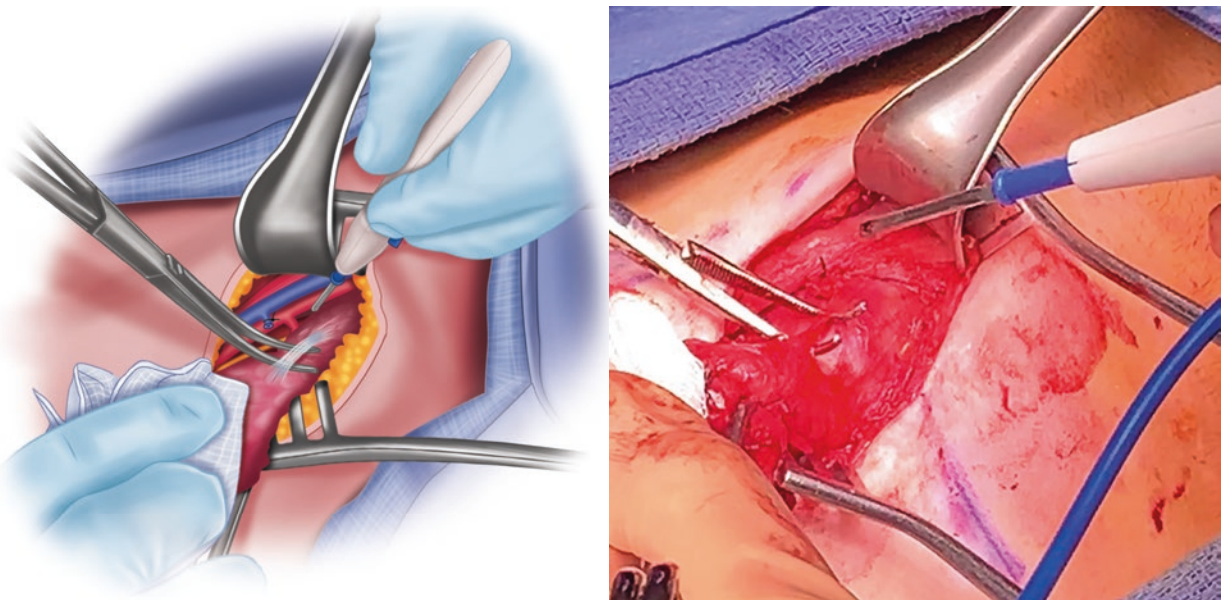

Fig. 5.19 Division of attachments to the pyramidal lobe

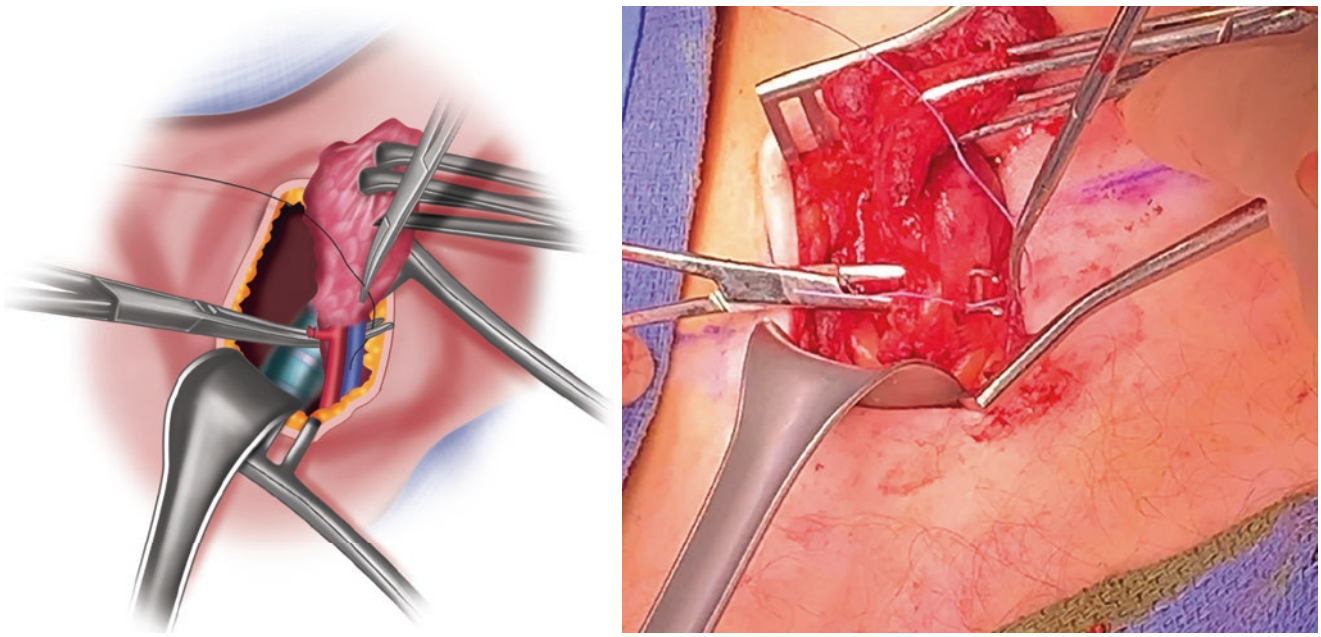

Fig. 5.20 Ligation of thyroidea ima vessels at the anterior surface of the trachea

normal vocal fold function, often employs vocal cord ultrasonography (VCUS) performed by the surgical team as a screening tool, and obtains preoperative laryngoscopy for all reoperative patients. If postoperative VCUS is abnormal, the patient is referred for laryngology evaluation and management, which in the immediate postoperative setting often includes nimodipine, an agent that can increase the likelihood of vocal fold recovery and decrease the interval to recovery. The rate of permanent vocal fold paralysis at this program is <1%.

