Thyroid Lobectomy and Total Thyroidectomy

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The incidence of thyroid cancer has almost quadrupled over the last quarter of a century. In 1975, we used to see 8000 new patients with thyroid cancer, whereas today we see approximately 66,000 new patients with thyroid cancer in the U.S. [1]. The majority of these cases are directly related to incidentalomas i.e., nonpalpable nodules, incidental findings of thyroid nodules on routine clinical examination, imaging studies such as ultrasound, carotid Doppler studies, and CT scans or MRIs performed for other cervical problems. Appropriate evaluation of the thyroid mass includes a dedicated ultrasound of the thyroid with recognition of the suspicious features, such as hypervascularity, irregular margins, and punctate calcification. After initial clinical evaluation and ultrasound examination, the patient is generally advised to have a fine needle aspiration biopsy. The results of the biopsy are used to determine whether the patient requires surgical intervention or close monitoring and follow-up. If the needle biopsy is suspicious for or proves to be cancer, the patient will require surgical intervention.

Diagnostic thyroid lobectomy is performed for patients in whom the fine needle aspiration biopsy is reported to be atypical, such as in Hurthle cell lesion or follicular neoplasm (Bethesda type III or IV). Appropriate evaluation of the opposite lobe is critical prior to consideration of the extent of thyroidectomy. However, a small percentage of patients who undergo diagnostic thyroid lobectomy may need completion thyroidectomy at a later date if the final pathology report shows this to be aggressive thyroid cancer. Advances in technology and molecular biology have helped us to further our diagnostic acumen, with additional tests such as *BRAF, RET, NRAS*, and *KRAS* mutation analysis, PAX-8/PPAR rearrangement, and the Afirma genetic expression classifier [2]. These tests are quite helpful in selecting patients in whom the decision to have surgery is important, especially in young women who may not want a scar on their necks. There continues to be a strong debate about the extent of thyroidectomy, and whether this should be lobectomy or total thyroidectomy. The decisions about the extent of thyroidectomy are best made in the operating room based on gross findings at the time of surgery, preoperative evaluation with needle biopsy, the status of the opposite lobe, the size of the suspected tumor, the status of the neck nodes, and the possibility of requiring radioactive iodine (RAI) in the future.

If there are gross abnormalities on the opposite lobe or the patient is likely to require RAI based on the initial extent of the malignancy, it is most appropriate to consider total thyroidectomy at the outset. Clearly, the complications of thyroid surgery are directly related to the extent of thyroidectomy and inversely proportional to the surgeon's experience. There is considerable debate about the number of procedures surgeons should be performing, but those doing more than 30–50 thyroidectomies a year are generally considered to have adequate volume [3].

6.1 Indications for Surgery

The major indication for surgery includes a thyroid nodule that is suspicious or atypical on needle biopsy or when the diagnosis of malignancy has been confirmed preoperatively. The decision about extent of thyroidectomy, i.e., lobectomy or total thyroidectomy, should be based on discussions with the patient, the endocrinologists, and the long-term follow-up plan. Diagnostic thyroid lobectomy is commonly performed for atypical fine-needle aspiration biopsy. The incidence of thyroid cancer is much higher in patients with thyroid nodules greater than 3 cm, and most of these patients will require surgical intervention both for diagnostic and therapeutic purposes even if the needle biopsy is inconclusive. Clinical findings such as a hard thyroid nodule, a fixed nodule, the presence of hoarseness of voice or vocal cord paralysis, tracheal deviation, and suspicious nodal metastasis are strong indications for surgical intervention, since the risk of malignancy is quite high in this group of patients.

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6.2   Preoperative Work-Up

The preoperative work-up includes standard thyroid function tests to make sure the patient is euthyroid, checking preoperative calcium levels to rule out simultaneous hyperparathyroidism, and employing thyroid antibodies to rule out Hashimoto thyroiditis. The incidence of complications in patients with hyperthyroidism or with Hashimoto thyroiditis is quite high, and it is important to know about these pathologies preoperatively, both to prepare the patient for a slightly higher incidence of complications and to consider total thyroidectomy. In these individuals the opposite lobe is generally heterogeneous and may develop thyroid nodules in the future. A preoperative flexible laryngoscopy or mirror examination is crucial to evaluate the function of the vocal cords. Preoperative vocal cord palsy will indicate the locally advanced nature of the thyroid cancer, and appropriate cross-sectional imaging would be important to evaluate the extent of the disease and the proximity of the thyroid gland to the vital structures in the central compartment of the neck. It is also helpful to know if there is a paralysis of one vocal cord so that one can be absolutely sure to protect the opposite recurrent laryngeal nerve and to perform an oncologically sound surgical procedure with resection of the recurrent laryngeal nerve on the side of the paralysis. Generally, patients with vocal cord paralysis may have pathologically aggressive thyroid cancers such as the tall cell or insular variety.

