



Transoral Endoscopic Total Thyroidectomy via Vestibular Approach (TOETVA)

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Introduction

Transoral thyroidectomy is the first true “scarless” minimally invasive approach, unlike its predecessors such as transaxillary, bilateral axillo-breast, and retroauricular approaches, because it does not involve any incision on the skin. The concept was first proposed by Witzel in 2008, when he demonstrated the first proof-of-concept hybrid transoral thyroidectomy with human cadavers and animals [1]. In the early stages of its development, the approach was sublingual (Fig. 14.1), meaning that the access was made through the oral cavity inside the mandible [1–3]. But as several cases of recurrent laryngeal and mental nerve injuries were reported in the early stages of its clinical application, the sublingual route lost its position as the primary oral access [4]. The alternative method was the vestibular approach (Fig. 14.1), first demonstrated in 2011, in which the access point was repositioned exterior to the mandible and beneath the platysma muscle layer [5]. This approach gained increasing popularity among endocrine surgeons, and in 2016, Anuwong published the first large-scale human transoral endoscopic thyroidectomy vestibular approach (TOETVA) study, including 60 cases [6]. In this landmark study, the postoperative complication rates of the novel approach were reported to be comparable to the conventional open and minimally invasive thyroidectomies. The same group subsequently published a comparison study of 432 TOETVA and open thyroidectomy cases, which were matched by propensity scores [7]. The postoperative results of this

study were comparable as well. At the moment, TOETVA is being conducted in more than 80 institutions across over 30 countries [8]. The advantages of TOETVA, apart from its scarless nature, include median symmetric view, which allows total thyroidectomy to be done without additional incisions, minimal transoral specific complications such as mental nerve injury and/or oral infection, and easy access to the central lymph nodes due to its cephalocaudal orientation [8].

Indication and Contraindication of TOETVA

TOETVA has just passed its juvenile stage in its development as a feasible surgical approach and is starting to be spread across the world. The procedure, however, remains relatively reserved to a select group of experts compared to open or other minimally invasive thyroidectomies. There are no absolute inclusion and exclusion criteria, which may differ according to the surgeons’ experience level of TOETVA. In general, the criteria are similar to those of other minimally invasive thyroidectomies [8]. (1) Benign tumors or follicular neoplasms that are 3 cm or smaller in its largest diameter and (2) differentiated thyroid carcinomas that are 2 cm or smaller in its largest diameter without evidence of lymph node metastasis may be feasible indications. For experienced surgeons, however, the indication may be extended to include controlled Graves’ disease and differentiated thyroid carcinomas larger than 2 cm in diameter with evidence of suspicious central lymph node metastasis. On the other hand, total thyroidectomy should be limited to lesions that do not require central neck node dissection for those with less experience to prevent complications such as bilateral recurrent laryngeal nerve palsies or hypoparathyroidism. Exclusion criteria consist of patients with (1) a history of radiation in the head, neck, or upper mediastinum or of previous neck surgery; (2) evidence of suspicious lateral lymph node, distant metastases, or tracheal/esophageal/posterior infiltration; and (3) medullary and poorly/undifferentiated histology.

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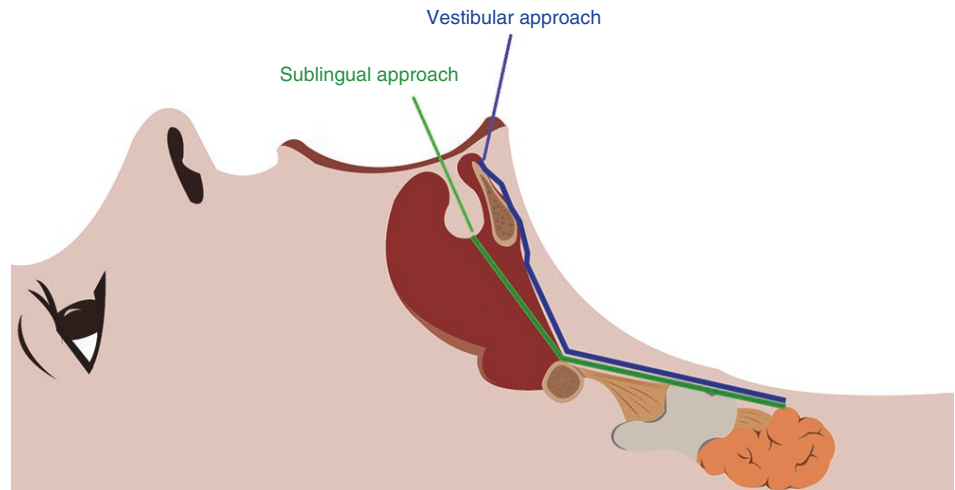
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Fig. 14.1 Schematics of sublingual and vestibular access of transoral thyroidectomy



