BWH 2015 GENERAL SURGERY RESIDENCY PROCEDURAL ANATOMY COURSE

7. CERVICAL PROCEDURES

CONTENTS

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7. CERVICAL PROCEDURES

LAB OBJECTIVES

Skills objectives

1. Complete the anatomy lab equivalent of a thyroidectomy.
2. Complete the anatomy lab equivalent of a parathyroidectomy.
3. Complete the anatomy lab equivalent of a carotid artery exposure.
4. Complete the anatomy lab equivalent of a tracheostomy.
5. Complete the anatomy lab equivalent of a vertebral artery exposure – proximal

Knowledge objectives

1. Describe the organization of the neck in terms of deep fascia and fascial compartments.
2. Explain why infections in the retropharyngeal space can track into the superior and posterior mediastinum.
3. Briefly describe the embryonic development of the thyroid gland, and how events in thyroid development provides the basis for understanding the formation of a lingual thyroid and the formation of thyroglossal duct cysts.
4. Briefly describe the embryonic development of the thyroid gland, and how events in parathyroid development provide the basis for understanding the occurrence of mediastinal parathyroid glands.

Preparation for lab

- ☐ *Read this guide.*
- ☐ *Watch those videos.*

BWH 2015 GENERAL SURGERY RESIDENCY PROCEDURAL ANATOMY COURSE

7. CERVICAL PROCEDURES

7.1 ORGANIZATION OF THE NECK

Superficial layers

In the head and neck, the **muscles of facial expression**, including the platysma muscle, lie within the subcutaneous fat (superficial fascia) (Figure 7-1).

Cervical deep fascia and fascial compartments

As in other regions, **deep fascia** organizes the neck into functional compartments (Figure 7-1).

The **investing deep fascia** surrounds sternocleidomastoid and trapezius, two upper limb muscles, and encloses the **spinal accessory nerve** that provides their motor innervation. The deep investing fascia bridging the interval between sternocleidomastoid and trapezius defines the posterior triangle of the neck.

The **infrahyoid deep fascia** encloses the infrahyoid (strap muscles) of the neck (sternohyoid, sternothyroid, omohyoid, and thyrohyoid). The infrahyoid muscles are innervated by branches of the **ansa cervicalis**, a division of the cervical plexus.

The **vertebral (prevertebral) deep fascia** surrounds the intrinsic cervical spinal muscles and the bones, joints, and ligaments of the cervical spine. Since vertebral deep fascia encircles this functional group, the term prevertebral fascia is somewhat misleading, since this continuous layer is also 'postvertebral fascia'. The **phrenic nerve** lies deep to the vertebral fascia. The intrinsic vertebral muscles are innervated by the **dorsal and ventral rami** of spinal nerves.

The **visceral (pretracheal) deep fascia** surrounds the upper aerodigestive tract in the neck and the thyroid and parathyroid glands. The portion of the visceral fascia posterior to the esophagus is often termed the **buccopharyngeal fascia**. In the neck, the skeletal muscles of the pharynx, larynx, and esophagus are innervated by the **vagus nerve**.

The **carotid sheath fascia** encloses the internal jugular vein, the common carotid artery and its branches, and the vagus nerve.

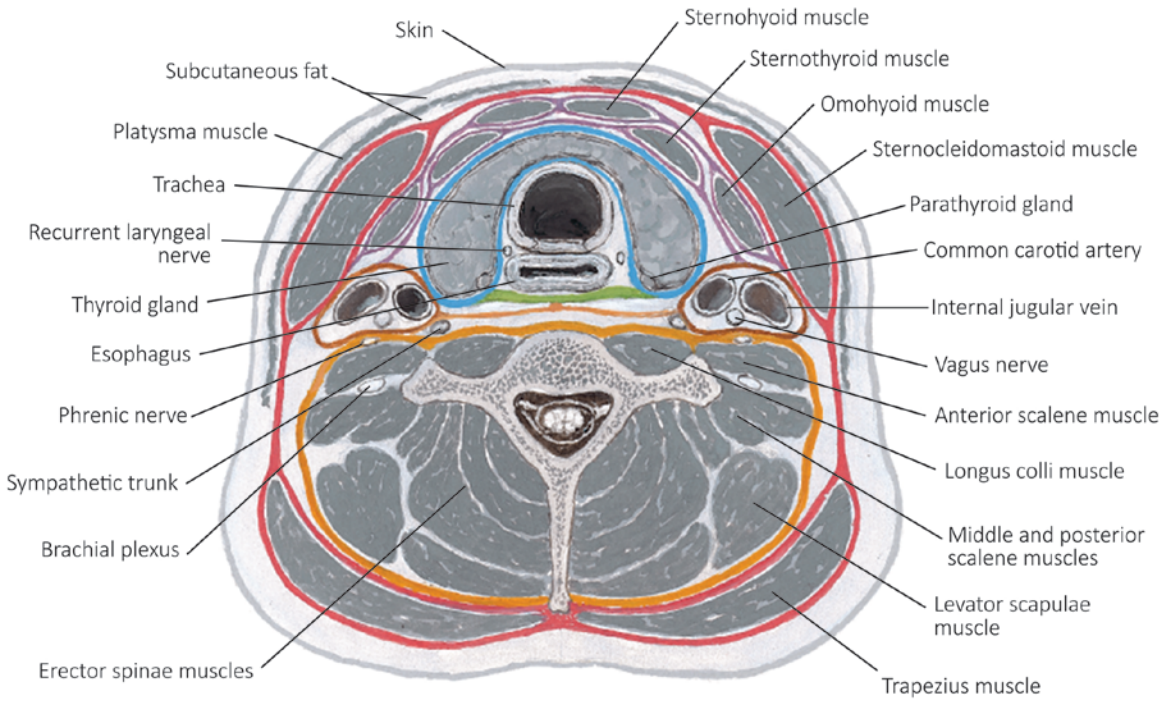
Communications with the mediastinum

The fascial compartments of the neck are **vertical compartments;** there are no horizontal partitions to impede the downward or upward spread of infection in the spaces between fascial compartments.

Infections in the **space between the infrahyoid fascia and visceral (pretracheal) fascia** can extend into the anterior mediastinum.

Infections in the **retropharyngeal space** between the buccopharyngeal fascia and vertebral fascia can extend into the superior and posterior mediastinum.

Infections **posterior to the vertebral fascia** can extend into the superior and posterior mediastinum but are initially contained within the vertebral fascia and do no initially communicate with mediastinal structures.



Axial section at the C7 vertebral level

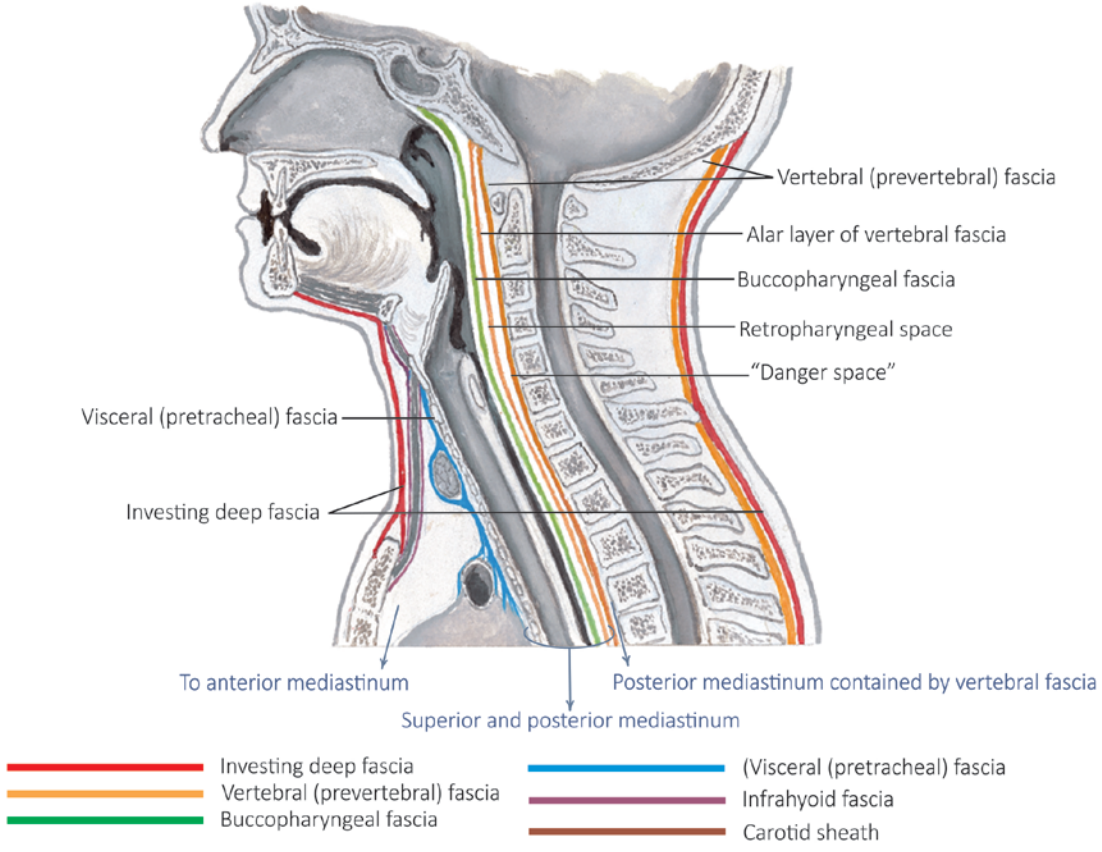


Figure 7-1. Organization of the neck. (Modified from *Netter Atlas of Human Anatomy*, 5th Edition. Philadelphia: Elsevier, 2010.)