Preoperative ultrasound of the thyroid is important to evaluate the extent of the disease and the status of the lymph nodes both in the central compartment and in the lateral neck. The lateral neck evaluation by ultrasound is considered important to identify abnormal lymph nodes preoperatively in the lateral neck so that they can be appropriately evaluated and resected at the time of surgery. In the presence of the thyroid gland, the central compartment lymph nodes are difficult to evaluate. However, if there are any suspicious lymph nodes noted on preoperative ultrasound, appropriate attention should be paid to the evaluation of the central compartment nodes ipsilaterally or bilaterally. Performing CT scans with contrast meets with considerable resistance because the iodinated contrast material delays the RAI ablation for a period of 2–3 months. However, such delay is unlikely to have any major effect on management. CT scans can definitely help the operating surgeon to evaluate the extent of the disease preoperatively, the status of the lymph nodes in the lateral neck and evaluate the parapharyngeal, retropharyngeal, and superior mediastinal areas, which are difficult to image with routine ultrasound of the neck. The CT scan should be critically reviewed to rule out retroesophageal innominate artery (arteria lusoria) with nonrecurrent laryngeal nerve. MRI is another cross-sectional imaging modality with utility, but we generally prefer a CT scan with contrast. PET scans are rarely necessary unless the patient has a very advanced stage cancer of the primary tumor with bulky nodal disease, suspicious distant metastasis, or recurrent thyroid cancer.

6.3   Preoperative Discussion and Consultation

It is important to discuss with the patient and the family the extent of thyroidectomy, lobectomy versus total thyroidectomy. This decision is based on preoperative ultrasound, size of the tumor and other diagnostic results. The final decision is best made in the operating room based on gross findings, the status of the opposite lobe, and possible nodal metastasis. Generally the procedure should begin on the diseased side first. If there is any concern about the nerve function, the procedure may need

to be terminated after lobectomy alone. A thorough discussion with the patient and the family should be carried out related to the complications of surgery such as scarring, hematoma, re-exploration, hoarseness of voice, inability to raise the voice, the need for thyroid medication, and calcium and vitamin D supplementation. Patients should be aware of the possibility of change of voice and inability to project the voice, which may have direct implications for professionals such as lawyers, teachers, singers, and others who use their voice for their livelihood. The majority of patients today are well-read and well-prepared from Internet searches to understand the procedure. However, every opportunity should be given for them to ask questions preoperatively. The complications related to hematoma requiring emergency re-exploration should also be discussed, even though its incidence is quite low.

Bilateral vocal cord paralysis leading to airway problems or tracheostomy is a rare complication but should be discussed in high-risk patients, especially those presenting with primary bulky tumors, or when one vocal cord is paralyzed preoperatively. Specific complications related to neck dissection, such as accessory nerve weakness, inability to raise the shoulder, excessive chyle drainage, and extended hospitalization, along with Horner syndrome, should be discussed. Horner syndrome with asymmetry of both eyes may be hard for a young woman to accept because of emotional and cosmetic concerns.

6.4   Anesthesia

Most thyroidectomies are performed under general anesthesia; however, some surgeons may consider performing it under twilight anesthesia without intubation and with regional block. The operating surgeon and anesthesiologist must be familiar with regional block and continuous propofol sedation. Some surgeons prefer this so that the patient can verbalize during surgery to evaluate his or her vocal cord function. Performing surgery under local anesthesia requires previous experience and expertise, since such patients may become claustrophobic once the drapes are placed on the face. Blood type and cross-matching are rarely necessary; however, some institutions preserve a sample of blood in the blood bank in the event that any life-threatening emergency occurs. Most patients can be easily intubated with a standard technique of anesthesia, paralysis, and intubation. Intubation for thyroidectomy should be attempted with a No. 6 or 7 tube to avoid intratracheal friction injury. The larger tubes are not necessary for thyroidectomy because they may cause more trauma to the endolarynx and vocal cords. Intubation should be performed by a senior member of the anesthesia team avoid any intubation related trauma or arytenoid injury and dislocation. Thyroid surgery may be performed with laryngeal mask anesthesia (LMA). However, this will be dictated by the practice of the institution and the operating surgeon. Patients should be paralyzed during the surgical procedure to avoid any coughing or bucking in the middle of the surgical procedure, which may lead to trauma to the endolarynx. The cuff of the endotracheal tube should be way below the vocal cords. If the anesthesiologist is going to use a glide scope, the position of the endotracheal tube and cuff can be easily confirmed. This is more crucial if the nerve integrity monitor (NIM) technique and a special NIM tube are going to be used. With the NIM monitor the patient cannot be paralyzed, so that one can check for nerve stimulation during surgery.

6.5   Position of the Patient and the Incision

The incision should be marked to conform to the neck crease when the patient is sitting in the office or in the holding area near the operating room. In young women, it is better to place the incision higher up. However, in general

the incision should be very close to the cricoid cartilage area (Fig. 6.1).