Postoperatively, patients are monitored in the hospital for a minimum of 6 hours after a thyroid lobectomy and overnight after a total or completion thyroidectomy. An initial postoperative evaluation by the surgeon at 6 hours must evaluate for a cervical hematoma that would require operative evacuation. The incidence of a postoperative hematoma requiring evacua-

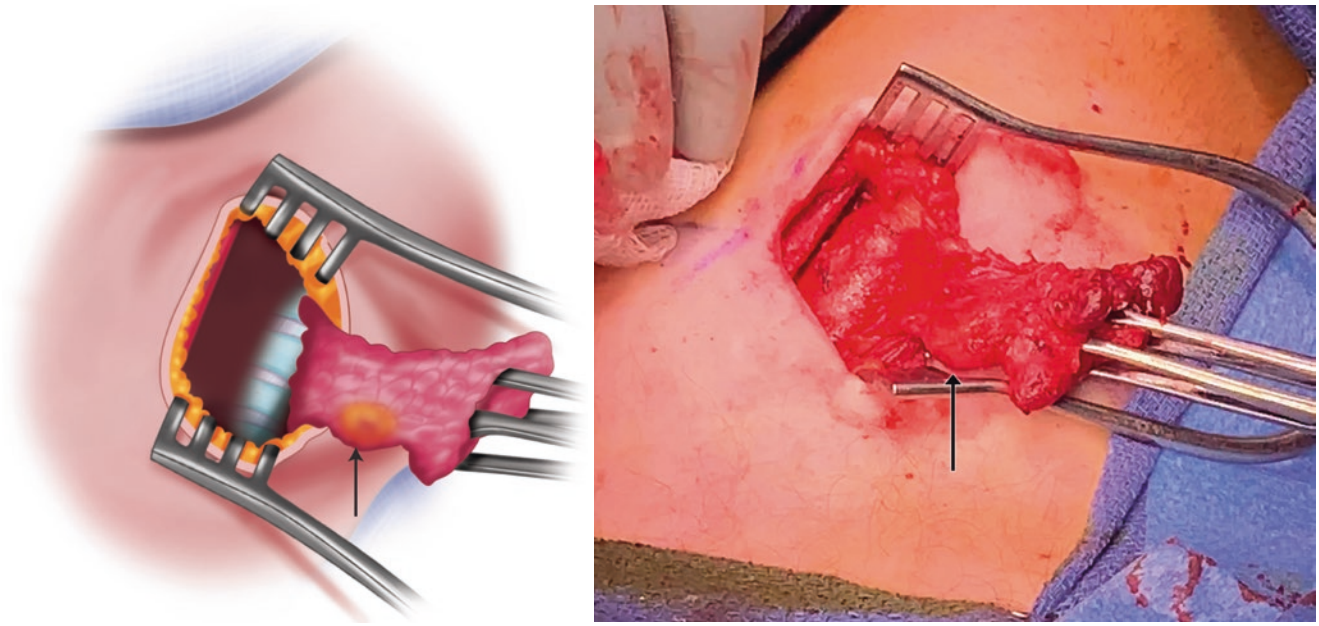

Fig. 5.21 Dissection carried along the anterior surface of the trachea to the junction of the thyroid isthmus and the left thyroid lobe. The cancerous nodule can be seen near the inferior pole of the right lobe (arrow)