7.2 ANTERIOR APPROACH AND SUPERFICIAL STRUCTURES

In Figure 7.2, the skin, superficial fascia and platysma muscle have been removed. The **superficial veins of the neck**, and the initial portions of the cutaneous nerves lie deep to the platysma muscle, and hemorrhage from the superficial veins will initially be contained by platysma.

Erb's point, located at the intersection between the middle and upper thirds of the sternocleidomastoid muscle, is the point at which the **sensory branches of the cervical plexus** emerge from the vertebral compartment. Sensory branches of the cervical plexus include the great auricular nerve, transverse cervical nerve, and supraclavicular branches.

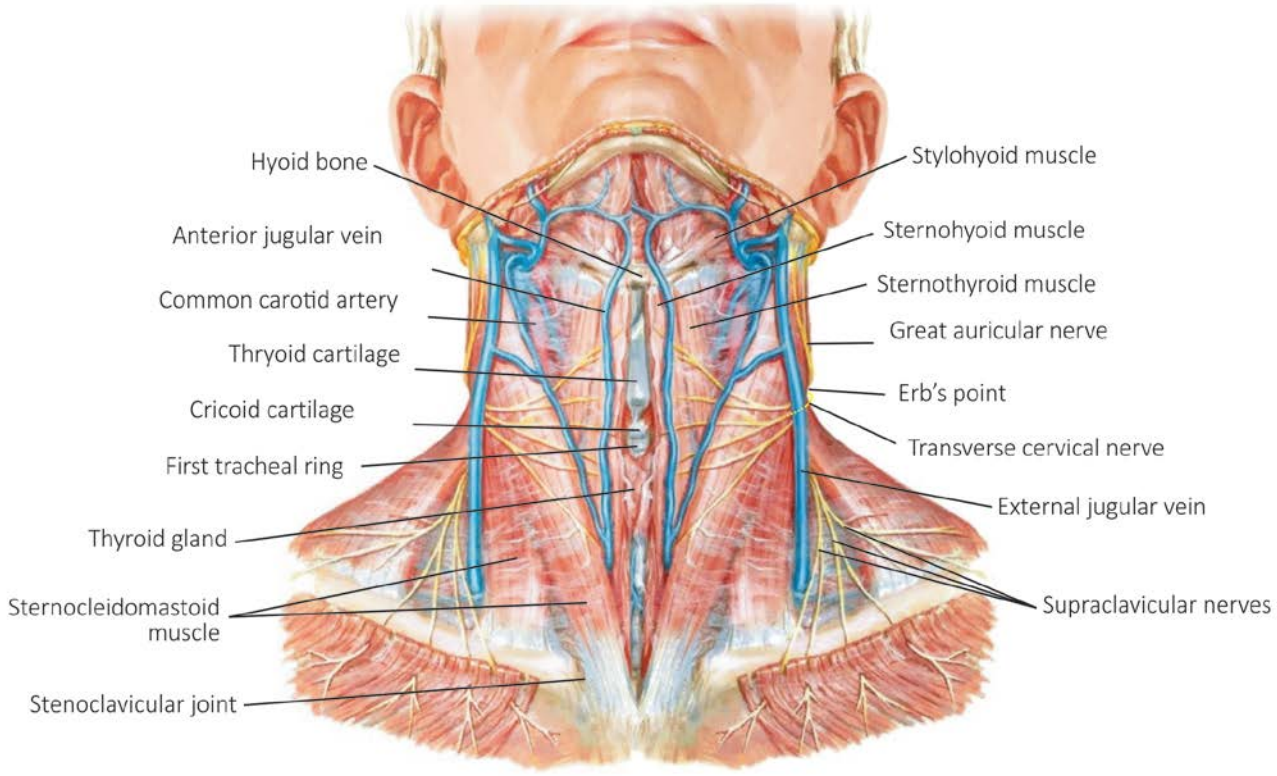


Figure 7-2 Superficial structures. (Modified from *Netter Atlas of Human Anatomy*, 5th Edition. Philadelphia: Elsevier, 2010.)

7.3 THYROID AND PARATHYROID GLANDS

Thyroid gland

Gross structure. The thyroid gland consists of **left and right lobes** connected by a narrow **isthmus**. An inconstant **pyramidal lobe** often extends superiorly from the gland over the cricothyroid membrane and thyroid cartilage toward the hyoid bone.

Microstructure. A thin connective tissue capsule surrounds the thyroid gland; connective tissue septa extend inward from the capsule and divide the thyroid lobes into lobules. Within the lobules, a fine connective tissue stroma surrounds individual thyroid follicles, the active functional units of the thyroid gland.

Thyroid follicular cells produce and store the inactive forms of tri-iodothyronine (T3) and tetra-iodothyronine (thyroxine, T4). Thyroid hormone regulates basal metabolic rate and influences tissue growth and maturation. T3 and T4 are stored within follicles as the iodinated glycoprotein iodothyroglobulin. Release of thyroid hormone into the blood circulation is regulated by thyroid-stimulating hormone (TSH) secreted by the anterior pituitary gland.

Thyroid parafollicular (C) cells produce the peptide hormone calcitonin. Calcitonin lowers blood calcium levels by inhibiting the rate of bone resorption by osteoclasts and inhibiting the rate of calcium recovery from renal ultrafiltrate. Release of calcitonin into the general circulation is regulated by blood calcium levels.

Position and relations. The thyroid isthmus lies anterior to the trachea, the thyroid lobes extend laterally over the cricoid and thyroid cartilages of the larynx. The thyroid gland typically extends from the C5 through T1 vertebral levels. Visceral (pretracheal) fascia covers the anterior surface of the gland, separating the thyroid gland from the overlying sternohyoid and sternothyroid muscles.

Development. he thyroid gland appears as an **endothelial proliferation** in the floor of the primitive pharynx. During the fourth week, this region invaginates to form a **median diverticulum** that grows caudally through the tongue and hyoid bone as the thyroglossal duct. The tip of the duct divides to form a series of cellular plates that develop into the parenchyma of the thyroid isthmus and lobes and subsequently differentiates to form the thyroid follicles. The thyroid parafollicular (C) cells arise from the **ultimobranchial body** of the fourth pharyngeal pouch. The thyroid capsule, stroma, and perifollicular stroma are derived from **cardiac neural crest mesenchyme**. The thyroid reaches its definitive position during the seventh week and begins to function at the end of the third month.

Ectopic thyroid tissue, including lingual thyroid and a pyramidal lobe, may occur at any location along the thyroid pathway of descent. **Thyroglossal duct cysts** result from failure of thyroglossal duct closure following descent.

Neurovasculary supply. The thyroid gland is supplied by the **superior thyroid artery**, a branch of the external carotid artery, by the **inferior thyroid artery**, a branch of the thyrocervical trunk, and often by the **thyroidea ima artery**, a branch of the braciocephalic artery or the aortic arch. The superior thyroid artery is closely associated with the external laryngeal branch of the superior laryngeal nerve (nerve of Galli-Curcl) which provides motor innervation to the thyrohyoid muscle. The inferior thyroid artery is closely associated with the recurrent laryngeal nerve which provides motor innervation to the remaining laryngeal muscles and conveys sensation from the larynx inferior to the vocal folds.

