# Single-Gland Parathyroidectomy

Courtney E. Gibson

*Editor's note: This technique requires a rapid (intraoperative) parathyroid hormone blood level assay, which is not usually available in resource-limited settings. However we feel that this well-written chapter will contribute to the reader's understanding of the overall management of parathyroid disease.*

**Introduction:**

Parathyroidectomy, or the surgical removal of diseased, overactive parathyroid tissue, is one of the most common endocrine surgical procedures performed annually. The most common indication for parathyroidectomy is primary hyperparathyroidism, or overactivity of one or more parathyroid glands that leads to the development of hypercalcemia, along with its consequent signs and symptoms. Primary hyperparathyroidism affects approximately 1 in 500 women over the age of 45 years but can occur at any age and affect any gender.

Some common signs and symptoms of primary hyperparathyroidism include bone pain, osteoporosis, nephrolithiasis (kidney stones), polyuria (frequent urination), and constipation. Neurocognitive symptoms, such as memory loss, poor concentration, mental fogginess, anxiety, and depression can also be associated with primary hyperparathyroidism. Primary hyperparathyroidism is typically due to the over secretion of parathyroid hormone by a single parathyroid gland (parathyroid adenoma); however, in some cases, all four glands are diseased (multigland hyperplasia).

Minimally invasive parathyroidectomy involves the removal of a single, overactive parathyroid gland, and requires preoperative imaging for localization. Such imaging includes either a neck ultrasound, nuclear medicine scan, or parathyroid-protocol CT scan. Subtotal parathyroidectomy is performed in patients who have multigland hyperplasia and will be described elsewhere in this atlas (see Neck Exploration and Subtotal Parathyroidectomy.)

The general steps to minimally invasive, single gland parathyroidectomy include:

- Making a transverse cervical incision above the clavicles
- Mobilization and medial rotation of the ipsilateral thyroid lobe
- Identification and isolation of the parathyroid adenoma
- Isolation and division of the blood supply to the adenoma, followed by removal of the gland

**Steps:**

1. The patient is placed on the operating table, in either a supine, or semi-Fowler ("beach chair") position. Either general anesthesia, or conscious sedation with local field block is provided. When general anesthesia is utilized, a specialized endotracheal tube that allows for nerve monitoring can be used; an esophageal tube and/or esophageal temperature probe are often inserted as well, to help identify the esophagus intraoperatively. A preoperative blood sample is sent to check the parathyroid hormone level before the start of the procedure.

*The Semi-Fowler "Beach Chair" position decreases venous congestion for operations in the neck.*

2. Using a fine scalpel (#15 blade,) make an approximate one-inch (2.5–3.5-cm) transverse cervical (Kocher) incision in the midline of the neck, one to two fingerbreadths above the sternal notch (depending on the length of the patient's neck area). This is followed by the development of subplatysmal flaps.

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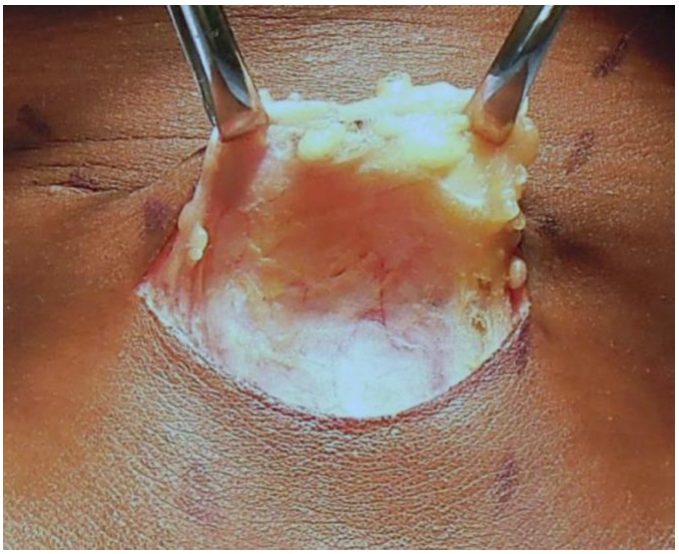
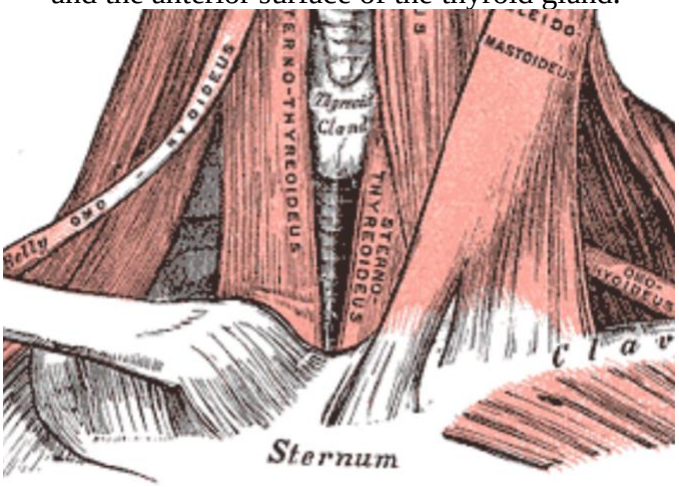