Procedure

Position and Preparation

The patient is placed in a lithotomy position with the neck extended under general anesthesia (Fig. 14.2). Either nasotracheal or oral intubation is possible. The monitor is positioned between the legs of the patient. The surgeon faces the monitor on the head side of the patient, and the assistant and nurse are positioned on the left side and right side of the surgeon, respectively, for right-handed surgeons (vice versa for left-handed surgeons). The type and dosage of preoperative prophylactic antibiotics do not differ from those of open thyroidectomy.

Skin marking should be done on the skin of the neck area to indicate the thyroid notch, cricothyroid cartilage, medial borders of the sternocleidomastoid muscles (SCM), sternal notch, and midline for orientation purposes (Fig. 14.3). The oral cavity is disinfected with chlorhexidine-soaked gauzes. The disinfectant solution should not be poured freely into the oral cavity as it may flow into the nasal cavity and cause adverse effects on the olfactory nerves.

Incision

The incisions are situated at the lower buccal mucosa. The main 11-mm incision is made at the center of the oral vestibule, and the auxiliary 5-mm incisions are made at both sides (Fig. 14.4a). Attention should be paid to position the main incision nearer the lip rather than the inferior buccal gingiva and leave at least 1 cm of spare buccal mucosa in order to facilitate the angulation of the camera during operation and mucosal suture at the end of surgery. Furthermore, the 5-mm trocar incisions should be situated lateral to the canine in order to avoid mental nerve injury.

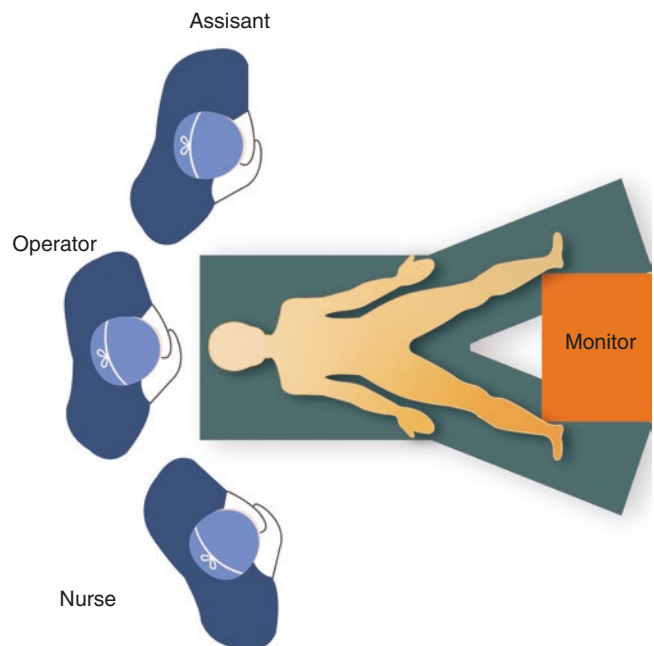


Fig. 14.2 Operating room setting; the patient is in lithotomy position, and the monitor is placed between the legs. The surgeon faces the monitor on the head side of the patient, and the assistant and nurse are positioned on the left and right side of the surgeon, respectively

In patients without any cardiovascular history, a mixture of 0.5 ml 1:1000 epinephrine solution and 4.5 ml saline can be injected into the incision site prior to the incision in order to reduce profuse mucosal bleeding (Fig. 14.4b).

Flap Formation

Through the middle incision, the periosteum of the mental protuberance should be visualized after resecting the mentalis muscles. After identifying the periosteal layer, a vascular graft tunneler is used to create the initial part of the flap

