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ТОПОГРАФИЧЕСКАЯ АНАТОМИЯ И ОПЕРАТИВНАЯ ХИРУРГИЯ ШЕИ

TOPOGRAPHIC ANATOMY AND OPERATIVE SURGERY OF THE NECK

Учебно-методическое пособие



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INTRODUCTION

The neck is the region of the body that lies between the head and trunk. It is strengthened by the cervical part of the vertebral column, which is convex forward and supports the skull. In the central region of the neck there are parts of the respiratory system, namely, the larynx and the trachea, and behind them the organs of the alimentary tract, the pharynx and the part of the esophagus. On the sides along these structures carotid arteries, internal jugular veins, the vagus nerves, and the deep cervical lymph nodes are located.

Neck Boundaries:

- upper: inferior border of the mandible, mastoid process tip, superior nuchal line of the occipital bone, external occipital protuberance;
- lower: suprasternal (jugular) notch, clavicle, line connecting acromion with the spinous process of the 7th cervical vertebra (Fig. 1).

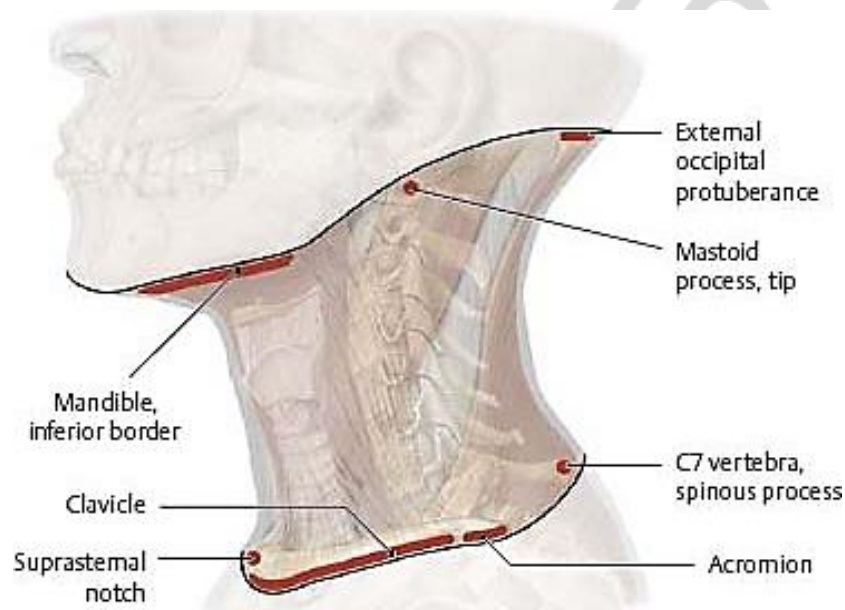


Figure 1. Neck boundaries

SURFACE LANDMARKS OF THE NECK

In the midline anteriorly, the following structures can be palpated from above downwards:

1. The hyoid bone lies at the level of the 3rd cervical vertebra.
2. The notch of the thyroid cartilage lies at the level of 4th cervical vertebra.
3. The arch of the cricoid cartilage lies at the level of the 6th cervical vertebra. It indicated the levels of junctions between the larynx and trachea, pharynx and esophagus, location of the middle cervical sympathetic ganglion, the inferior thyroid artery entering the thyroid gland.
4. The cricothyroid ligament lies between the cricoid cartilage and the thyroid cartilage. This structure is important in case of cricothyroid puncture and can be felt as a depression just below the thyroid prominence (Addams Apple).

5. First ring of the trachea, which can be felt by gentle palpation just above the isthmus of the thyroid gland.

6. The jugular notch, which can be felt between the anterior ends of the clavicles. It is the superior border of the *manubrium sterni* and corresponds to the level of the 2nd thoracic vertebra lower border (Fig. 2).