The length of the incision should be determined based on the extent of the surgical procedure, the patient's size, the neck configuration, and the extent of the disease. If the patient is likely to need neck dissection as the first procedure or in the future, the incision should be placed close to the
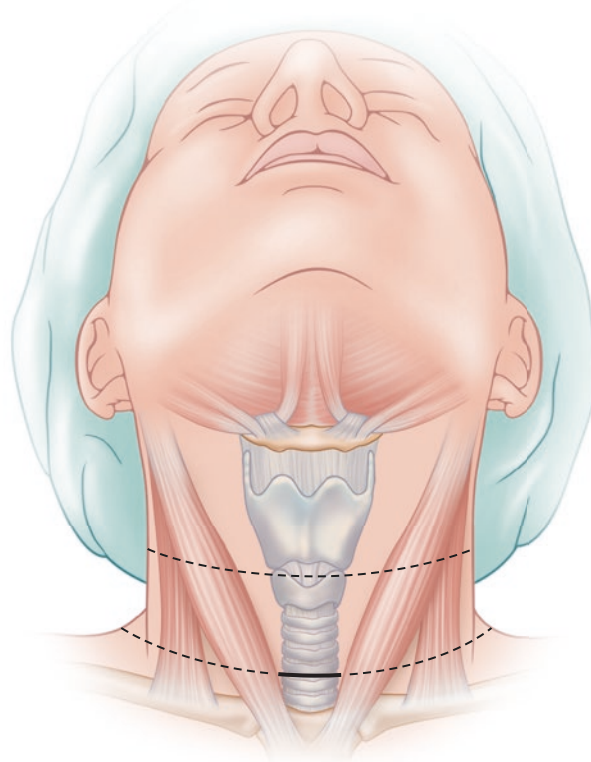
Figure 6.1

The incision may be placed just below the cricoid cartilage, conforming to the skin crease. If the patient is likely to require neck dissection, a higher incision on the cricoid cartilage is preferred rather than making an apron-shaped incision

Figure 6.2

The patient's neck is extended on the head plate of the operating table. A shoulder rest is preferred for best extension of the neck

cricoid cartilage. This position gives the best exposure to the entire neck and the J-shaped or the apron-shaped incision can be avoided. Although cosmetic concerns should be kept in mind, the operating surgeon needs to remember that exposure is the most important factor in completeness of resection in thyroid cancer, which is a key factor in the best control of cancer. The position is a standard supine position with the arms padded and tucked and with the shoulder resting on three flat sheets to support the scapula and to extend the neck (Fig. 6.2). The neck should be stabilized with a doughnut, and the incision generally marked and then infiltrated with lidocaine and epinephrine. Approximately 1 mL of the solution should be used to avoid excessive bleeding from the skin and the subcutaneous area.

Figure 6.1

Figure 6.2
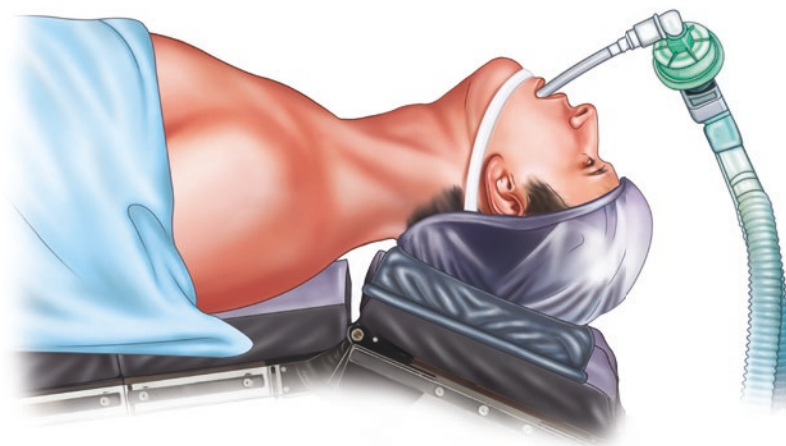
6.6 Surgical Procedure

The skin should be incised with a knife. After the skin incision, most of the dissection is performed with electrocautery. Unipolar cautery is commonly used. Initially, the subcutaneous tissue should be incised with pointed electrocautery, and subsequently a flat electrocautery should be used. The skin and subcutaneous tissue are incised. The platysma is then incised. There is hardly any platysma in the midline, and the platysma can be seen as a well-developed muscle in its lateral potion. The upper flap should be raised under the platysma by elevation with skin hooks where an essentially avascular plane can be raised under the platysma (Fig. 6.3). The upper flap should be raised up to the thyroid notch, and the lower flap taken down to the sternal notch. At this time, the midline fasciae is exposed, and this should be incised with electrocautery. Occasionally, there are communicating veins between the two anterior jugular veins, which should be cauterized, ligated, or divided with a harmonic scalpel or LigaSure energy device. The strap muscles should be separated in the midline. Opening this area can be compared to opening a "gift box," with the thyroid situated under the gift wrap, covered by strap muscles and the fascia [4]. The anterior strap muscles (sternohyoid) can be easily separated and pulled laterally. Rarely, this may require transection for better exposure if the tumor is adherent to the strap muscles. There is a debate about cutting of the inner strap muscle (sternothyroid). When necessary, we generally prefer to cut the inner strap muscle superiorly both from an oncologic point of view and for better exposure of the superior thyroid pole. The sternothyroid may be cut above and below for better exposure of a thyroid tumor. At this time, the dissection is performed on the lateral side of the thyroid. The middle thyroid vein is identified, and is clamped, ligated, and cut, or an energy device used. Gentle dissection may be performed in the inferior portion to expose the tracheoesophageal groove in this area.