Blood from the **superior thyroid vein** and **middle thyroid vein** drains to the internal jugular vein. Blood from the **inferior thyroid vein** drains to the left brachiocephalic vein or superior vena cava.

Thyroid lymphatic vessels drain to the prelaryngeal, pretracheal, paratracheal, and deep cervical nodes.

Postganglionic sympathetic fibers reach the thyroid gland from the inferior cervical ganglion via a plexus on the inferior thyroid artery.

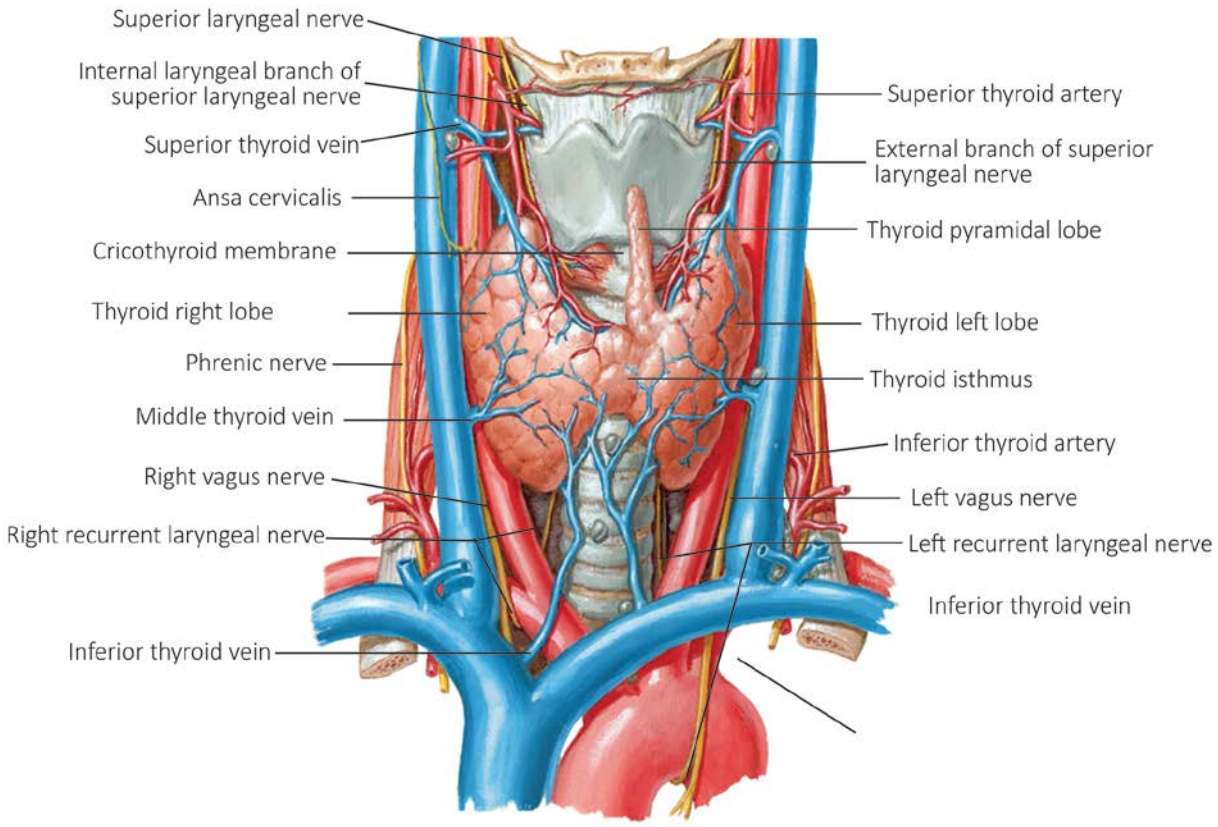


Figure 7-3. Thyroid gland and parathyroid glands. (Modified from *Netter Atlas of Human Anatomy*, 5th Edition. Philadelphia: Elsevier, 2010.)

Parathyroid glands

Gross structure. The **parathyroid glands** are small oval structures typically located on the posterior surface of the thyroid gland, but variable in position and number.

Microstructure. A **connective tissue capsule** surrounds the parathyroid gland and sends connective tissue **septa** inward through the parathyroid parenchyma.

Cords and clusters of **chief cells** synthesize and secrete parathyroid hormone (parathormone, PTH). Parathyroid hormone regulates serum calcium and phosphate levels.

Isolated **oxyphil cells**, of uncertain function, are scattered among the tightly clustered chief cells.

Position and relations. The **superior parathyroid gland** is typically located near the superior pole of the thyroid gland, and the **inferior parathyroid gland** is typically located near the inferior pole. Ectopic locations are common, particularly for the inferior parathyroid gland, which may be arrested in its descent at the carotid bifurcation or continue to descend with the thymus into the proximal neck or thorax.

The superior parathyroids usually lie posterior to the recurrent laryngeal nerves and the inferior parathyroids usually lie anterior to this nerve.

Development. During the fifth week of development, epithelium in the dorsal portion of the **third pharyngeal pouch** differentiates to form the **inferior parathyroid gland** as epithelium in the ventral portion forms the thymus. Once the connection with the pharynx is lost, the thymus descends toward the thorax, dragging the inferior parathyroid caudally and medially to the dorsal surface of the thyroid gland or beyond.

Epithelium in the dorsal recess of the **fourth pharyngeal pouch** differentiates to form the **superior parathyroid gland**, which also descends to the dorsal surface of the thyroid gland. The parathyroid capsule and connective tissue septa are derived from cardiac neural crest mesenchyme. Parathyroid hormone secretion begins during the 12th week of development.

Neurovasculary supply. The **inferior thyroid artery** usually supplies both the superior and inferior parathyroid glands with a variable contribution from the superior thyroid artery or its anastomosis with the inferior thyroid artery. Blood from the parathyroid glands usually drains to the **venous anastomosis** on the anterior surface of the thyroid gland. **Lymphatic vessels** from the parathyroid glands are associated with thyroid and thymic lymphatic vessels.

Sympathetic postganglionic fibers reach the parathyroid glands from the superior or middle cervical gangl

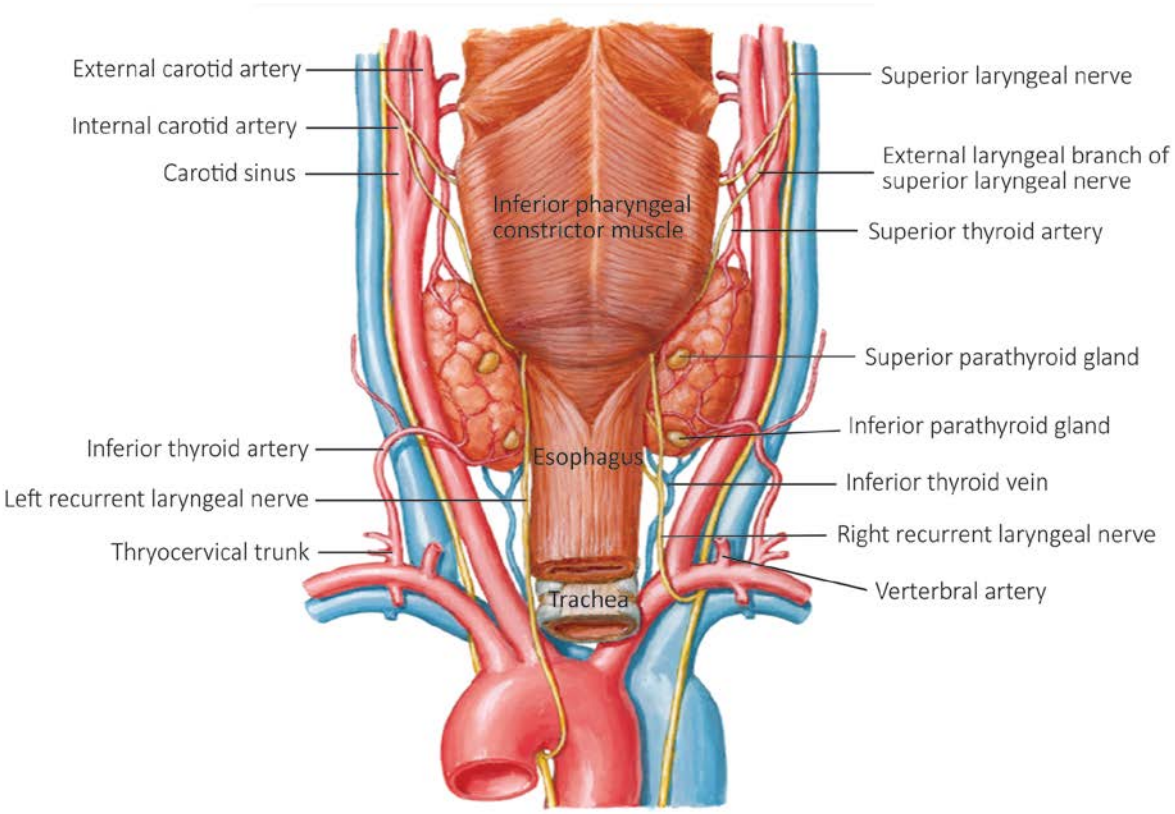


Figure 7-4. Thyroid gland and parathyroid glands. (Modified from *Netter Atlas of Human Anatomy*, 5th Edition. Philadelphia: Elsevier, 2010.)