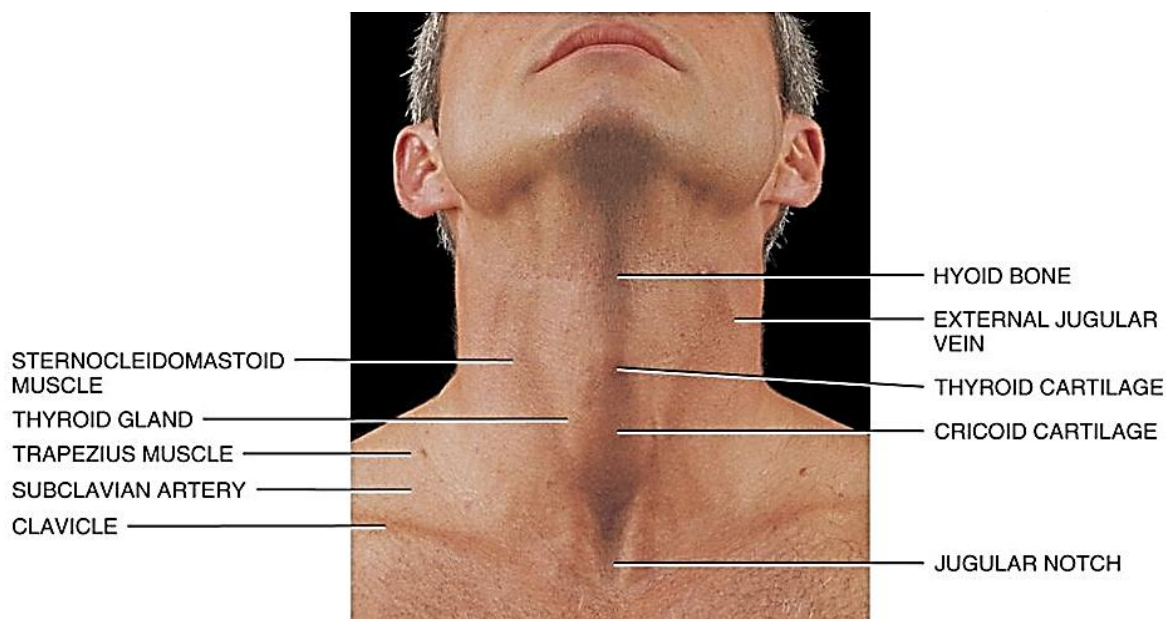


Figure 2. Surface landmarks of the neck

To summarize: it is important to remember that the *lower border of the cricoid cartilage* corresponds not only to the level of the 6th cervical vertebra but also to:

- 1) the junction of the larynx with the trachea;
- 2) the junction of the pharynx with the oesophagus;
- 3) the level at which the inferior thyroid artery and the middle thyroid vein enter the thyroid gland;
- 4) the level at which the vertebral artery enters the transverse foramen in the 6th cervical vertebra;
- 5) the level at which the superior belly of the omohyoid muscle crosses the carotid sheath;
- 6) the level of the middle cervical sympathetic ganglion;
- 7) the site at which the carotid artery can be compressed against the transverse process of the 6rd cervical vertebra (the carotid tubercle).

Regions of the neck. Totally there are 6 regions in the neck:

1. Anterior cervical region (anterior triangle).
2. Right sternocleidomastoid region.
3. Left sternocleidomastoid region.
4. Right lateral cervical region (right posterior triangle).
5. Left lateral cervical region (left posterior triangle).
6. Posterior cervical region (Fig. 3).