The upper pole is now exposed. A clamp is placed on the upper portion of the thyroid lobe, and the thyroid lobe is pulled inferiorly and laterally; this opens up the medial aspect of the superior thyroid vessels known as Joll's triangle. There are always tiny veins in this area from the superior thyroid vein, which should be cauterized. At this juncture, the superior thyroid vessels are pulled inferiorly and laterally, which may expose the superior laryngeal nerve (Fig. 6.4). If the nerve can be identified, it is pushed up and medially and preserved carefully by ligating the superior thyroid

vessels inferior to the superior laryngeal nerve. Quite often the superior laryngeal nerve may be difficult to identify, and the superior thyroid vessels should be clamped, ligated, and cut or an energy device to divide it very close to the upper pole of the thyroid. There are always minor veins with multiple branches from the superior thyroid vessels, which should be carefully ligated or cauterized. At this time, the dissection continues from the superior pole on the lateral side. On the right side, due consideration should be given at this time to evaluate if the patient has a nonrecurrent laryngeal nerve. The dissection is performed on the lateral side of the thyroid gland, exposing the entire thyroid lobe and pulling it medially. We generally prefer finger retraction of the thyroid lobe and dissection into the paratracheal area; however, some surgeons prefer using an Allis or Lahey clamp on the thyroid, although this may cause capsular trauma and bleeding from the thyroid gland. The surgeon's hand-retraction probably gives the best nontraumatic exposure of this area. The dissection may be continued in the medial aspect of the superior thyroid pole, where the pyramidal lobe may be identified. There is always a tiny vein in front of the cricoid cartilage, which should be ligated. This vein is important because if it is not identified it may cause postoperative bleeding when the patient coughs or bucks at the end of the surgical procedure. As the superior pole and the lateral aspect of the thyroid are exposed, the tracheoesophageal groove area should also be exposed. The parathyroid glands can be identified in the superoinferior portion of the thyroid gland in front of and behind the recurrent laryngeal nerve (Figs. 6.5 and 6.6). Occasionally, the parathyroid glands may be in the thyroid capsule, which requires careful dissection and separation of the thyroid from the parathyroid gland. Every effort should be made to carefully preserve the vasculature of the parathyroid gland, and separating them intact is important (Fig. 6.6) [5]. If a parathyroid gland appears to be devascularized, it should be auto-transplanted into the sternocleidomastoid muscle after confirming that it is parathyroid tissue on frozen section from a small biopsy. It is important to avoid implantation of lymph nodes or metastatic thyroid carcinoma. As the dissection continues on the lateral aspect of the thyroid, the area of the tuberculum Zuckerkandl is identified.

The recurrent laryngeal nerve is generally posterior to the tuberculum Zuckerkandl, which can be easily identified by the retraction of the tuberculum. The recurrent laryngeal nerve may be identified in three distinct areas. First, in the tracheoesophageal groove and traced in its entirety up to the

cricoid cartilage. This is where it is more commonly found when evaluating suspicious lymph nodes. The second region where the nerve can be found is its crossing on the inferior thyroid artery. However, it must be remembered that in approximately a quarter of the patients, the nerve may be in front of the inferior thyroid artery and not behind it (Fig. 6.7). Our current practice is to find a short segment of the nerve near the ligament of Berry, behind the tuberculum Zuckerkandl (Fig. 6.8).

The dissection in the region of ligament of Berry and tuberculum Zuckerkandl is quite critical, and meticulous dissection and mobilization of the thyroid should be performed. The thyroid gland is generally mobilized medially, although excessive medial retraction may cause traction injury to the nerve. This should be kept in mind at the time of transecting the ligament of Berry. Invariably, there are tiny vessels in the ligament of Berry that may cause bleeding. The bleeding should be controlled very carefully, either with electrocautery or with bipolar cautery with a fine tip forceps. If a tie is to be placed on this bleeding vessel, it should be with Vicryl or chromic catgut, which are dissolving suture materials. The inferior thyroid veins, which are generally multiple and some of which may be parallel to the recurrent laryngeal nerve or the trachea, should be carefully ligated. One may find an arteria thyroidea ima vessel in this region, which generally runs from the brachiocephalic trunk along the trachea to the inferior aspect of the thyroid. The hemostasis of inferior thyroid veins is critical, as these veins may retract into the mediastinum, causing bleeding that is difficult to control. After mobilization of the entire lobe, the dissection continues on the surface of the trachea in the pretracheal plane. The extent of thyroidectomy will depend upon the disease process and the personal philosophy of the operating surgeon. Occasionally, a small remnant of thyroid tissue is left behind in an effort to protect the parathyroids and the recurrent laryngeal nerve. However, generally we perform extracapsular true total thyroidectomy in patients with suspected malignancy. In spite of this, a small portion of thyroid tissue may be left behind near the ligament of Berry, the superior pole, and the pyramidal lobe area.