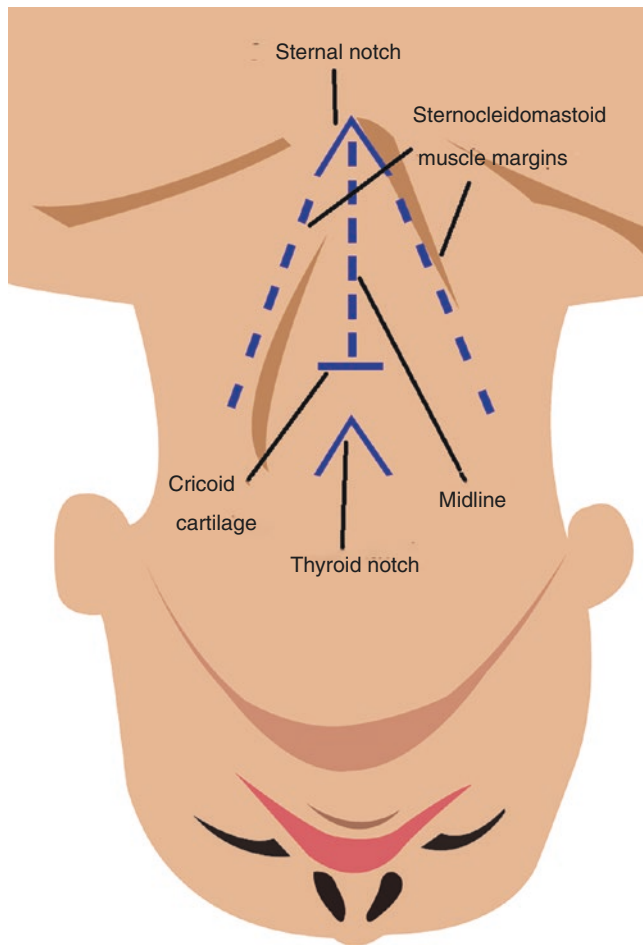


Fig. 14.3 Skin marking to demarcate the important structures for orientation purposes

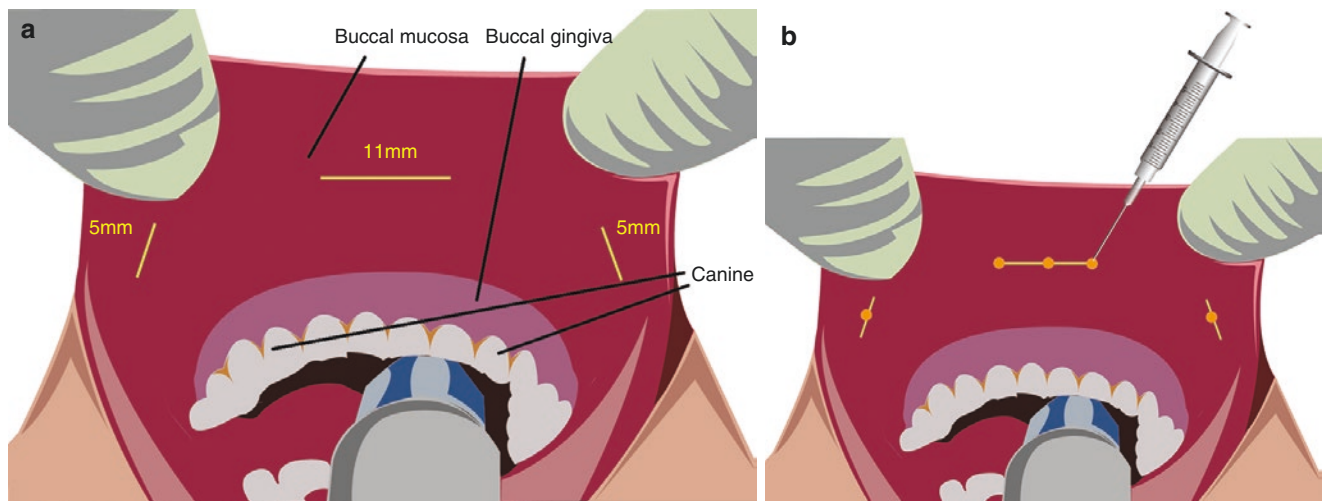


Fig. 14.4 Intraoral incision of TOETVA. (a) The main 11-mm incision is made in the middle of the oral mucosa. It should be situated nearer the lip than the inferior buccal gingiva, leaving at least 1 cm of buccal mucosa to facilitate camera angulation and mucosal suture. The 5-mm

over the mandible down to the level of the larynx. When gliding the tunneler over the mandible, it should feel as if the surgeon is attempting to scratch the bone with the instrument to ensure access to the subplatysmal layer. A blunt-tipped 10-mm trocar is then inserted through this path, and CO₂ is connected to insufflate the working space to pressure at no higher than 6 mmHg to prevent subcutaneous emphysema. The two 5-mm trocars are inserted through the lateral incisions straight down before crossing over the chin and redirected medially after crossing the mandible (Fig. 14.5). While gliding over the chin, special attention must be paid to prevent the trocars from perforating the skin. At this stage, a 10-mm 30-degree rigid endoscope is inserted through the main trocar to visually check if both 5-mm trocars have access to the subplatysmal working space.