7.4 NECK VASCULATURE

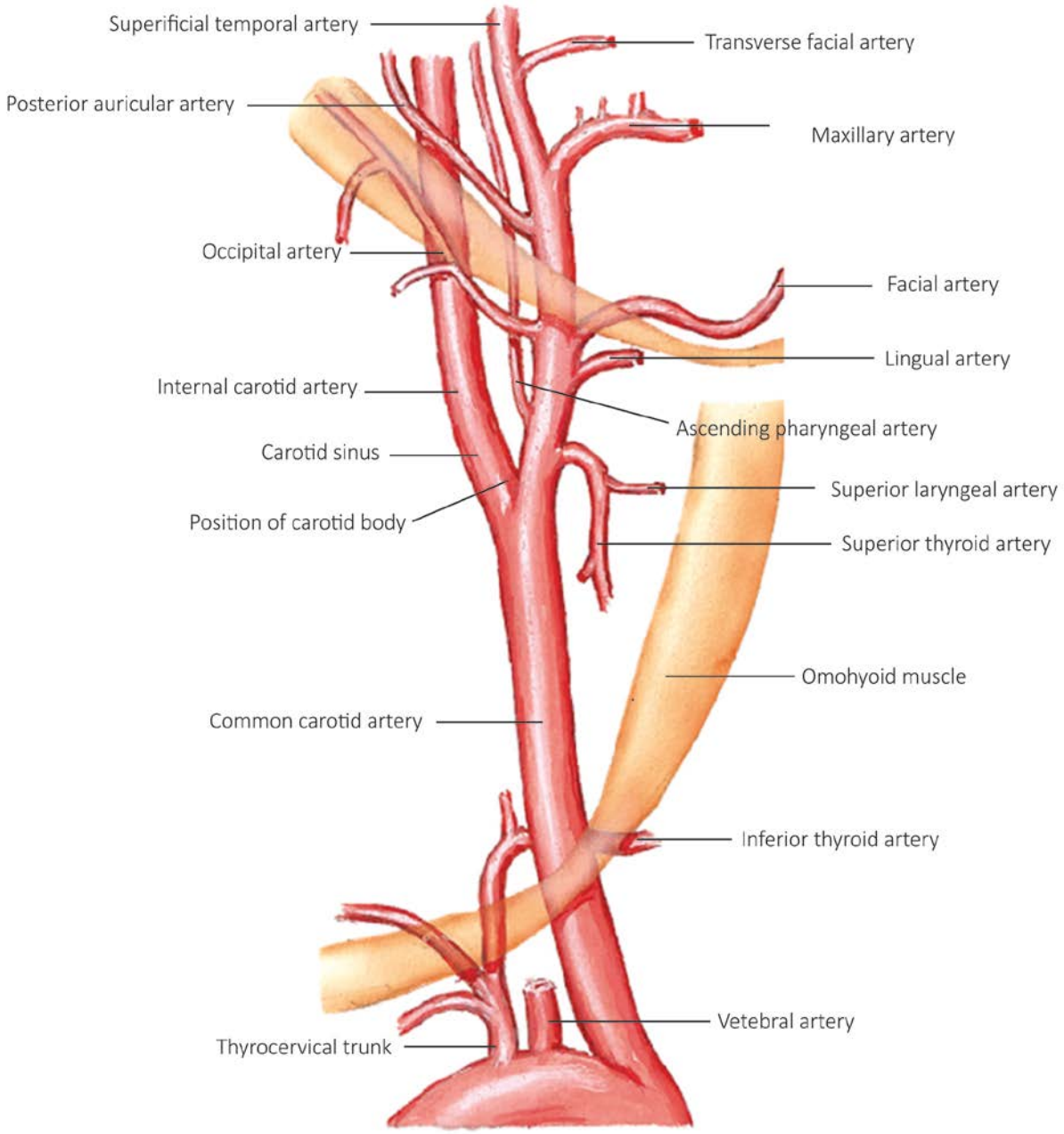
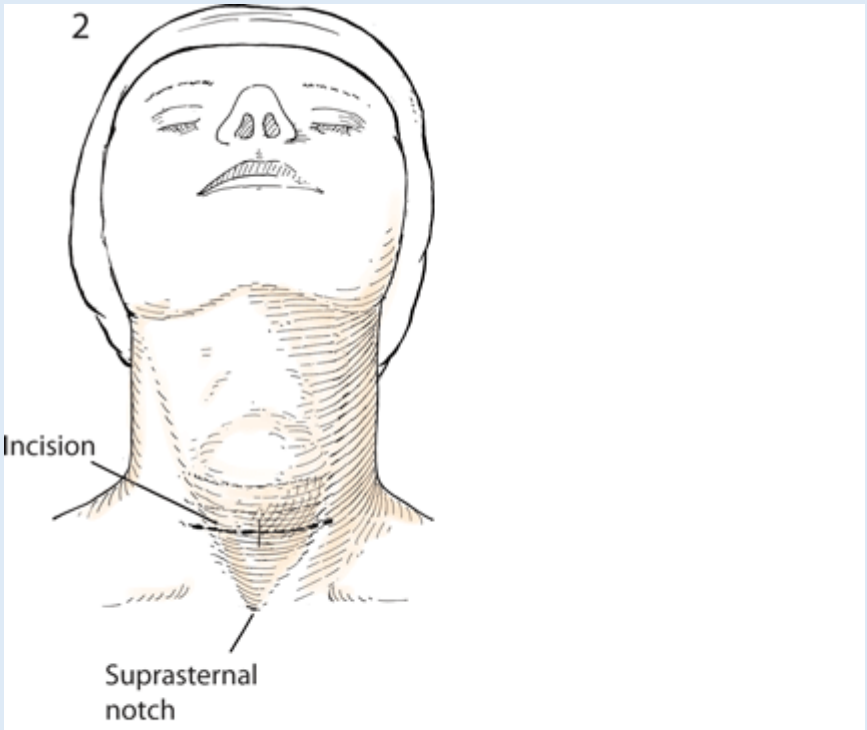


Figure 7-5. Cervical arteries. (Modified from *Netter Atlas of Human Anatomy*, 5th Edition. Philadelphia: Elsevier, 2010.)

1 Thyroidectomy

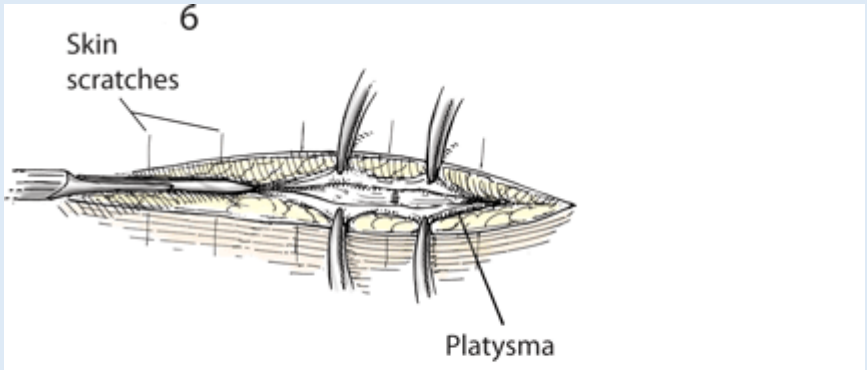
a. Place patient in a supine position with the arms tucked and the neck extended



Source: Zollinger RM, Ellison EC: *Zollinger's Atlas of Surgical Operations, 9th Edition*: http://www.accesssurgery.com

b. Make incision in natural skin fold for about 5cm in length

c. Skin flaps are mobilized superiorly to thyroid cartilage and inferiorly to sternal notch