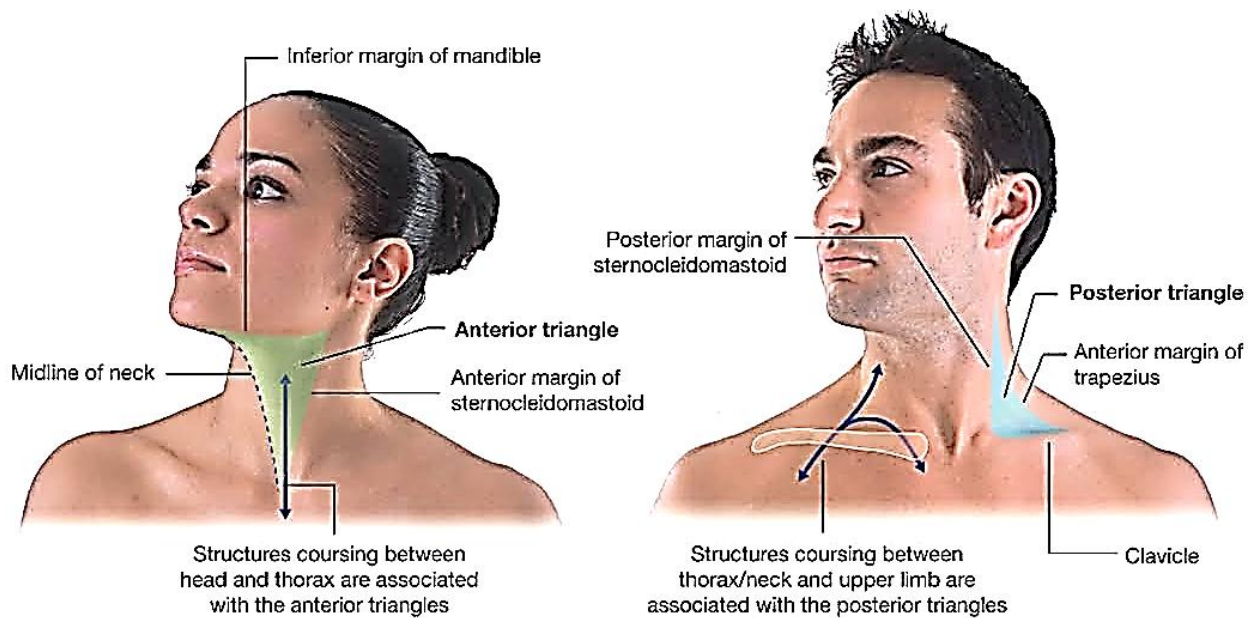


Figure 3. Regions of the neck

ANTERIOR CERVICAL REGION (ANTERIOR TRIANGLE)

Anterior cervical region (Anterior Triangle) has the following boundaries:

- the lower border of the mandible;
- anterior border of the sternocleidomastoid muscle;
- jugular notch.

The anterior triangle of the neck contains muscles, nerves, arteries, veins and lymph nodes.

Anterior cervical region (Anterior triangle) is subdivided into the:

- 1) carotid triangle;
- 2) submandibular (digastric) triangle;
- 3) submental triangle;
- 4) omotracheal (muscular) triangle (Fig. 4).

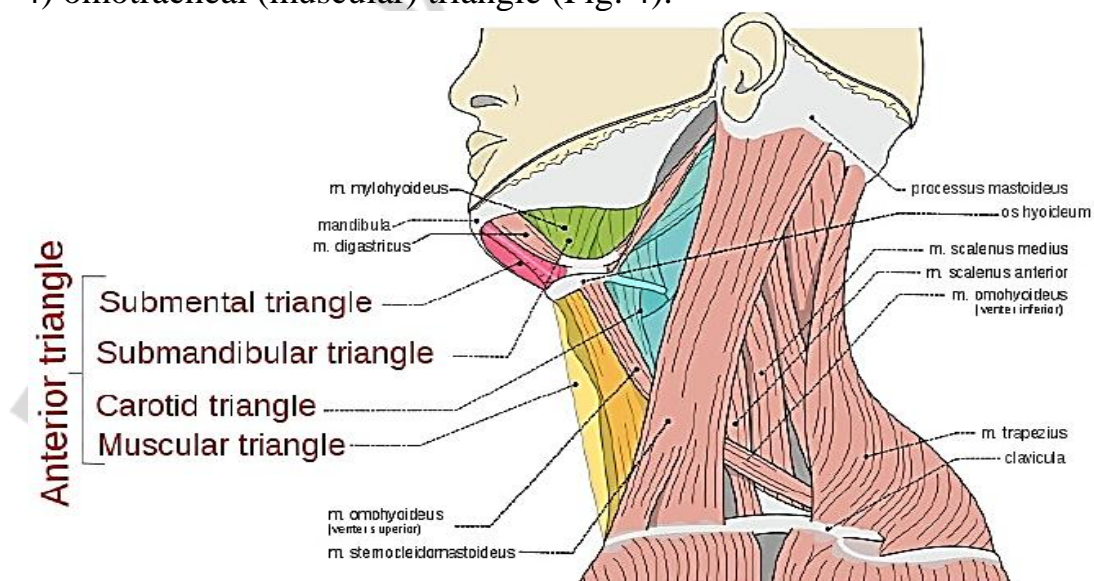


Figure 4. Anterior triangle

LATERAL CERVICAL REGION (POSTERIOR TRIANGLE)

Lateral cervical region (Posterior Triangle) has the following boundaries:

- the anterior border of the trapezius muscle;
- the posterior border of the sternocleidomastoid muscle;
- the clavicle.