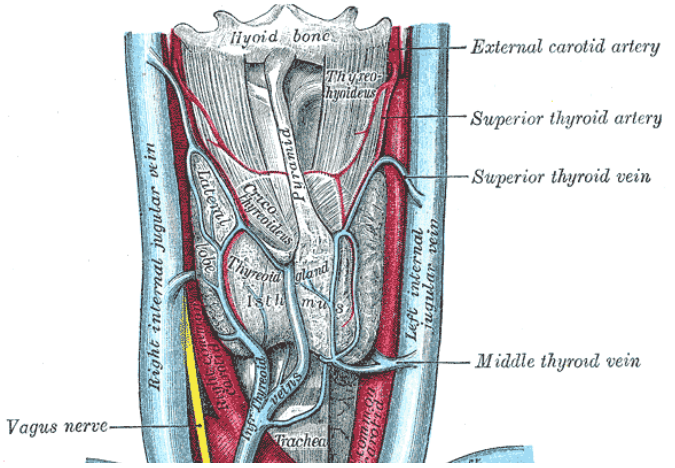
*This picture from a thyroidectomy shows the subplatysmal flaps in a cranial (shown) and caudal direction after skin incision. Note that at the midline, this plane is fibrous and not muscular. Source: Eugenio Panieri and Johan Fagen- https://vula.uct.ac.za/access/content/group/ba5fb1bd-be95-48e5-81be-586fbaeba29d/Thyroidectomy.pdf*

3. Open the median raphe, an avascular plane of connective tissue separating the left and right strap muscles. Dissect between the strap muscles and the anterior surface of the thyroid gland.

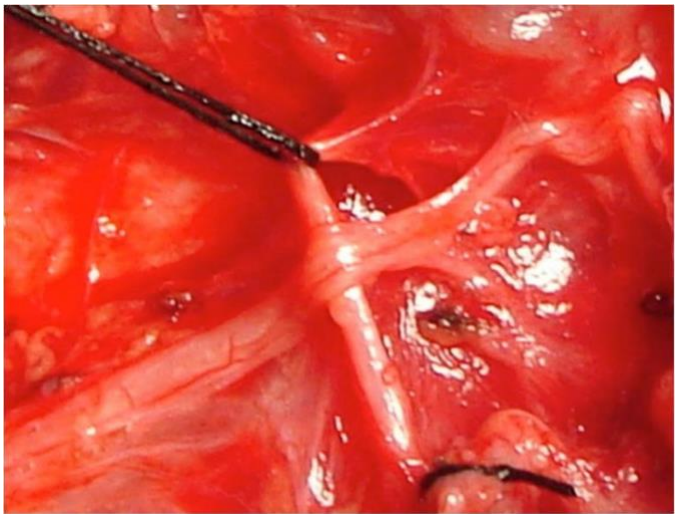



*The sternothyroid and sternohyoid muscles (also known as the strap muscles) meet at the midline just over the trachea: division at the midline allows the trachea to be reached in a relatively bloodless plane.*

4. Next, the ipsilateral thyroid lobe is grasped with a clamp, and pulled medially, toward the trachea. This maneuver exposes the middle thyroid vein, which is then ligated and divided. The thyroid lobe is then further retracted medially, to expose the tracheoesophageal groove, where the recurrent laryngeal nerve lies. The recurrent laryngeal nerve is then carefully dissected free from surrounding tissue and preserved.