The extent of the flap should consist of the upper border as the top of the larynx, the lower border as the sternal notch, and the lateral borders as the medial borders of both SCM. In patients with a protruding chin, it is difficult to obtain a lower area view due to acute angulation. In such cases, the view may be more easily acquired by rotating the 30-degree rigid endoscope 180 degrees (Fig 14.6a, b).

Midline Dissection and Isthmectomy

After creating the working space, the midline of the strap muscles should be resected starting from above the thyroid notch all the way down to the sternal notch. In order to easily visualize the upper pole of the thyroid gland later on, it is important to dissect the midline as high up as possible.

trocars should be situated lateral to the canine in order to avoid mental nerve injury (b). Injection site of the saline/epinephrine mixture prior to incision. Inject 5 mm of the mixture at the red dotted area equally to reduce mucosal bleeding

The isthmus of the thyroid gland will be revealed after dissecting the midline of the strap muscles. In total thyroidectomy cases, it is advisable to dissect the isthmus evenly across the middle in order to leave some tissue for both lobes to grasp during medial traction, if there are no lesions in the isthmus. Depending on which direction it is skewed, the pyramidal lobe should be resected from the larynx and resected later *en bloc* with the closer lobe.

Lateral Dissection

By medially retracting the isthmus stump, it becomes easy to separate the strap muscles from the thyroid gland along the avascular plane. Attention should be paid to preserving the

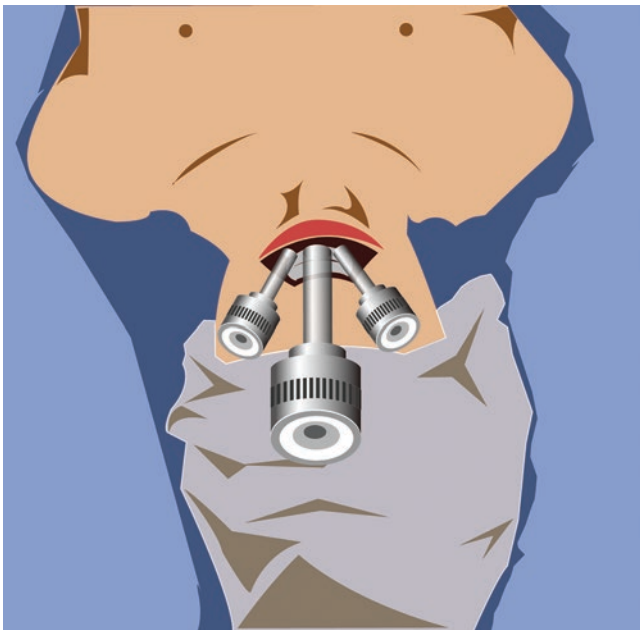


Fig. 14.5 Trocar placement

vessels on the surface of the glands during this procedure, especially for cases with concurrent thyroiditis, to prevent profuse bleeding. Lateral dissection is done, starting from the lower pole level then working up to the upper pole level. The middle thyroid vein should be ligated during this procedure. The isthmus portion of the thyroid gland should also be resected from the trachea to ensure thyroid lobe mobilization during the next procedures.

Upper Pole Ligation

After lateral dissection is completed, it becomes possible to view the upper pole. For patients whose upper pole is situated high up at the caudal end, it is necessary to laterally retract the strap muscles with 4-0 nylon sutures because the muscles obstruct the view of the upper pole, while both instruments are needed to ligate the upper vessels (Fig. 14.7). The suture needle should be inserted through the skin near the intersection of the cricothyroid cartilage level and the lateral end of the working space. After hooking the sternohyoid muscle with the suture and taking it out near its insertion site, the suture should be retracted laterally by the assistant to expose the upper pole. Although this may be enough in most cases, thyroid upper poles that go up extremely high need additional suturing and lateral traction of the sternohyoid muscles in the same manner (Fig. 14.7).