Lateral cervical region (posterior triangle) is subdivided by the inferior belly of the omohyoid muscle into:

- 1) omotrapezoid (occipital) triangle;
- 2) omoclavicular (supraclavicular, or subclavian) triangle (Fig. 5).

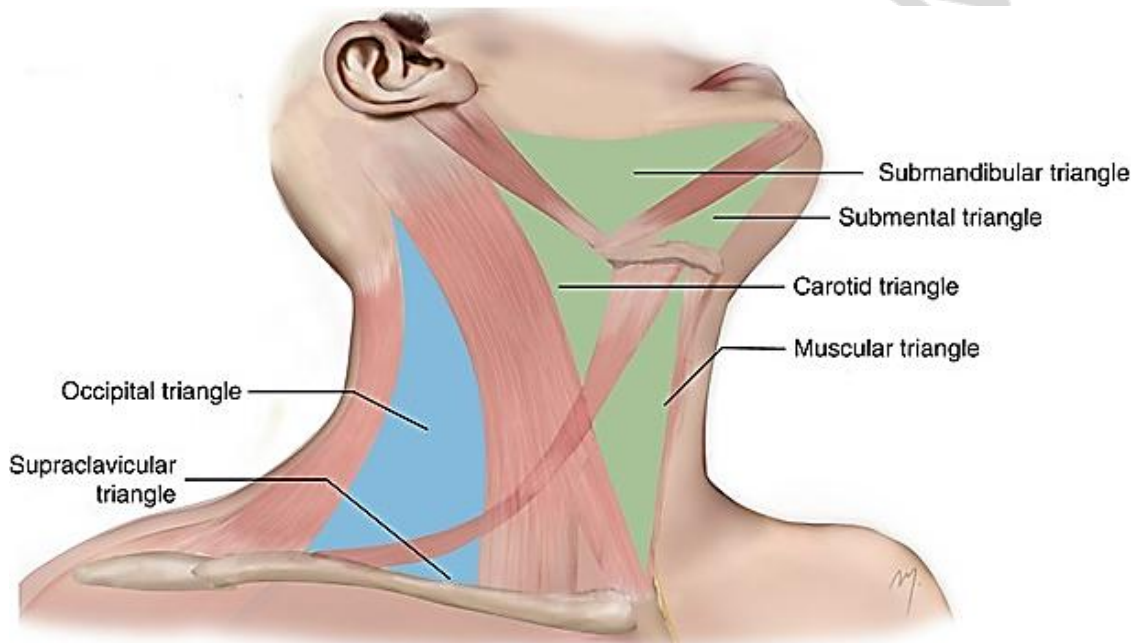


Figure 5. Lateral cervical region (posterior triangle)

FASCIAL LAYERS OF THE NECK

General Data. Superficial fascia. It forms a thin layer that encloses the platysma muscle. Superficial fascia lies beneath the skin, consists of fat and connective tissue. It encloses the cutaneous nerves, superficial veins and superficial lymph nodes.

Deep cervical fascia supports muscles, vessels, and viscera of the neck and is divided into the following three layers:

1. Enveloping (investing) fascia. It splits to enclose the trapezius and sternocleidomastoid muscles and the submandibular glands.

It is attached:

- *above* to the mandible, mastoid process and superior nuchal line;
- *below* to the manubrium sterni, clavicle, acromion and scapular spine;
- *posteriorly* to the spinous processes of the cervical vertebrae.

2. Pretracheal fascia. Lies in the anterior part of the neck; invests the infrahyoid muscles (muscular part), thyroid gland, trachea, and esophagus

(visceral part). Posteriorly it is called the buccopharyngeal fascia because it covers the buccinator and pharyngeal constrictor muscles.

3. Prevertebral fascia. The prevertebral fascia is a thick layer that passes like a septum across the neck behind the pharynx and the esophagus and in front of the vertebral column. It invests the prevertebral muscles and vertebral column.

- *above* it is attached to the base of the skull;
- *laterally* covers the scalene muscles together with the phrenic nerve and the brachial plexus and subclavian artery;
- *inferiorly* this fascia blends with endothoracic fascia in the mediastinum.