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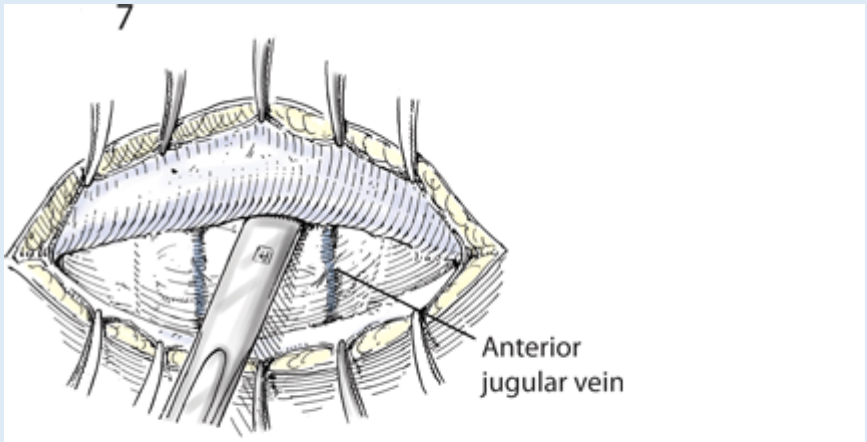

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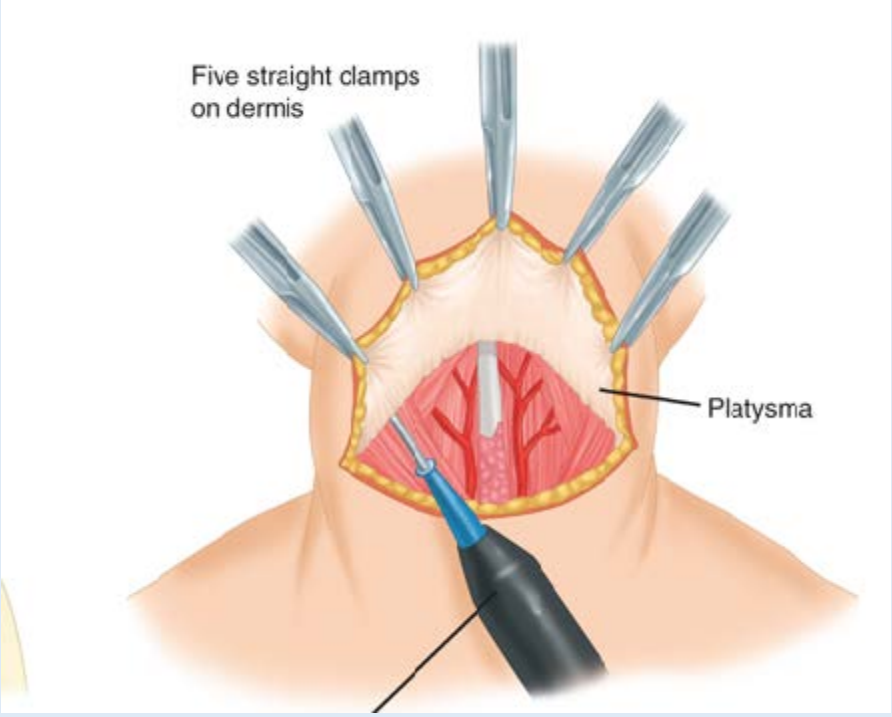
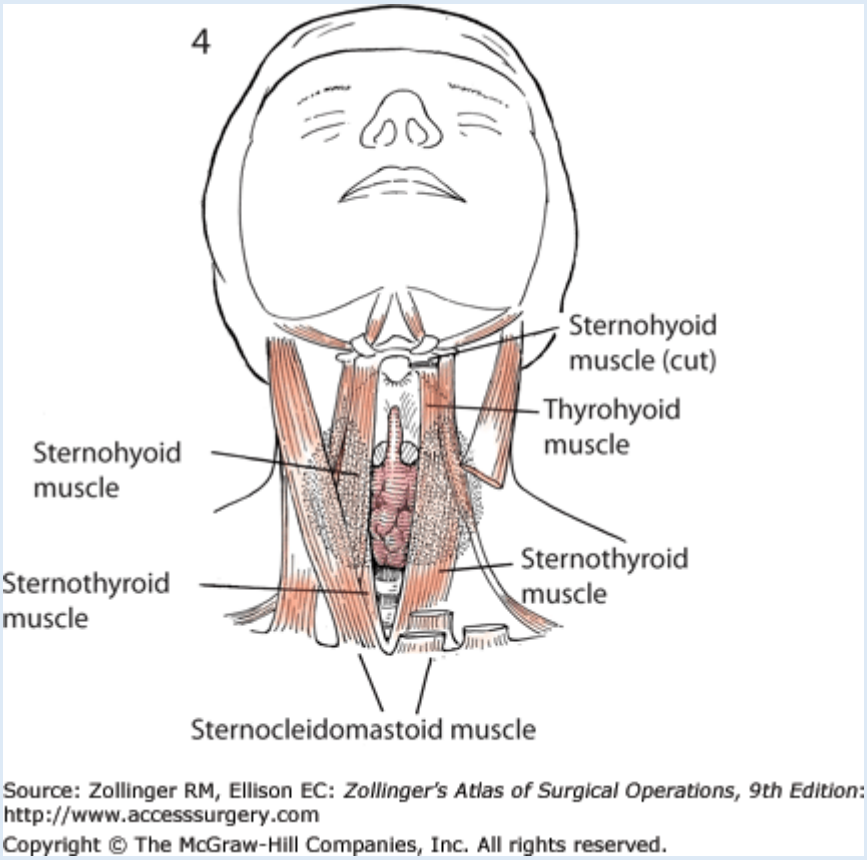


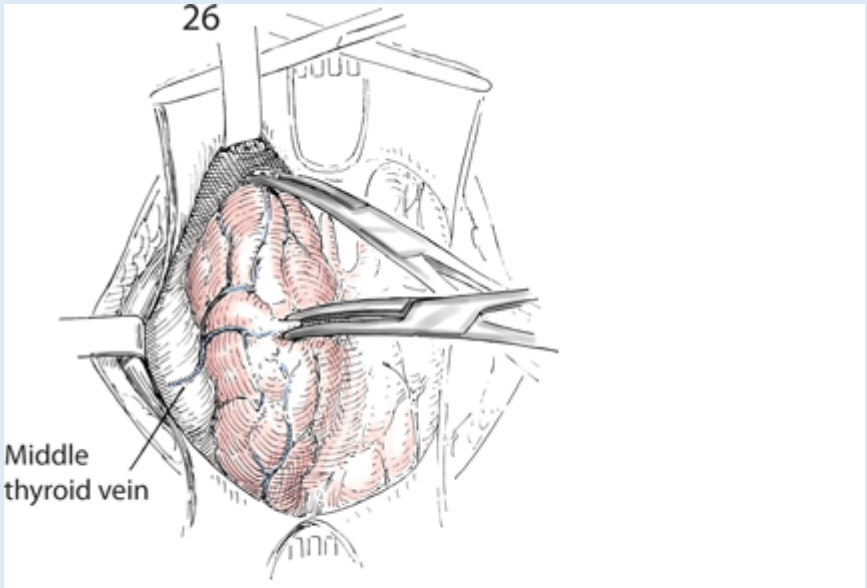
d. Strap muscles are divided, if needed.