After mobilization of the entire lobe, careful attention should be paid to hemostasis and evaluation of the tracheoesophageal groove area for any obvious evidence of suspicious or enlarged lymph nodes. If there are any suspicious lymph nodes, they should be excised, frozen section findings obtained, and appropriate central compartment dissection performed. Some surgeons use prophylactic central compart-

ment dissection, especially in high-risk thyroid cancer patients. After mobilization of the entire thyroid lobe, some surgeons may consider transecting the isthmic area before proceeding to the other side. Generally, we would leave the specimen intact and go to the other side and perform a similar procedure to achieve appropriate total thyroidectomy. Careful attention should be paid to the preservation of the parathyroid glands in patients undergoing total thyroidectomy. The parathyroid glands must be preserved with their blood supply. The branches of the inferior thyroid artery are ligated close to the thyroid and branches supplying the parathyroids are carefully preserved (*see* Figs. 6.5 and 6.6). Appropriate evaluation of the superior mediastinum is also important to evaluate for the presence of suspicious lymph nodes in this region. At the conclusion of the procedure, the wound may be irrigated with saline. However, we prefer no or minimal irrigation of the wound because excessive irrigation may cause disruption, devascularization, or accidental suctioning out of the parathyroid glands. If the parathyroid is to be autotransplanted, it should be done into the sternomastoid muscle contralateral to the tumor and the area should be marked either with a staple or a silk stitch for future reference.

Occasionally the tumor may be very adherent to the trachea, and the surgeon needs to make a critical decision about separation of the tumor from the trachea. Preoperative evaluation by clinical examination and appropriate imaging studies may give some indication of the adherence to or invasion of the tumor into the trachea. Obviously, if the tumor is invading the trachea, it will require appropriate tracheal resection in the form of sleeve resection and end-to-end anastomosis. If there is any indication of tracheal involvement, the surgeon must be prepared to undertake tracheal resection at the time of thyroidectomy. However, if there is no direct invasion of the trachea, most of the time the tumor can be shaved off the trachea. Careful attention must be paid to avoid tracheal injury or inadvertent opening into the trachea.

The tumor may be intimately adherent to the recurrent laryngeal nerve, but if the nerve is functioning preoperatively, most of the time the tumor can peeled off the nerve. However if it appears that the nerve is directly involved in the tumor and there is a possibility of leaving gross tumor behind, due consideration must be given to resect the ipsilateral nerve. Prior to resection of the functioning nerve, it is important to mobilize the opposite lobe and preserve the contralateral recurrent laryngeal nerve.

Figure 6.3

After incising the platysma, the flaps are raised in an essentially avascular plane below the platysma