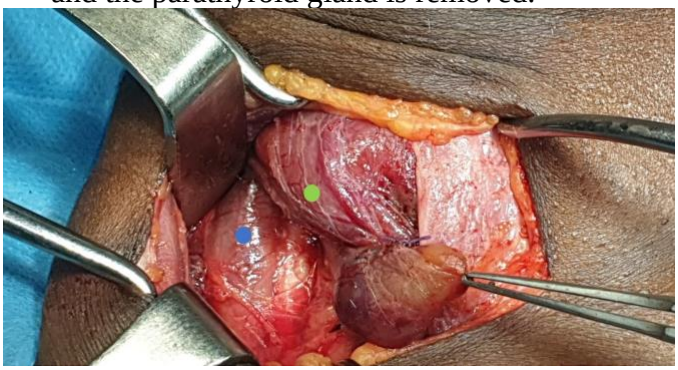

*The middle thyroid vein will be the first large vein you encounter when dissecting along the anterior surface of the thyroid gland. Once it is divided, it is possible to rotate the thyroid gland medially even as you preserve its blood supply via the inferior and superior thyroid vessels.*



*Photograph showing the relationship between the recurrent laryngeal nerve and the inferior thyroid artery (artery retracted by a Black suture). The artery may have a single or multiple branches, which may pass anterior or posterior to the nerve, or both. As the inferior thyroid artery is the blood supply of both the superior and inferior parathyroid glands, this relationship is especially important. Source: Chintamani https://doi.org/10.1007/s12262-017-1691-2*

5. At this point, the parathyroid adenoma is searched for. Under normal circumstances, the

upper and lower parathyroid glands are located approximately 1 cm above or below the intersection of the recurrent laryngeal nerve and the inferior thyroid artery. Once the abnormal parathyroid gland is found, it is carefully dissected free from the surrounding tissue, its pedicled blood supply is identified and divided, and the parathyroid gland is removed.



*Right inferior parathyroid adenoma removed during single gland parathyroidectomy. The thyroid gland (Green dot) was retracted medially, allowing visualization and dissection of the adenoma. The internal jugular vein is shown by a Blue dot. Photo courtesy of Dr. Chege Macharia.*

6. At this point, the parathyroid hormone level is again checked with several blood samples. The goal is to make sure that the level has dropped by at least 50% of its baseline level, and into the normal range. Once this is achieved, the area is irrigated thoroughly and suctioned dry, to ensure that hemostasis is achieved. The surgical wound is closed in layers with absorbable suture, and a sterile dressing is applied.

**Pitfalls**

- Mishandling of abnormal parathyroid tissue can lead to a condition called parathyromatosis. In this condition, foci of hyperfunctioning parathyroid tissue form in the neck and mediastinum. This is a rare cause of recurrent hyperparathyroidism. It is felt to occur from seeding after rupture of the parathyroid gland capsule during surgical removal of a parathyroid adenoma. Most adenomas still have a remnant of normal parathyroid tissue, along with some fibrofatty tissue; it is important to grab the abnormal parathyroid gland in this area, to avoid piercing the capsule of the tumor, and thereby causing leakage (or seeding) of hyperfunctioning parathyroid cells.
- Misinterpretation of the intact parathyroid hormone (iPTH) assay: For minimally invasive single-gland parathyroidectomy, iPTH assessment is crucial to ensuring all diseased parathyroid tissue is removed. Many describe a 50% drop in the iPTH level from baseline (from the value obtained prior to the start of the procedure), as adequate assurance that biochemical cure has been achieved. However, often the initial value is significantly high enough that a 50% drop would still leave the iPTH value above the normal range. For these reasons, it is recommended that iPTH blood levels be obtained beyond 10 minutes post-excision, to at least 15 to 20 minutes. If the levels fall into (and stay in) the normal range, the procedure can be completed. However, if the levels start to rise at the 15–20-minute time point, this suggests that additional parathyroid glands are abnormal (hyperfunctioning), and therefore further exploration and excision is required.
- Inability to find the abnormal parathyroid gland: There are typical locations where upper and lower parathyroid glands are found in the neck-usually within 1 cm above or below the intersection of the recurrent laryngeal nerve and inferior thyroid artery. In many cases, abnormal parathyroid tissue can be found in ectopic (unusual) locations. Some of these locations include (but are not limited to):
    - The cervical horn of the thymus,
    - Within the carotid sheath,
    - Intrathyroidal,
    - Paraesophageal,
    - Prevertebral
    - Undescended (at the level of the hyoid bone or laryngeal muscles).

  It is imperative that a parathyroid surgeon have expert knowledge of these ectopic locations, so as not to have a failed procedure. For more information on this situation, see "Neck Exploration and Subtotal Parathyroidectomy."