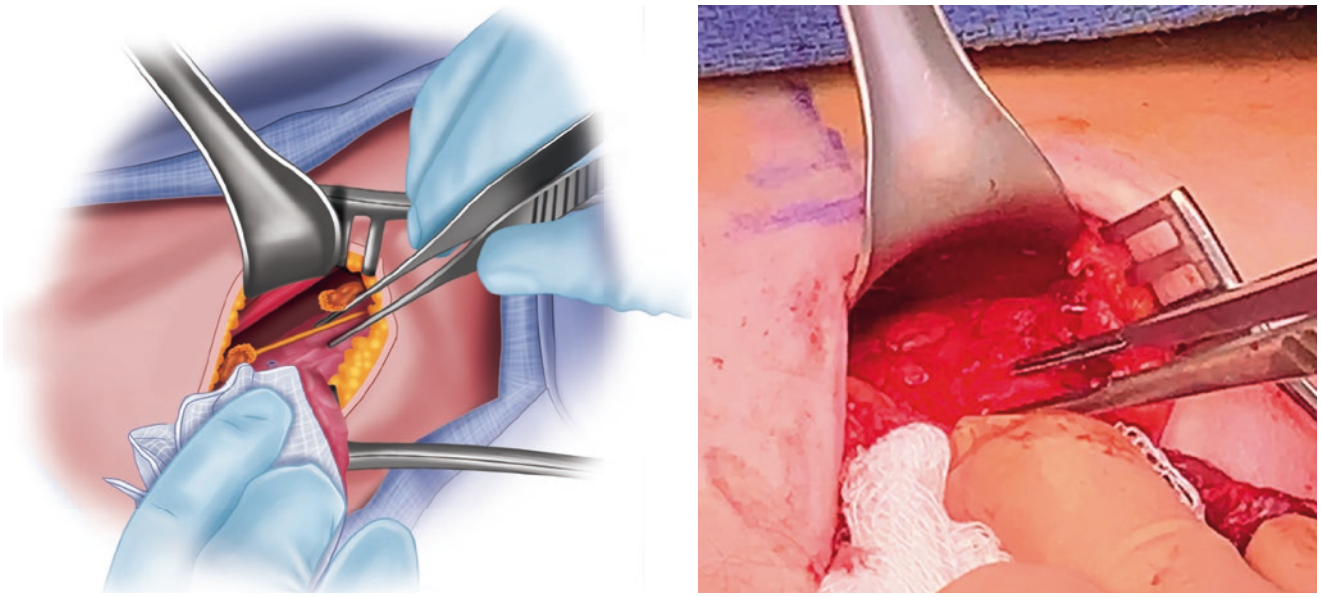

Fig. 5.22 Identification of the right recurrent laryngeal nerve, as well as the inferior parathyroid gland anteriorly and the superior parathyroid gland posteriorly

tion is about 1 in 300. Preoperative antibiotics are not routinely administered for thyroidectomy, and our wound infection rate is <1%. Thyroid lobectomy patients do not have postoperative labs checked and are not placed on oral calcium supplementation. After a total or completion thyroidectomy, a morning calcium level is checked, and patients are empirically placed on 2 g of calcium carbonate twice a day. If these patients have symptomatic hypocalcemia or an abnormally low morning calcium level, the frequency is increased to three times a day. All patients are given a standard postoperative instruction sheet that includes postoperative expectations, wound care, activity restrictions, and indications for calling the emergency contact number (Video 5.1).