The upper pole should be grabbed with a grasper and retracted laterally and ventrally while a dissector meticulously exposes the avascular plane between the upper pole and cricothyroid muscles attached to the thyroid cartilage, also known as Joll's space (Fig. 14.8a, b). The superior thyroid vessels and certain types of the external branch of the superior laryngeal nerves (Cernea type 2) can be identified when this space is exposed [9]. It is important to ligate the connective tissue close up to the thyroid gland (Fig. 14.8c, d) and work your way up bit by bit to the superior thyroid ves-

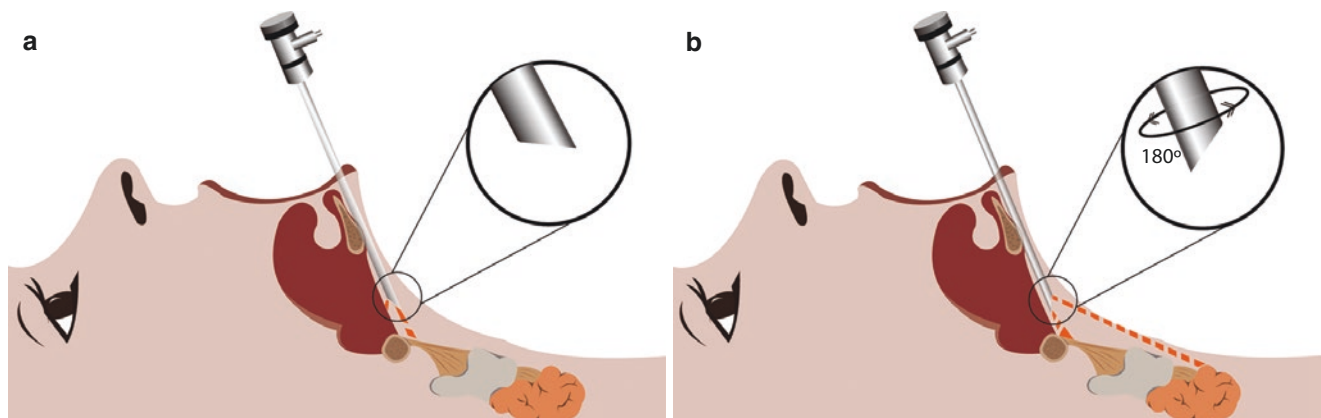


Fig. 14.6 Camera manipulation during flap formation. (a) During the initial phase of flap formation, visualizing the deeper sternal side may be difficult. (b) By rotating the 30-degree rigid endoscope 180 degrees, the visual of the lower area may be more easily acquired

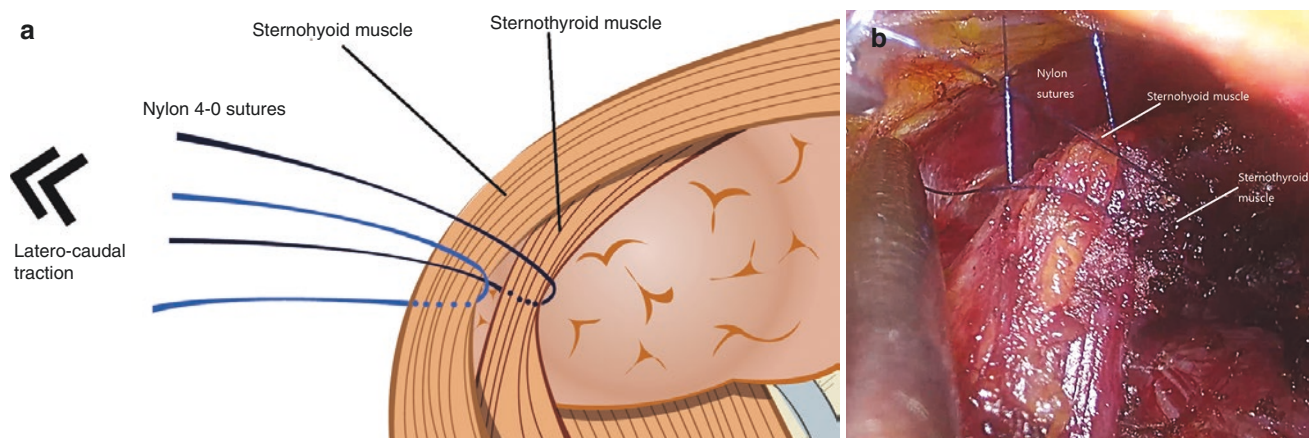


Fig. 14.7 Use of 4-0 nylon sutures to laterally retract the strap muscles

sels in order to preserve the cricothyroid muscle and superior parathyroid gland function (Fig. 14.8e, f). Each main superior vessel should be ligated separately. The posterior side of the upper pole should be dissected caudally to a level no lower than the cricothyroid cartilage to prevent recurrent laryngeal nerve (RLN) injury.