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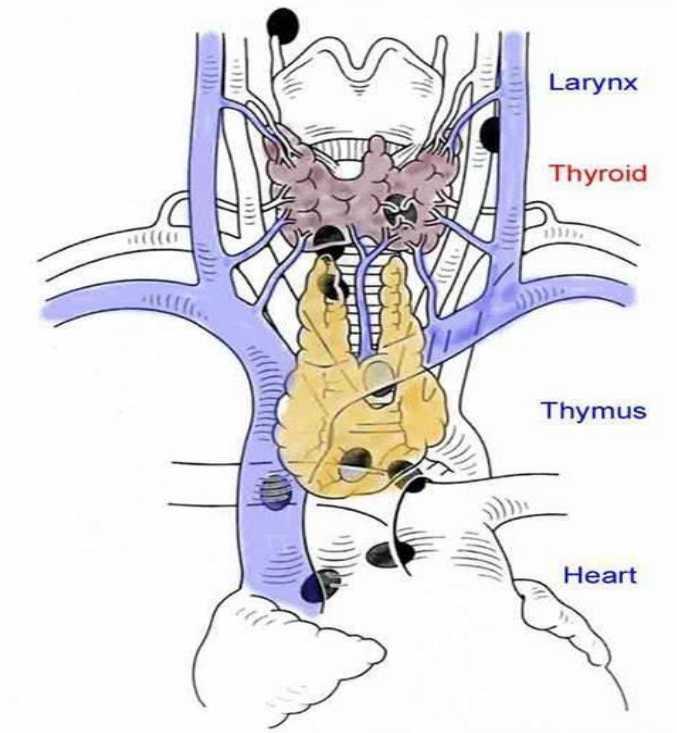
*A paraesophageal left upper parathyroid adenoma, which is a common location for an ectopic upper gland.*




*Potential ectopic parathyroid locations, for both superior and inferior glands. Source: [http://www.endocrinesurgery.net.au](http://www.endocrinesurgery.net.au), used with permission.*

- Recurrent laryngeal nerve (RLN) injury is rare in parathyroid surgery, but can be devastating, leading to significant voice changes in the patient that may sometimes be permanent. Expert knowledge of the location of the recurrent laryngeal nerve, and its relationship to the blood supply to the parathyroid glands is important to minimize risk of injury to this important nerve. In most cases, the blood supply to the inferior parathyroid glands courses anterior to (in front of) the RLN; therefore, inferior parathyroid adenomas are often encountered before the RLN is even identified, and the nerve is therefore at minimal risk of injury when removing inferior glands. In contrast, the blood supply to the superior parathyroid glands typically course posterior to (behind) the RLN. Therefore, identification of the RLN prior to searching for an upper gland is the best way to avoid nerve injury.

*The association between the blood supply to an upper adenoma and the recurrent laryngeal nerve (shown by the Black pointer.) The blood supply for upper glands typically courses beneath the nerve, which is important to know when dissecting out upper parathyroid adenomas.*

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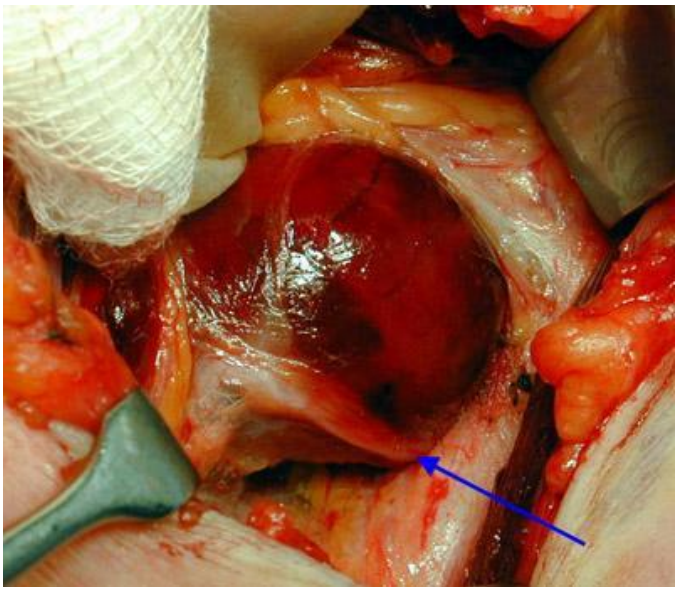

*A parathyroid adenoma that is dangerously close to the recurrent laryngeal nerve (Blue arrow.) Careless technique or less than meticulous dissection would lead to nerve injury and hoarseness of voice.*
*Source: http://www.endocrinesurgery.net.au, used with permission.*

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