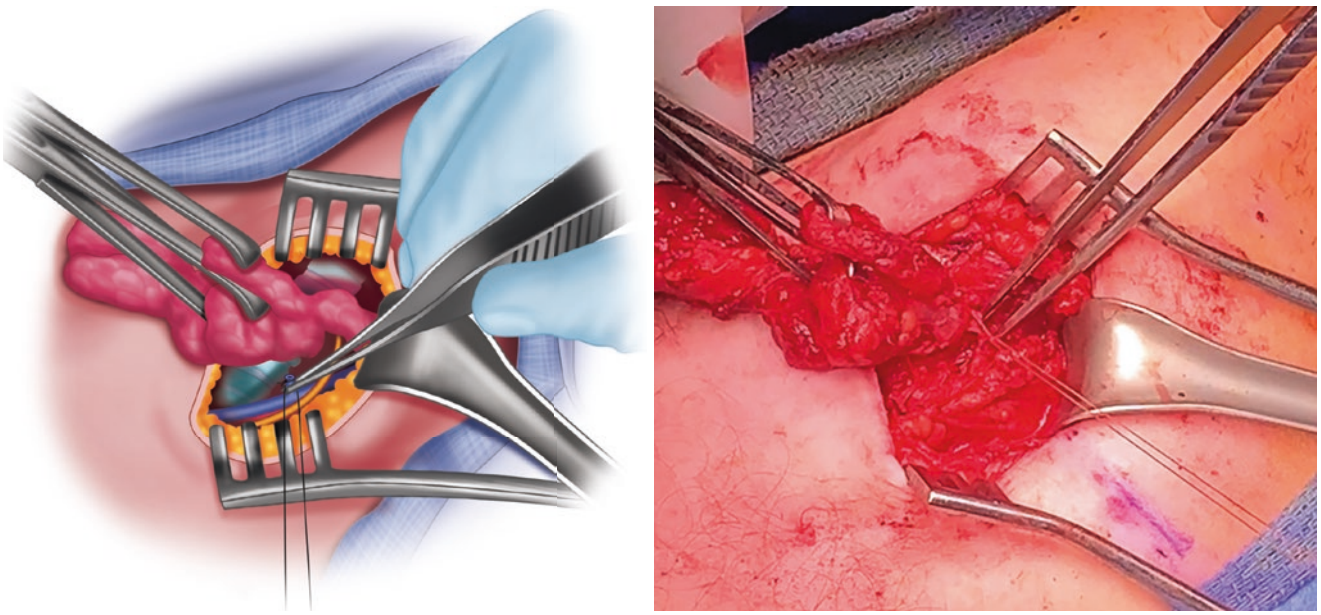

Fig. 5.23 The left "vein of doom" is carefully ligated near the insertion of the recurrent laryngeal nerve