Recurrent Laryngeal Nerve Identification and Preservation

The ligated upper pole should be retracted in a medial, caudal, and ventral direction with contralateral forceps to expose Berry's ligament (Fig 14.9a, b). The most important aspect of identifying the RLN in TOETVA is safely exposing the structure at the laryngeal entry point near Berry's ligament and protecting it from thermal damage during gland resection. Meticulous use of the ipsilateral dissecting forceps, such as an endoscopic right angle, will expose the RLN without rupturing adjacent vessels (Fig 14.9c, d). Even more judicious use of energy-based surgical devices is of paramount importance in preventing inadvertent thermal damage to the nerves. One tip is to cover the exposed RLN with packed gauze and retract it laterally while using an energy device near the nerve entry point (Fig 14.9e, f). This will help prevent high-temperature fluids from directly contacting the nerves.

Lower Pole Ligation and Resection of the Gland

After safely preserving the RLN near Berry's ligament, the RLN should be exposed along its course all the way down to the lower pole level. During this procedure, each lower thyroid vessel should be ligated separately as close as possible to the thyroid gland in order to preserve the lower parathyroid

gland and its function. At this point, it is possible to completely resect the thyroid lobe from the attached trachea.

Specimen Retrieval

Once the thyroid lobe is resected, the endoscope is removed and an endobag is blindly inserted through the 10-mm port with the wires removed. After reinserting the endoscope, the bag should be properly opened up for the specimen and other foreign materials, such as gauzes, to be placed in (Fig. 14.10). Because the bag cannot be extracted through the trocar, it should be pulled out along with the trocar. The trocar should be reinserted after the bag and specimen are retrieved.

Contralateral Resection

Contralateral lobectomy should be carried out in the same manner. However, consideration should be made in choosing which side to start from. In some cases, the main lesion may be too large, and additional dissection may be needed to extract the specimen. This will lead to air leakage during the subsequent lobectomy. The surgeon, therefore, may choose to start with the contralateral thyroid lobe.

Suture and Stitch-Out

After extracting both thyroid glands and making sure there is no bleeding, the midline of the strap muscles should be sutured. After removing the trocars, the resected mentalis muscle through the midline incision should be sutured with three 4-0 Vicryl stitches. The oral mucosa should be lightly stitched with five 4-0 Vicryl sutures. The lateral incisions require one 4-0 Vicryl stitch each only on the mucosal layer. The suture stump should be 0.5 cm long so it may be easily