Source: Zollinger RM, Ellison EC: *Zollinger's Atlas of Surgical Operations, 9th Edition*:
http://www.accesssurgery.com

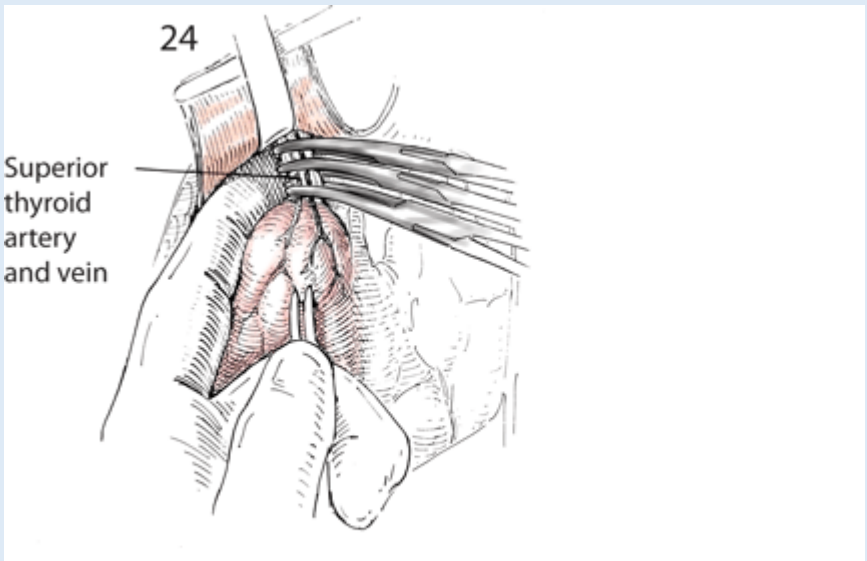
e. Dissection is carried bluntly to the carotid artery medially and superiorly to identify the superior pole vessels.

f. Identify middle thyroid vein and ligate it to avoid tearing



Source: Zollinger RM, Ellison EC: *Zollinger's Atlas of Surgical Operations, 9th Edition*: http://www.accesssurgery.com

g. Superior vessels are taken; retracting thyroid laterally and caudally to avoid injury to external laryngeal nerve



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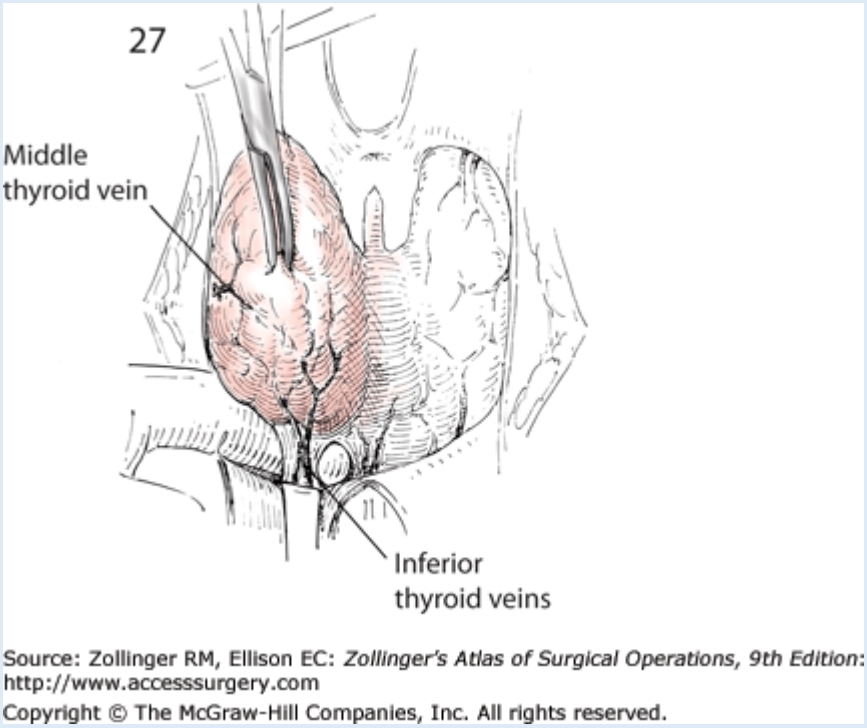
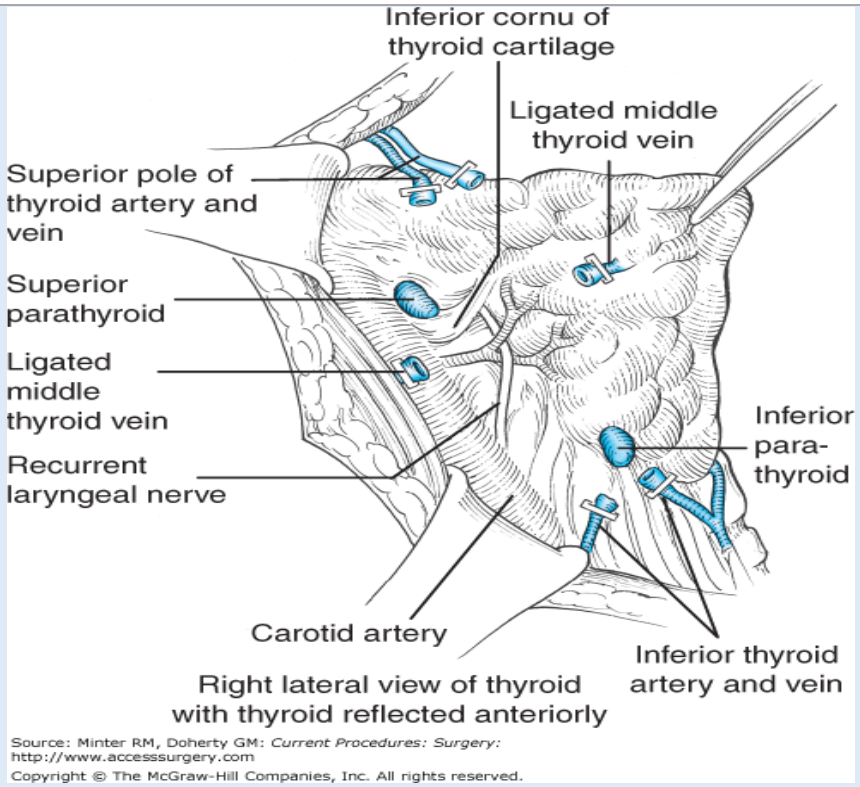
h. Inferior vessels are identified and taken close to the gland as well



Source: Zollinger RM, Ellison EC: *Zollinger's Atlas of Surgical Operations, 9th Edition*:
http://www.accesssurgery.com

i. Repeat on the other side and mobilize gland off the trachea


Inferior cornu of thyroid cartilage
Ligated middle thyroid vein
Superior pole of thyroid artery and vein
Superior parathyroid
Ligated middle thyroid vein
Recurrent laryngeal nerve
Inferior para-thyroid
Carotid artery
Inferior thyroid artery and vein
Right lateral view of thyroid with thyroid reflected anteriorly
Source: Minter RM, Doherty GM: Current Procedures: Surgery: http://www.accesssurgery.com
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2 Parathyroidectomy

a. Place the patient in a supine position with the arms tucked and neck extended

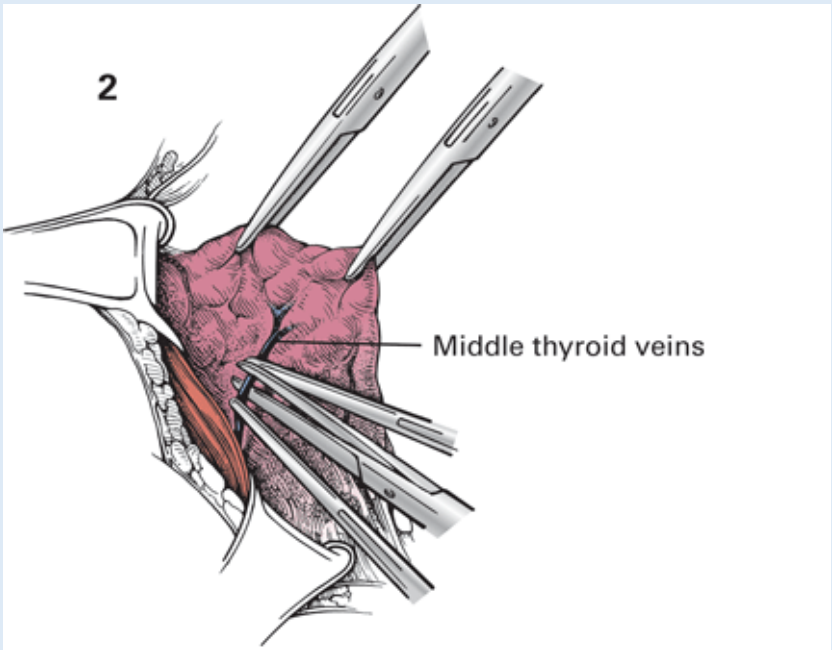
b. Make incision in natural skin fold for about 5cm in length

c. Skin flaps are mobilized superiorly to thyroid cartilage and inferiorly to sternal notch

d. Strap muscles are divided, if needed

e. Dissection is carried bluntly to the carotid artery medially and superiorly to identify the superior pole vessels.