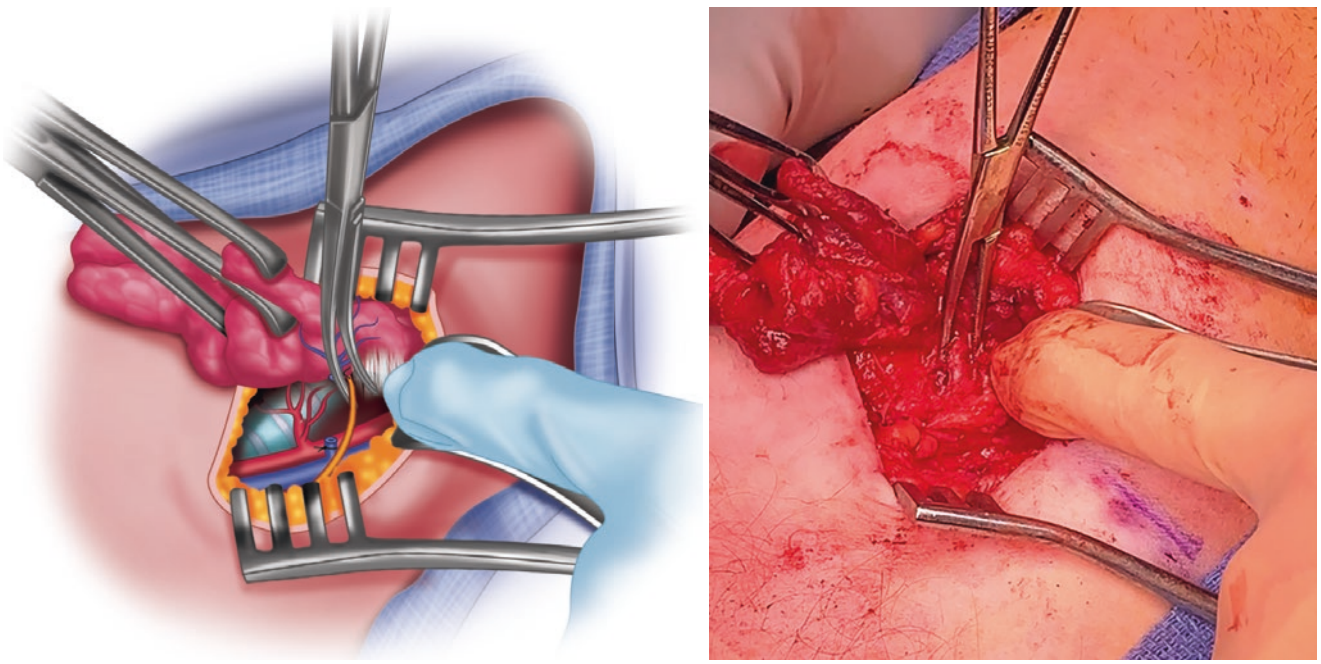

Fig. 5.24 Identification of the left recurrent laryngeal nerve

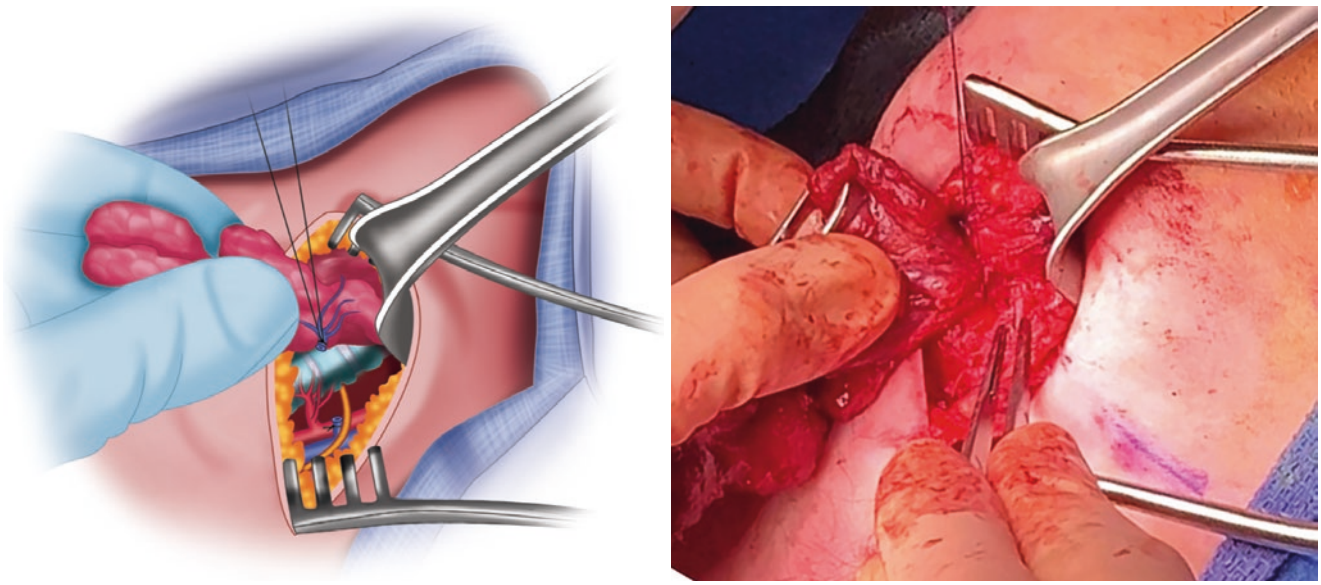

Fig. 5.25 Ligation of the left ligament of Berry while protecting the recurrent laryngeal nerve