Figure 6.4

Variations in the relation of the superior laryngeal nerve and the superior thyroid vessels. *Left*, The nerve may be medial to the superior thyroid vessels. *Center*, The nerve may enter the cricoid thyroid muscle above the cricoid cartilage. *Right*, The nerve may enter the muscle higher to the upper pole of the thyroid. *IC* inferior constrictor muscle, *CP* cricopharyngeus muscle, *CT* cricothyroid muscle
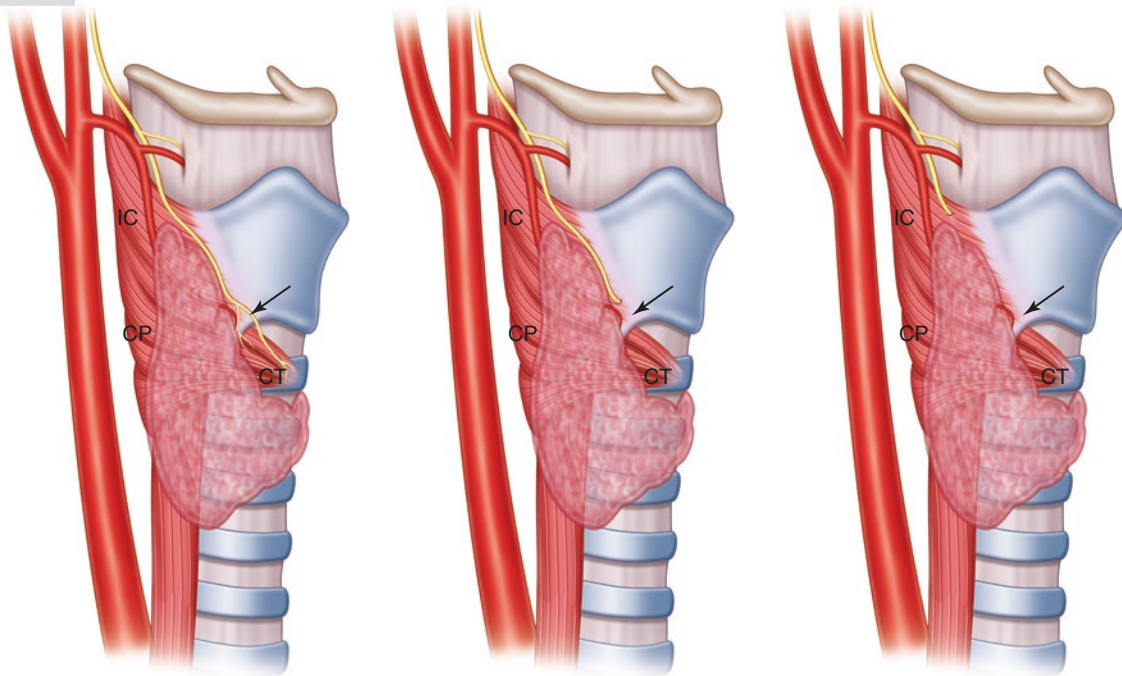
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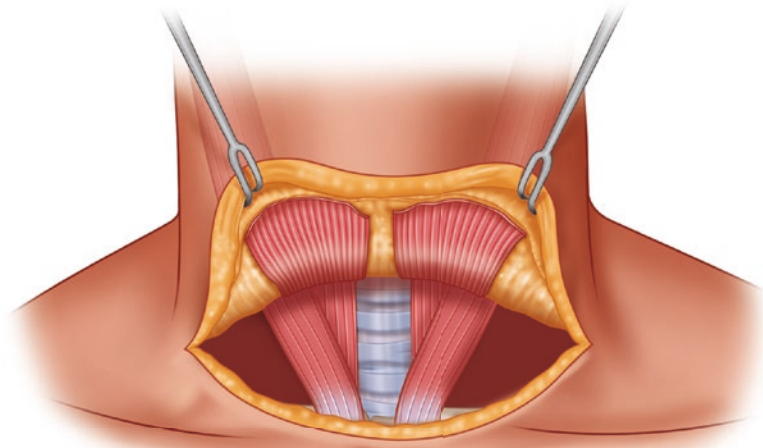
Figure 6.4

Figure 6.5

Individual ligation of the parathyroid vessels and careful preservation of the parathyroid blood supply are critical

Figure 6.6

The inferior thyroid artery directly supplies the parathyroid gland
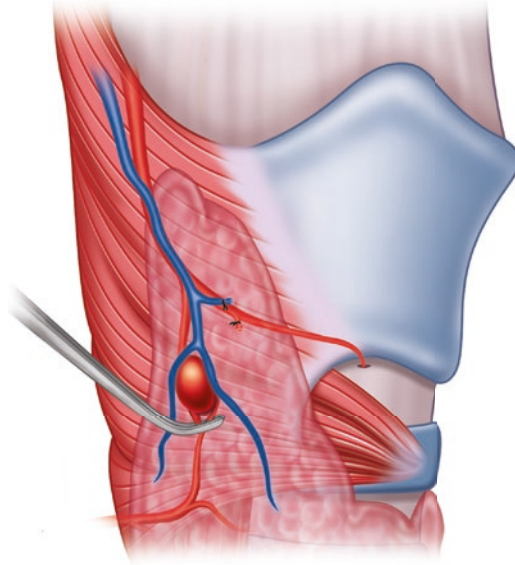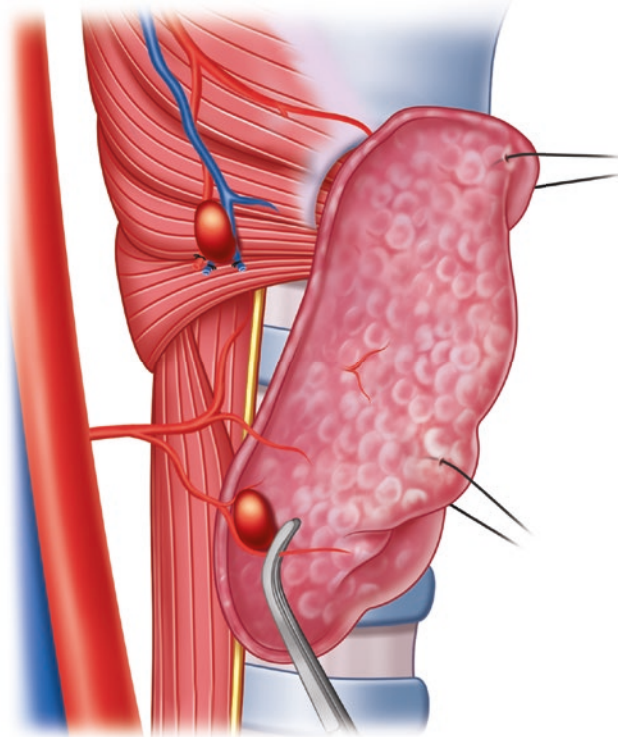
Figure 6.5