Carotid sheath blends with these three fascial layers but is distinct and contains the common carotid artery, internal jugular vein, and vagus nerve (Fig. 6).

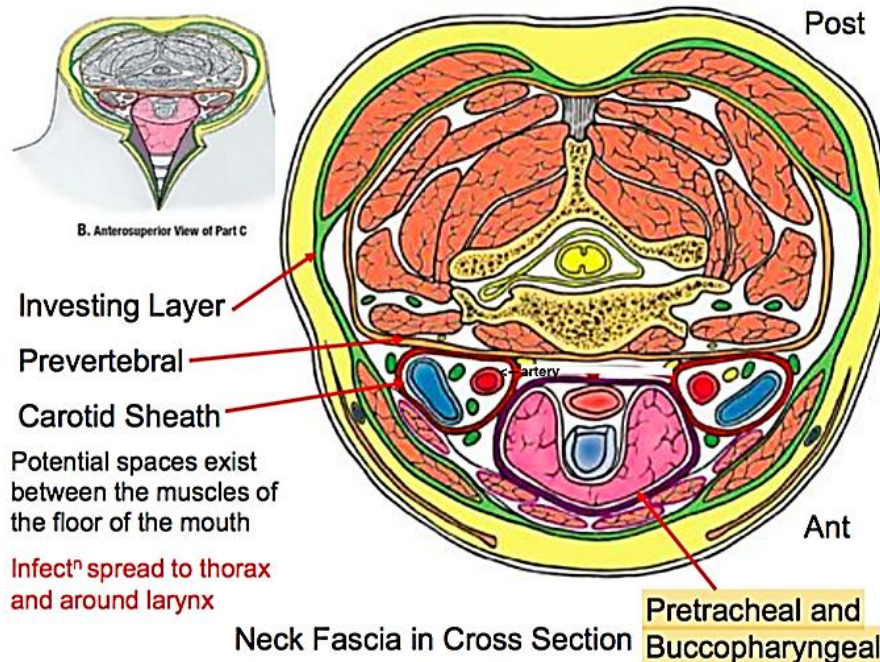


Figure 6. Neck fascia

CELLULAR FACIAL SPACES

Between the more dense layers of deep fascia in the neck there is loose connective tissue that forms clinically important potential spaces. The fascial spaces are important because infections originating in the mouth, teeth, pharynx, and esophagus can spread among the fascial sheets and spaces, and the tough fascia can determine the direction of spread of infection and pus. It is also possible for blood, pus, or air in the retropharyngeal space to spread downward into the mediastinum of the thoracic cavity.

Acute Infections of the Neck Fascial Spaces. Dental infections most commonly involve the lower molar teeth. The infection spreads medially from the mandible into the submandibular and masticatory spaces and pushes the tongue forward and upward. Further spread downward may involve the visceral space and lead to edema of the vocal cords and airway obstruction.

Ludwig's angina is an acute infection of the submandibular fascial space and is commonly secondary to dental infection.

Chronic Infection of the Neck Fascial Spaces. Tuberculous infection of the deep cervical lymph nodes can result in liquefaction and destruction of one or more of the nodes. The pus is at first limited by the investing layer of the deep fascia. Later, this becomes eroded at one point, and the pus passes into the less restricted superficial fascia. The clinician is aware of the superficial abscess but must not forget the existence of the deeply placed abscess.

Cellular facial spaces:

1. Submandibular space is formed by the enveloping (investing) layer of the deep fascia which encloses the submandibular gland.

2. Fascial capsule of the sternocleidomastoid muscle is formed by the enveloping (investing) layer of the deep fascia.

3. Suprasternal space is located between the enveloping (investing) of the deep fascia, contains jugular venous arch.

4. Carotid sheath (cellular space of the neurovascular bundle of the neck) is a local condensation of the prevertebral, the pretracheal, and the investing layers of the cervical deep fascia surrounding the common carotid artery, internal jugular vein and vagus nerve.

5. Prevertebral space is located behind the prevertebral layer of the deep fascia, contains prevertebral muscles and sympathetic trunk.

6. Cellular space of the posterior (lateral) triangle is connected with the axillar region.

7. Pretracheal (previsceral) space is located between the visceral layer of the pretracheal fascia and the thyroid gland, and communicates with the mediastinum.