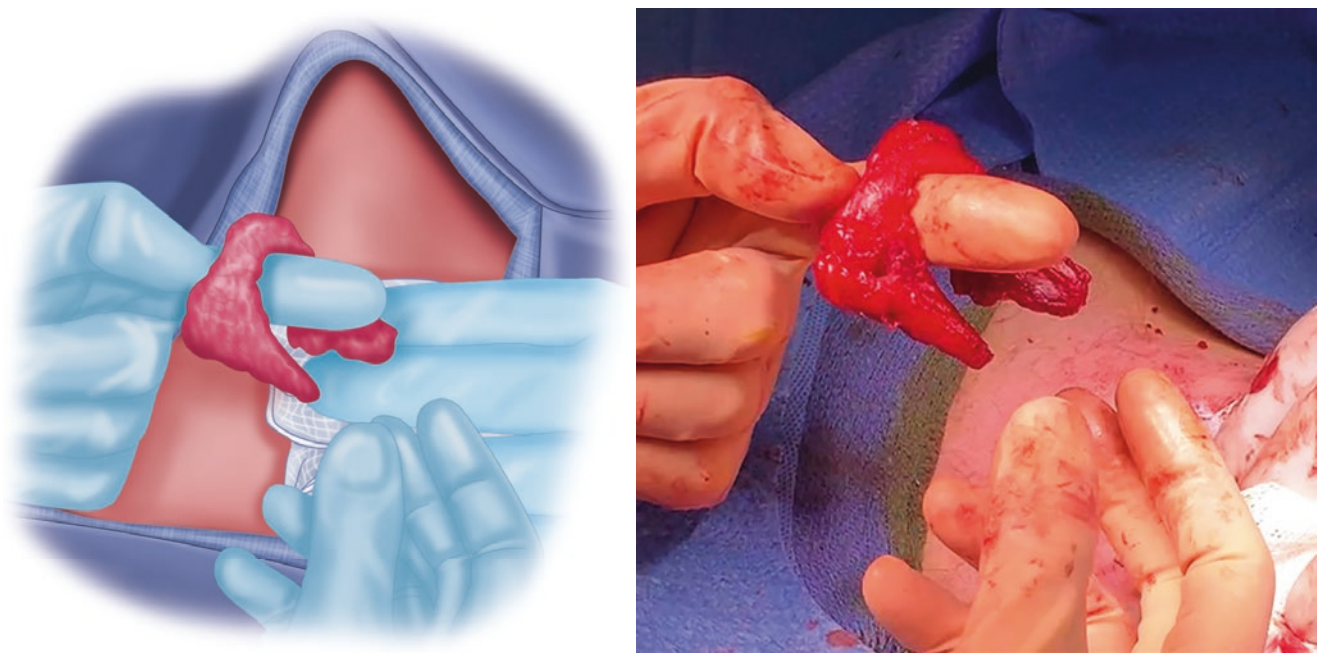

Fig. 5.26 Inspection of the resected thyroid gland for any attached parathyroid glands, with none identified here

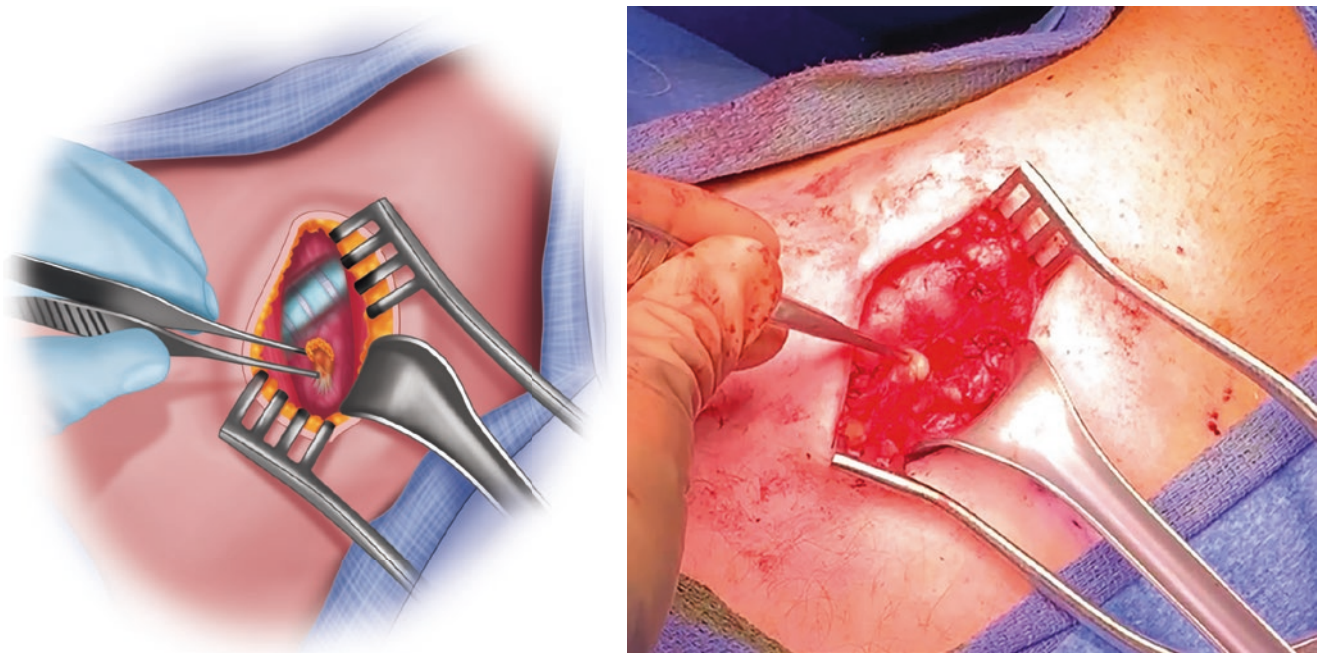

Fig. 5.27 Inspection for hemostasis, while the left inferior parathyroid gland is identified and appears viable