Figure 6.6

Figure 6.7

The variations in the relationship of the recurrent laryngeal nerve and inferior thyroid artery. (**a**) The nerve is behind the inferior thyroid artery. (**b**) The nerve may be in-between the branches of the artery. (**c**) The nerve may be anterior to the inferior thyroid artery

Figure 6.8

The recurrent laryngeal nerve generally runs posterior to the tubercle Zuckerkandl. *IC* inferior constrictor muscle, *CP* cricopharyngeus muscle, *CT* cricothyroid muscle
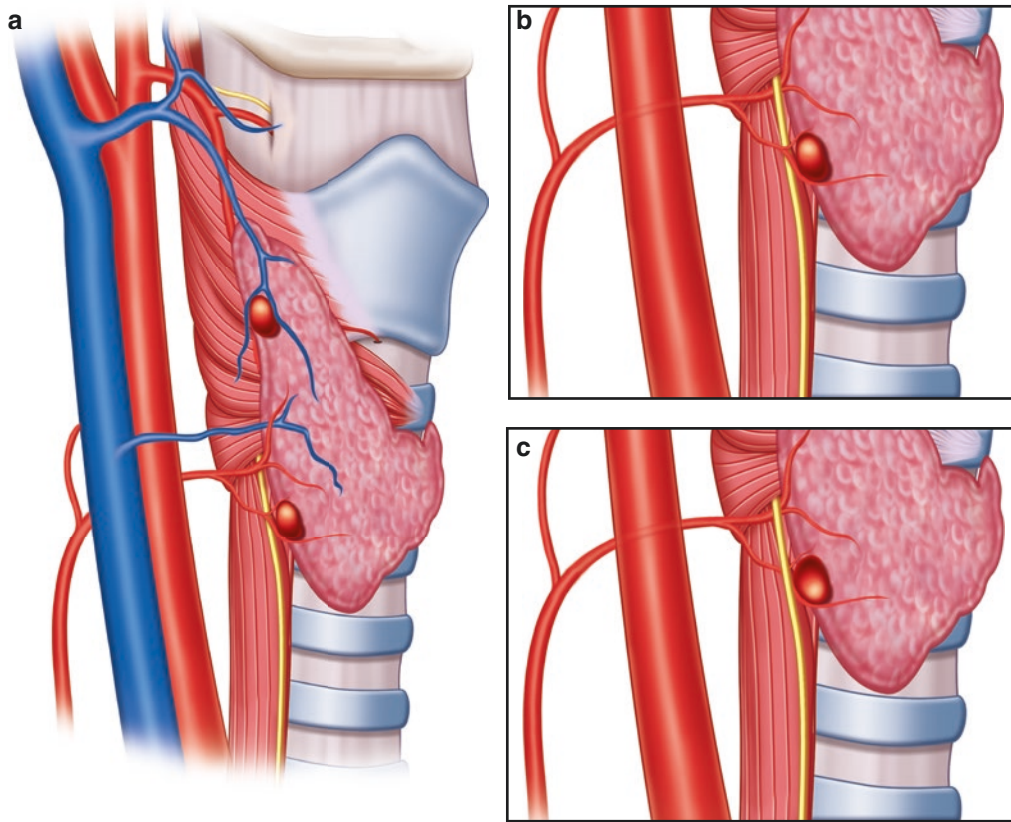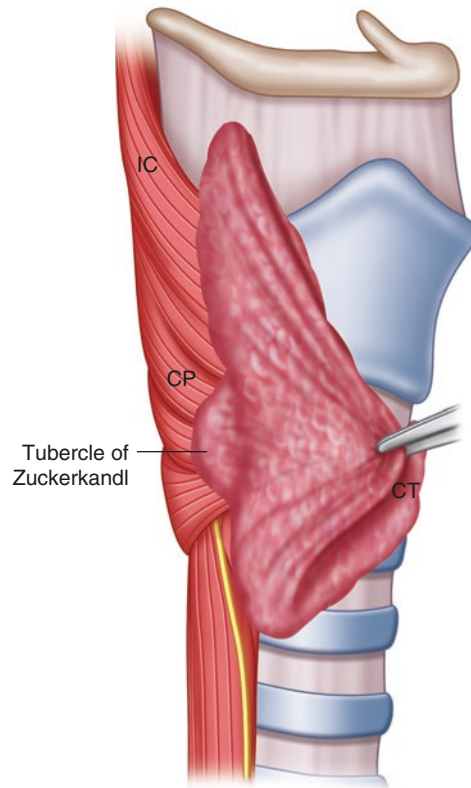
Figure 6.7