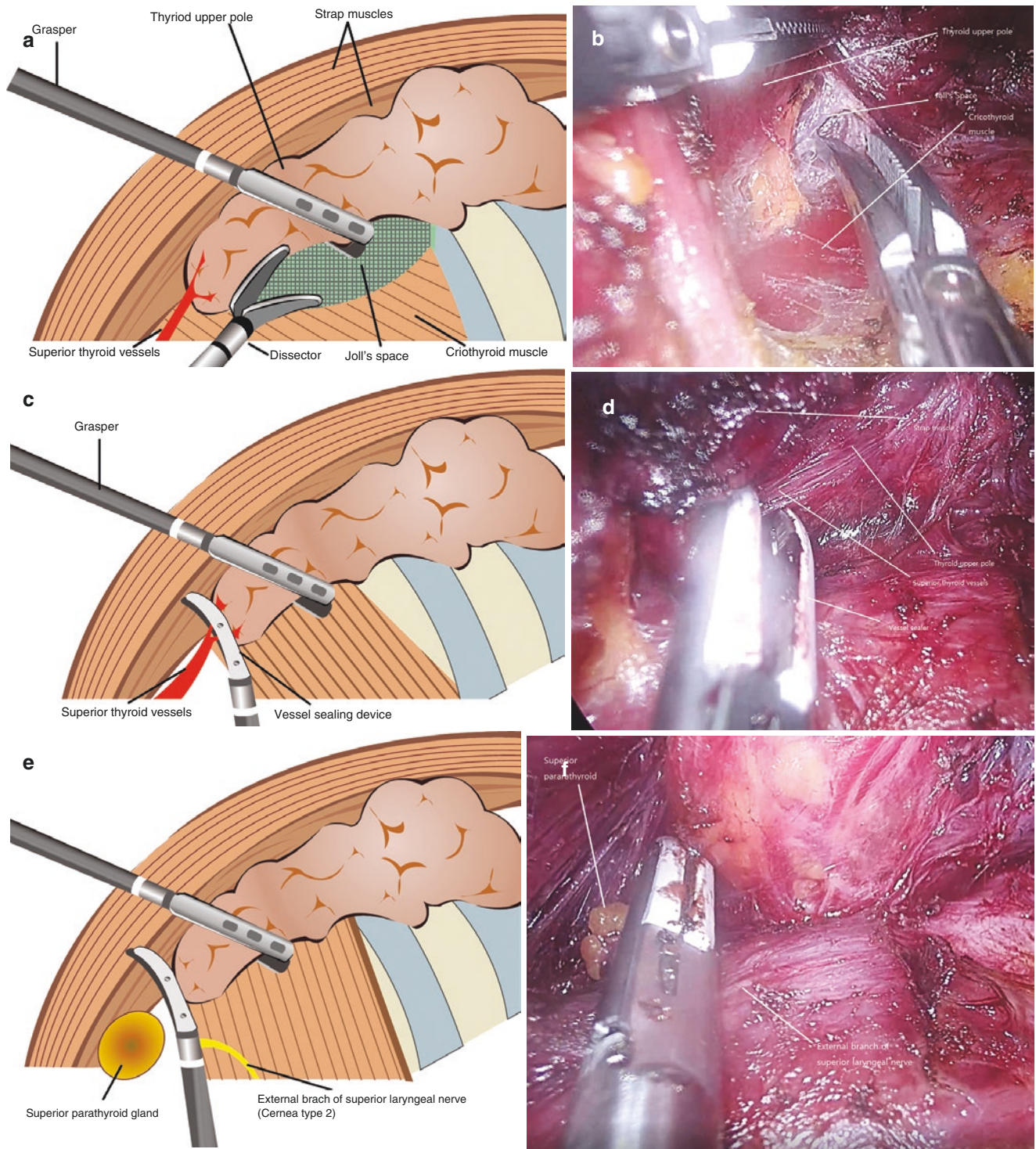


Fig. 14.8 Illustrations and images of upper pole resection. The most important point is to work bit by bit until the superior thyroid vessels are exposed. (a, b) Grab the upper pole and pull it to the ventral and lateral side away from the cricoid cartilage. Use the dissectors to expose

Joll's space (in green). (c, d) Ligate the superior thyroid vessel as close as possible to the thyroid gland. By ligating the vessels and connective tissue as close to the thyroid gland as possible, the superior parathyroid and external branch of superior laryngeal nerve can be preserved (e, f)