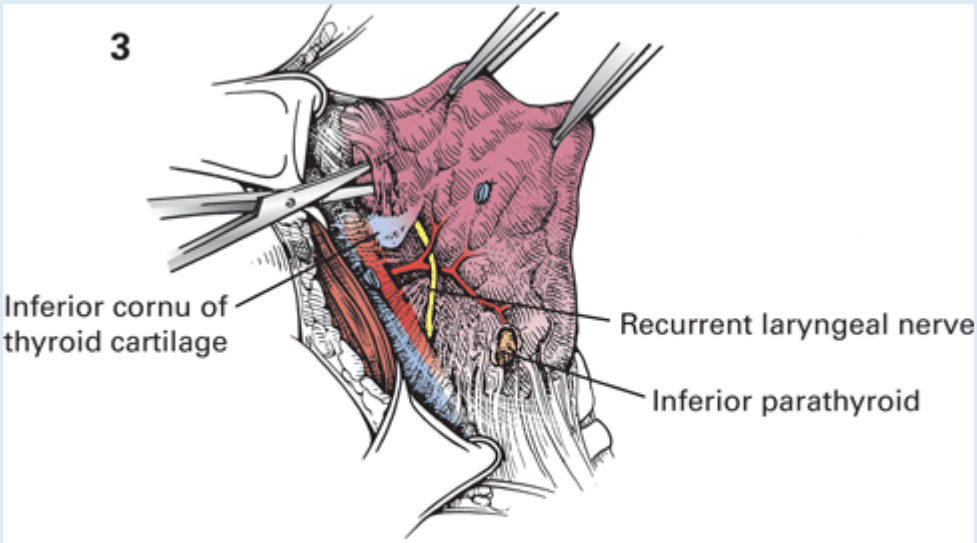
f. Identify middle thyroid vein and ligate it to avoid tearing



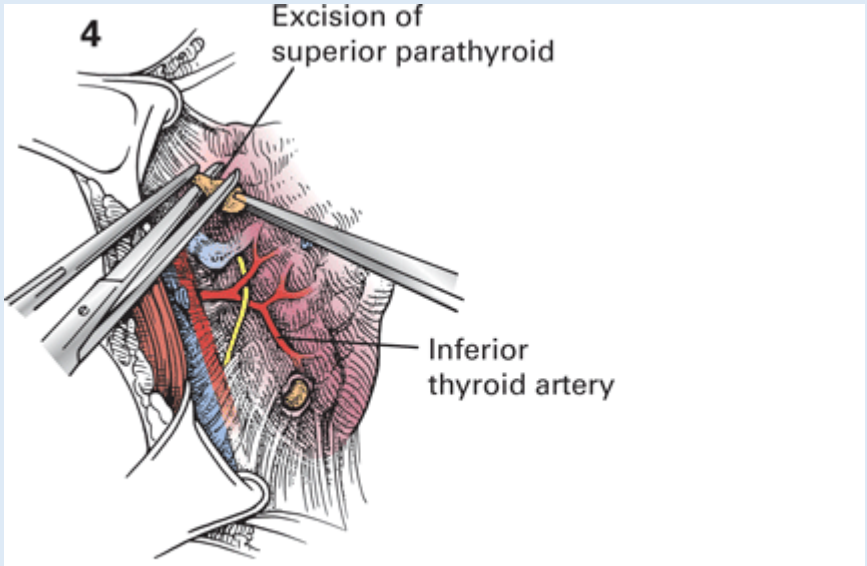
Source: Zollinger RM, Ellison EC: *Zollinger's Atlas of Surgical Operations, 9th Edition*: http://www.accesssurgery.com

g. Identify most common location of lower parathyroid glands:

i. Normally found in the thyrothymic tract, inferior to the thyroid lobe and anterior to the recurrent laryngeal nerve

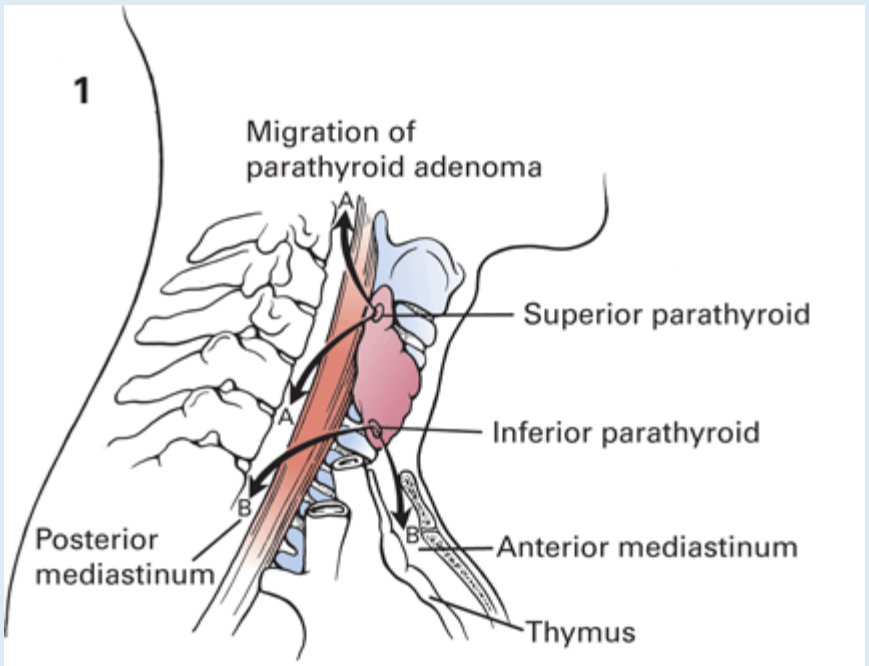


h. Identify most common location of superior parathyroid glands.



i. Normally within 1cm of the recurrent laryngeal nerve as it pierces the cricothyroid membrane, posterior to the superior pole of the thyroid

ii. All glands should be identified and their locations recorded before excision



Source: Zollinger RM, Ellison EC: *Zollinger's Atlas of Surgical Operations, 9th Edition*: http://www.accesssurgery.com

Locations of aberrant parathyroid glands:

If the superior parathyroid gland cannot be located, the tracheoesophageal groove, retroesophageal space, posterior mediastinum, carotid sheath, and thyroid capsule should be explored.

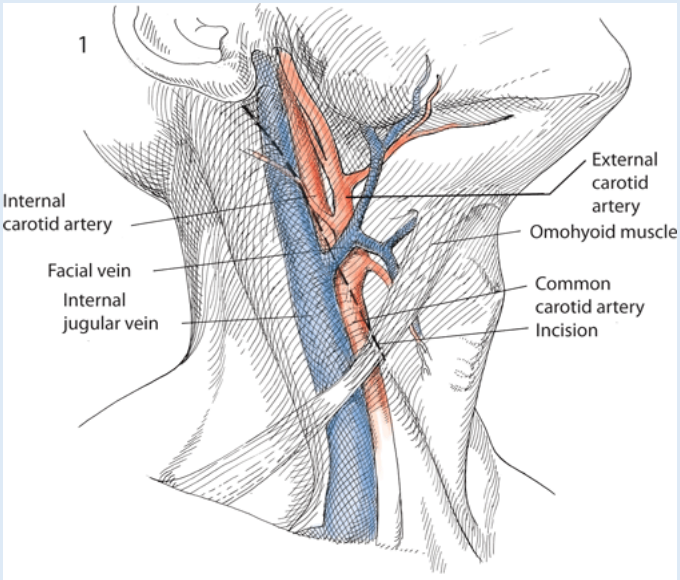
On the other hand, inferior glands are usually located posterior to the inferior pole of the thyroid lobe and ventral to the RLN. Ectopic inferior parathyroid glands are usually found in the thymus, but they may also be found within the thyroid gland, undescended in the carotid sheath, and in the anterior mediastinum.