Figure 6.8

6.7 Wound Closure

At the conclusion of the procedure, the anesthesiologist is requested to perform a Valsalva maneuver to check if there are any obvious bleeding areas. After hemostasis is assured, the strap muscles are approximated in the midline with two stitches. This closure should not be water tight because it must allow the hematoma to come into the subcutaneous tissue rather than be contained behind the strap muscles, which would cause airway problems. The platysma is approximated with Vicryl stitches. The skin is closed with Monocryl stitches, and generally the wound is approximated with Dermabond. Drains are rarely used in routine standard total thyroidectomy but are commonly used in patients with large substernal goiter, those with excessive bleeding at the time of surgery, or those needing more extensive dissection such as in Graves disease or Hashimoto thyroiditis. If a drain is to be used, it should be a closed suction drain. In most cases, the drain can be removed within 24 hr and the patient can be discharged.

6.8 Intraoperative Decisions

Certain decisions need to be made in the operating room based on gross findings of the ipsilateral thyroid lobe. If the patient appears to be at high risk for thyroid cancer with gross extrathyroidal extension or a large tumor, total thyroidectomy should be performed. The central compartment should always be evaluated for any suspicious lymph nodes and frozen sections may be used generously in these patients in order to make an appropriate decision regarding central compartment dissection. If there are suspicious lymph nodes on one side, ipsilateral central compartment dissection should be performed, including levels VI and VII. The Delphian nodes are positive in approximately 20% of patients with papillary carcinoma of the thyroid, and careful attention should be paid to remove these nodes [6].

Thyroid surgery may be difficult to perform in patients with Hashimoto's thyroiditis or Graves' disease. Patients should be informed of the higher risk of complications, such as temporary or permanent hypoparathyroidism and recurrent laryngeal nerve injuries. In patients with large goiters, meticulous attention should be paid to avoid injury to the superior laryngeal nerve. If a tumor appears to be fixed to the surrounding structures, the strap muscle should be resected for better oncologic margins. We generally resect the sternothyroid muscle both for better exposure of the superior pole and for a better oncologic result. If the tumor is adherent to the trachea or the esophagus, appropriate shaving of the tumor off of these structures should be performed. If there is any suspicion preoperatively of this problem, appropriate preoperative evaluation and imaging should be performed to decide whether the patient requires tracheal resection. Tracheal resection is reserved for patients with direct invasion of the trachea where up to four to five rings of trachea can potentially be resected with end-to-end anastomosis.

6.9 Postoperative Management

The majority of patients recover very well after thyroid lobectomy or total thyroidectomy. Serum calcium levels should be checked both 6 and 23 h after the surgery and the trend of calcium levels should be scrutinized to determine the amount of calcium supplementation needed. Some institutions use parathormone (PTH) levels for evaluation of parathyroid dysfunction. Patients need to be carefully monitored in the postoperative period for symptoms of hypocalcemia and appropriate replacement as needed with calcium and vitamin D. The overall incidence of temporary hypoparathyroidism ranges between 15% and 20%. However, the incidence of permanent hypoparathyroidism is only 2%. Similarly, the incidence of temporary recurrent laryngeal nerve palsy is 4–5% but the occurrence of permanent nerve palsy is below 1%. Patients should be observed closely for any increasing swelling, airway related issues such as shortness of breath or difficulty in breathing. If there is neck fullness or an expanding hematoma, the neck wound should be opened immediately to relieve pressure. When the neck is opened, it is important to open the strap muscles by inserting a finger into the wound and evacuating the hematoma.

References

1. Siegel R, Ma J, Zou Z, Jemal A. Cancer statistics, 2014. CA Cancer J Clin. 2014;64:9–29.
2. Alexander EK, Kennedy GC, Baloch ZW, Cibas ES, Chudova D, Diggans J, et al. Preoperative diagnosis of benign thyroid nodules with indeterminate cytology. N Engl J Med. 2012;367:705–15.
3. Sosa JA, Bowman HM, Tielsch JM, Powe NR, Gordon TA, Udelsman R. The importance of surgeon experience for clinical and economic outcomes from thyroidectomy. Ann Surg. 1998;228:320–30.
4. Moraitis D, Shaha AR. Opening the "gift box": a systematic approach to expose the thyroid and superior thyroid vessels in complicated thyroid surgery. J Surg Oncol. 2006;93:417–9.
5. Gil Z, Patel SG. Surgery for thyroid cancer. Surg Oncol Clin North Am. 2008;17:93–120.
6. Iyer NG, Kumar A, Nixon IJ, Patel SG, Ganly I, Tuttle RM, et al. Incidence and significance of Delphian node metastasis in papillary thyroid cancer. Ann Surg. 2011;253:988–9.