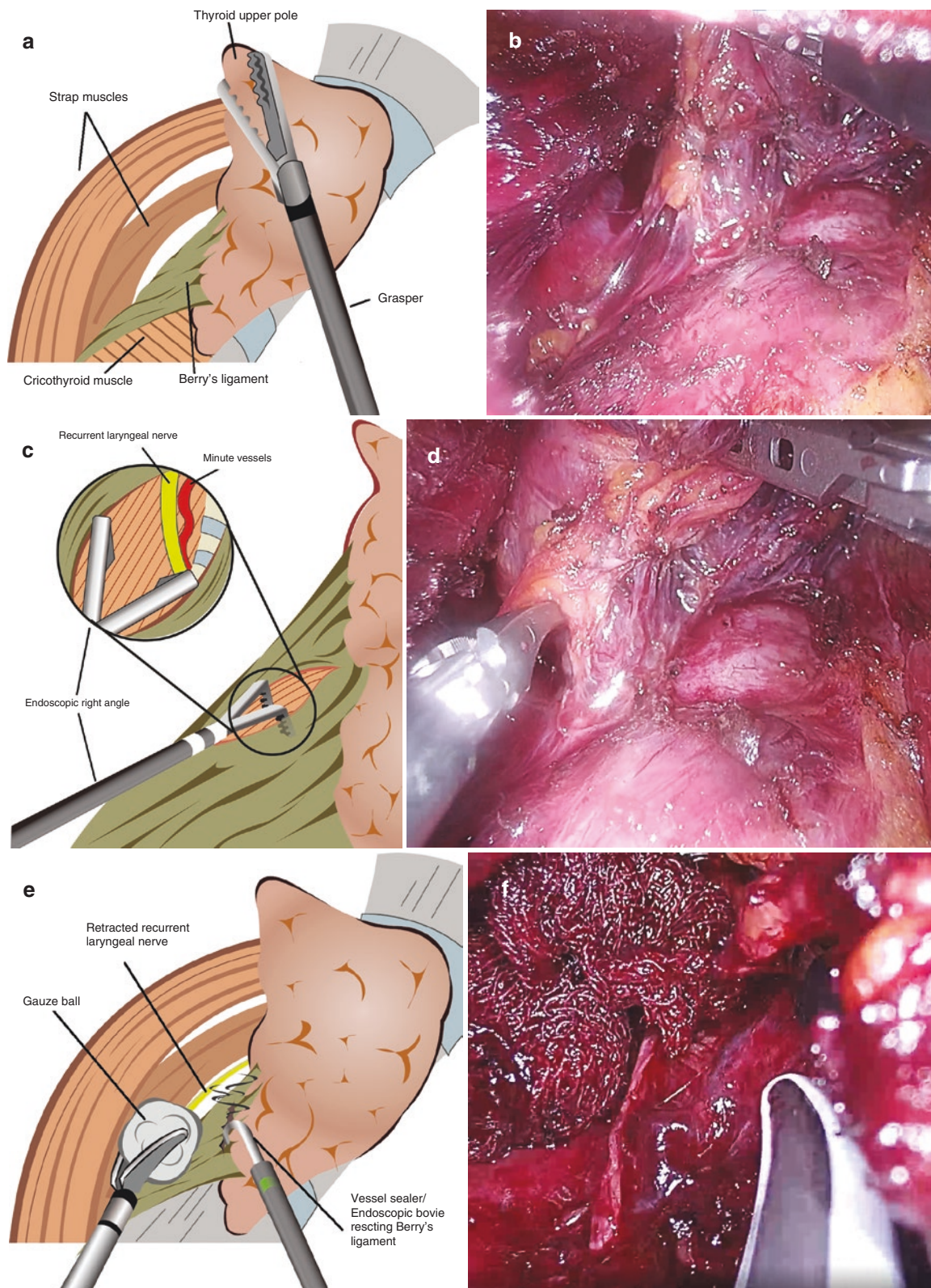


Fig. 14.9 Illustrations and images of identification of the recurrent laryngeal nerve after upper pole resection. (**a, b**) The mobilized upper pole should be retracted medially and caudally in order to expose Berry's ligament. (**c, d**) Soft tissue Berry's ligament should be meticu-

lously dissected with an endoscopic right angle until the recurrent laryngeal nerve is revealed. (**e, f**) A gauze ball should be used to laterally retract the RLN while resecting the thyroid at the ligament of Berry to reduce thermal damage to the energy device

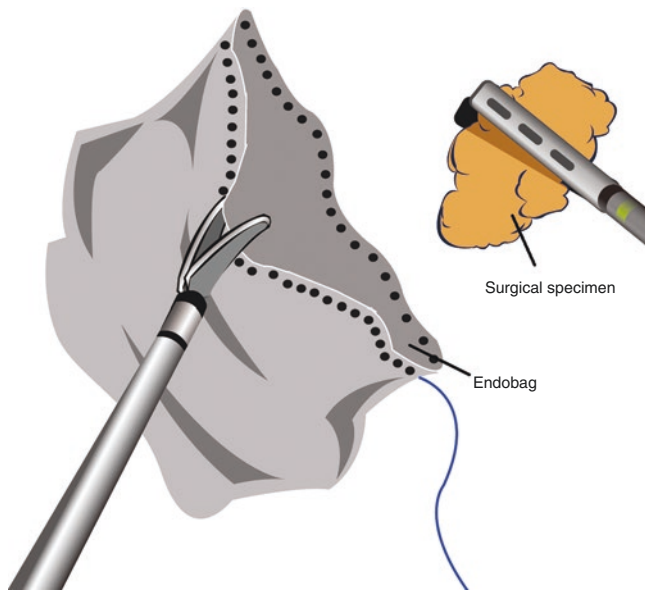


Fig. 14.10 Specimen retrieval. The endobag is blindly inserted through the 10-mm port, and the wires should be removed. After reinserting the endoscope, the bag should be properly opened up with a trocar, and a specimen should be inserted

identified 5–7 days later during the stitch-out. Routine oral hygiene care is enough after the patient is discharged 1 or 2 days after the operation.

Conclusion

TOETVA is the next step in minimally invasive thyroidectomy, whose feasibility among selected patients has been demonstrated through many clinical studies. Although

TOETVA may be more technically demanding than open surgery, it possesses the potential to establish itself as a favorable approach in selected cases. Further efforts to accumulate collective experience and evidence and to pioneer new frontiers with this approach are necessary for the potential to blossom.

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