3 Carotid artery exposure

a. *Place patient in recumbent position with head turned to opposite side*

b. *Prepare neck*

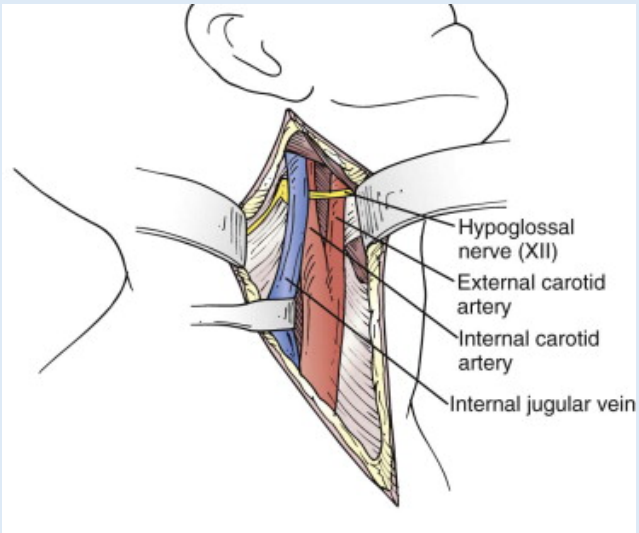
c. *Make an oblique incision along the anterior border of the SCM*



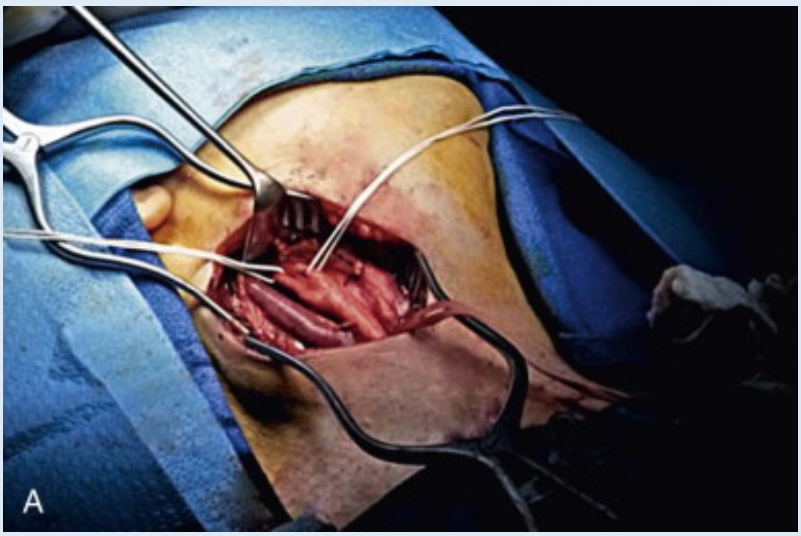
d. *Divide the facial vein as it comes across the level of the bifurcation*

e. *Dissect out the common carotid along the medial border to avoid the vagus nerve*

f. *Expose the common carotid, internal carotid, and external carotid to areas devoid of hard plaque*



g. Determine need for shunting (awake monitoring, cerebral monitoring, carotid stump pressure



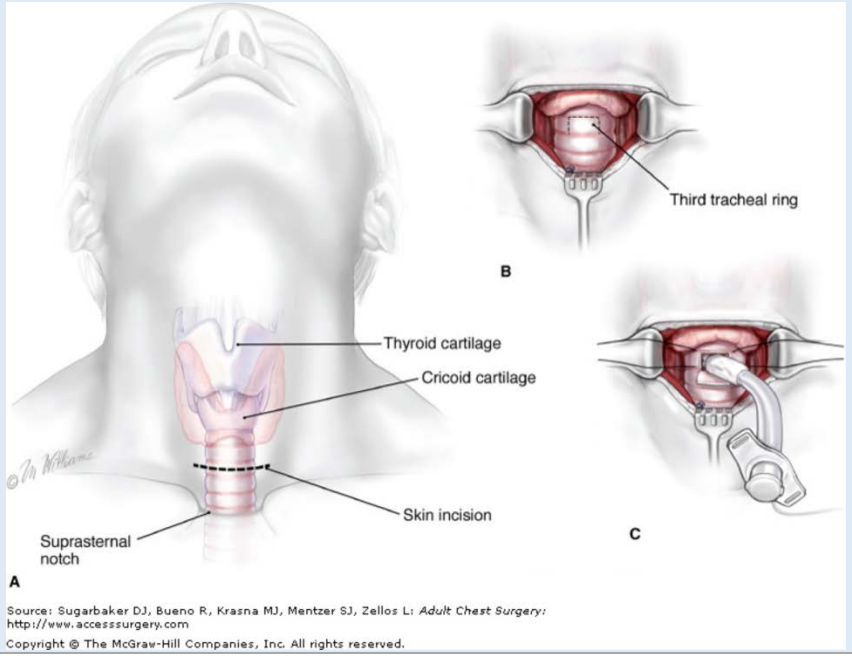
h. Administer heparin bolus before clamping

i. Clamp in disease-free areas, internal carotid first

Video: http://www.surgicalcore.org/videoplayer/510000054/58

4 Tracheostomy

a. *Position patient supine with neck extended*
b. *Make a transverse (or longitudinal) skin incision 1-2cm above the suprasternal notch and below the cricoid cartilage*
c. *Divide the plastysma transversely*
d. *Separate the strap muscles in the midline to identify the pretracheal fascia*
e. *Divide the thyroid isthmus or reflect it superiorly with retractors to approach anterior trachea*
f. *Count the tracheal rings from the cricoid cartilage, and place stay sutures laterally at the second or third tracheal ring*
g. *Minimize FiO2, incise the ring interspace with a blade , avoid cautery, and dilate ring interspace with a tracheal dilator*
h. *Place the pre-lubricated and pretested tracheostomy appliance into the airway and rotate it into position under direct vision*
i. *Confirm ventilation with anesthesia by auscultation and measuring end-tidal CO2.*
j. *Secure tracheostomy appliance to the skin with sutures*

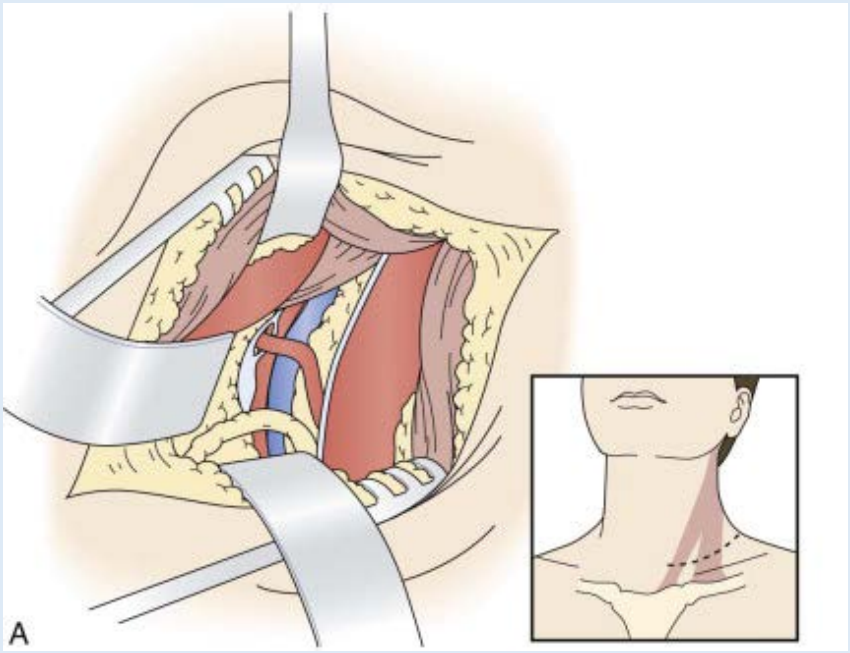


Video for cricothyroidectomy: http://www.surgicalcore.org/videoplayer/510000022/26

Video for percutaneous tracheostomy: http://www.surgicalcore.org/videoplayer/510000176/26

5 *Vertebral artery exposure – proximal*

a. *Incision is placed transversely about a fingerbreadth above the clavicle and directly over the two heads of the sternocleidomastoid muscle*



b. *Subplatysmal skin flaps are created to provide adequate exposure*

c. *Dissection is carried down directly between the two bellies of the SCM and the omohyoid muscle is divided*

d. *The internal jugular vein and vagus nerve are retracted laterally and the carotid sheath entered.*

e. *Expose the carotid artery as proximally as possible (one may have to temporarily stand at the head of bed and look down into mediastinum)*

f. *After carotid artery is mobilized, the sympathetic chain is identified running behind and parallel to it.*

g. *On the left side - the thoracic duct is divided between ligatures (proximal end is doubly ligated). On the right side – accessory lymph ducts are identified, ligated and divided. Inferior thyroid artery is identified, ligated, and divided.*

h. *The vertebral vein is next identified emerging from angle formed by the longus colli and anterior scalene and overlying vertebral artery. The vertebral vein is ligated in continuity and divided.*

i. *The vertebral artery is dissected superiorly to the tendon of the longus colli and inferiorly to its origin in the subclavian artery. The artery is freed from the sympathetic trunk resting on its anterior surface without damaging the trunk or the ganglionic rami.*

Video: http://www.surgicalcore.org/videoplayer/510000036/50