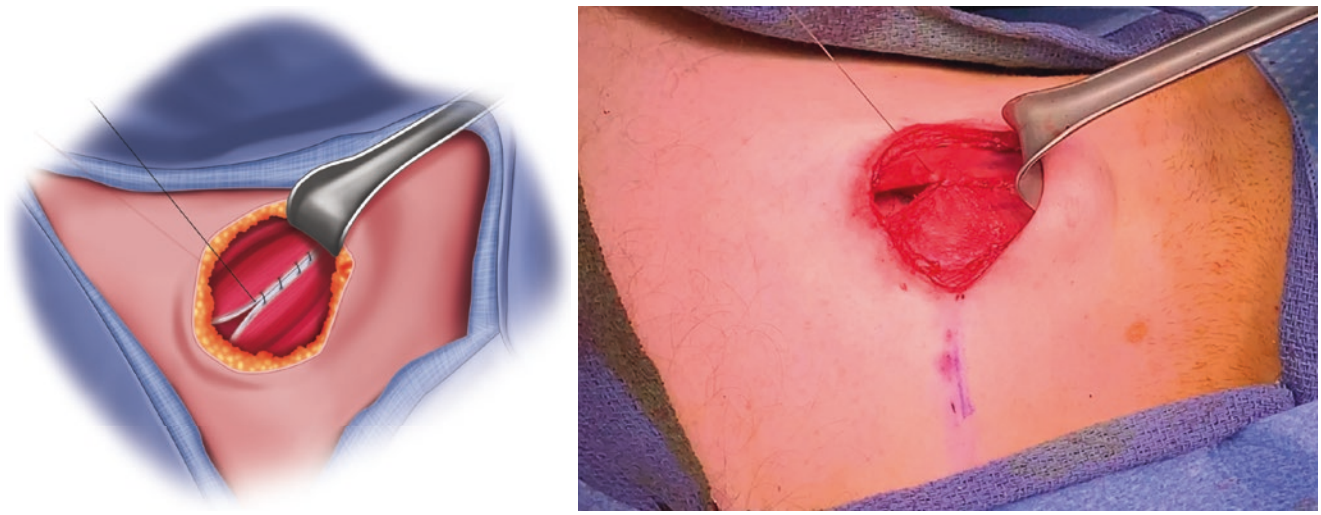

Fig. 5.28 Closure of the median raphe with a running suture

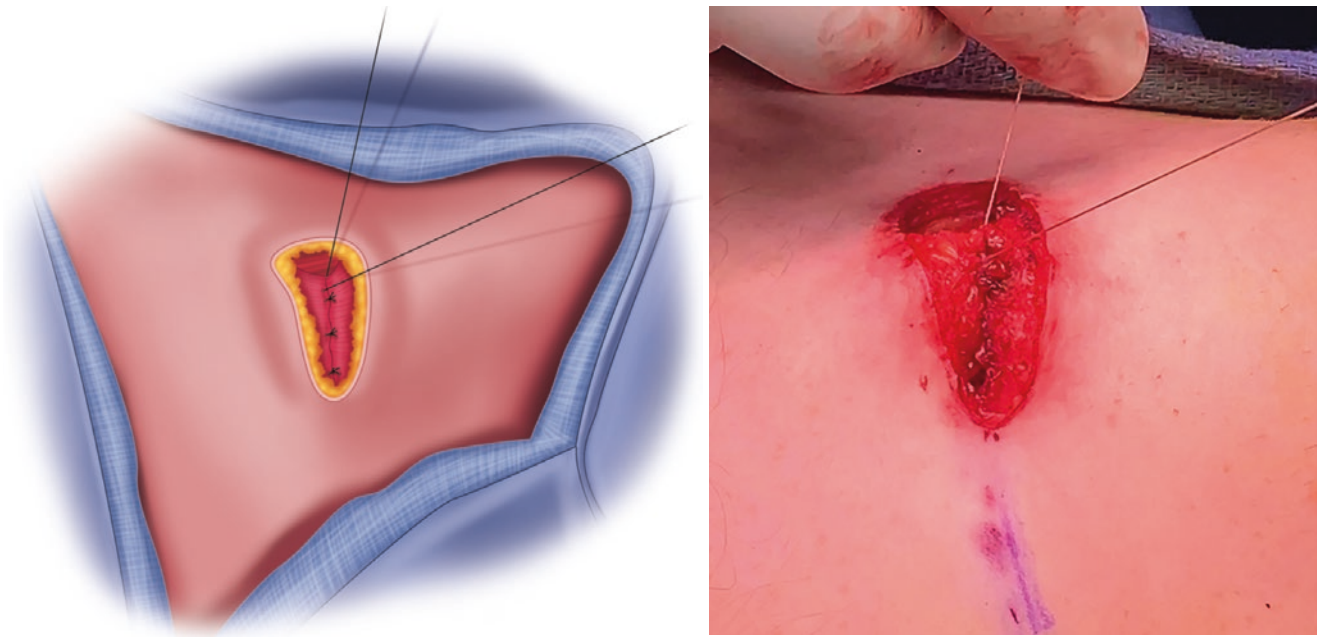

Fig. 5.29 Closure of the platysma with interrupted sutures

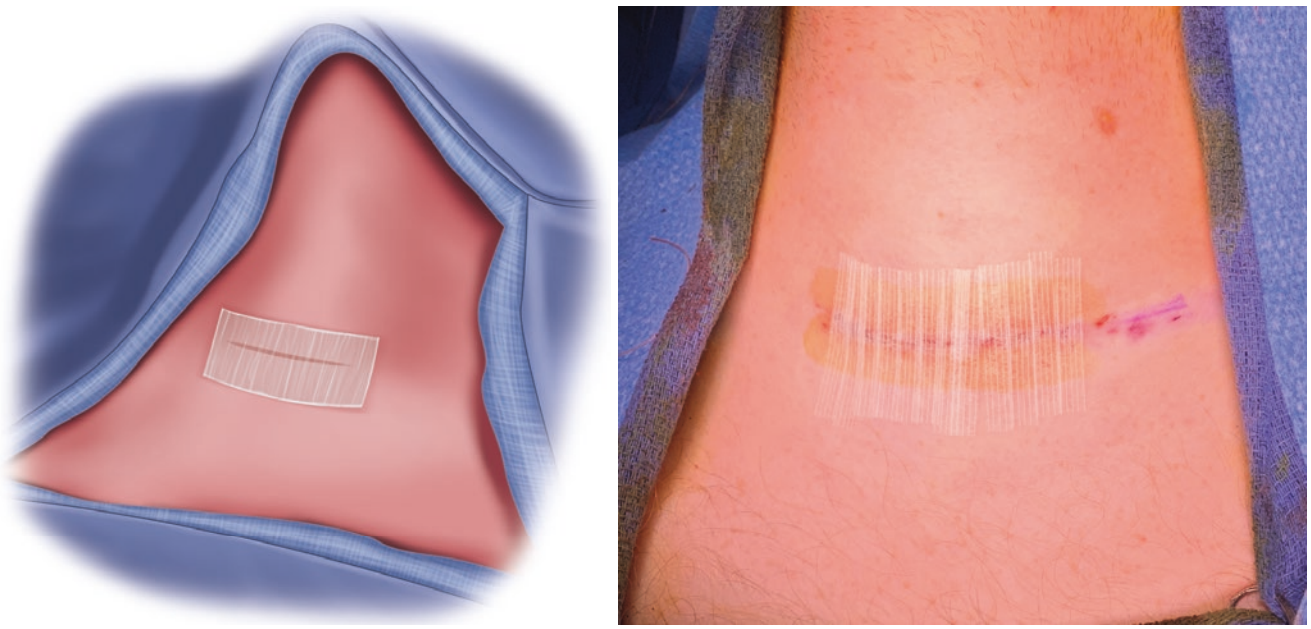

Fig. 5.30 Closed wound after application of wound closure strips

Suggested Reading

Patel KN, Yip L, Lubitz CC, Grubbs EG, Miller BS, Shen W, et al. The American Association of Endocrine Surgeons guidelines for the definitive surgical management of thyroid disease in adults. Ann Surg. 2020;271(3):e21–93.

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