8. Retrovisceral space is located between pretracheal and prevertebral layers of the deep fascia, contains only lymph nodes and communicates with the mediastinum.

STERNOCLEIDOMASTOID REGION

The boundaries of the sternocleidomastoid region correspond to the projection of this muscle. The sternocleidomastoid muscle, a strong, thick muscle crossing the side of the neck, protects the underlying soft structures from blunt trauma. Sternocleidomastoid region layers are the following:

- skin (thin and mobile, innervated by cervical plexus branches);
- subcutaneous tissues (variable);
- platysma muscle (covered by superficial fascia, innervated by facial nerve);
- sternocleidomastoid muscle (covered by enveloping (investing) fascia, innervated by the accessory nerve);
- neurovascular bundle of the neck (lies behind the sternocleidomastoid muscle). Topography of its elements is different at the upper, middle and lower part of the sternocleidomastoid muscle.

The following structures are located behind the *middle part of the sternocleidomastoid muscle*:

– Common carotid artery (lies medially). The common carotid artery runs upward through the neck under the anterior border of the sternocleidomastoid muscle, from the sternoclavicular joint to the upper border of the thyroid cartilage. Here, it is divided into the external and internal carotid arteries.

– Internal jugular vein (lie laterally). It starts as a continuation of the sigmoid sinus and leaves the skull through the jugular foramen. It then descends through the neck in the carotid sheath between the vagus nerve and the internal and common carotid arteries. It ends by joining the subclavian vein behind the medial end of the clavicle to form the brachiocephalic vein.

– Vagus nerve (X) (lies between common carotid artery and internal jugular vein).

– Jugular (deep) lymph nodes (lies along the vein). The deep cervical nodes form a vertical chain along the course of the internal jugular vein within the carotid sheath.

– Ansa cervicis (lies anteriorly) innervates the infrahyoid muscles.

– Sympathetic trunk (lies posteriorly). The cervical part of the sympathetic trunk extends upward to the base of the skull and downward to the neck of the 1st rib, further it continuous with the thoracic part of the sympathetic trunk. It lies directly behind the internal and common carotid arteries (i.e., medial to the vagus) and is embedded in the deep fascia between the carotid sheath and the prevertebral layer. The sympathetic trunk possesses three ganglia: the superior, middle, and inferior cervical ganglia.

Antescalene Space is located between the posterior surface of the *lower part of the sternocleidomastoid muscle* and the anterior scalene muscle. The anterior scalene muscle is a key muscle in understanding the neck root. It is placed deeply and descends almost vertically from the vertebral column to the 1st rib.

The following structures are located in the antescalene space:

1. Common carotid artery.

2. Venous angle which is formed by the junction of the internal jugular and subclavian veins. Internal jugular and subclavian veins form the brachiocephalic vein. External jugular vein empties into the venous angle which often receives the thoracic duct on the left side and the right lymphatic duct on the right.

3. Vagus nerve.

4. Phrenic nerve. The phrenic nerve arises in the neck from the 3rd, 4th, and 5th cervical spinal nerves of the cervical plexus. It runs vertically downward across the front of the scalenus anterior muscle.

Phrenic Nerve Injury and Paralysis of the Diaphragm. The phrenic nerve, which arises from the anterior rami of the third, fourth, and fifth cervical nerves, is of considerable clinical importance because it is the sole nerve supplying the muscle of the diaphragm. Each phrenic nerve supplies the corresponding half of the diaphragm. The phrenic nerve can be injured by penetrating wounds in the neck. If that occurs, the paralyzed half of the diaphragm relaxes and is pushed

up into the thorax by the positive abdominal pressure. Consequently, the lower lobe of the lung on that side may collapse. About one third of persons have an accessory phrenic nerve.

Scaleno-Vertebral Triangle is located between posterior surface of the anterior scalene muscle and cervical vertebrae. Contains:

1. Subclavian artery (first part, which gives the following branches: vertebral, internal thoracic arteries and thyrocervical trunk).
2. Sympathetic trunk.

CAROTID TRIANGLE

Boundaries:

- posteriorly: sternocleidomastoid muscle;
- anteriorly: anterior belly of omohyoid muscle;
- superiorly: posterior belly of digastric muscle.

Contents of the Carotid Triangle:

1. Common carotid artery is divided into two branches (bifurcation):
 - internal carotid artery (doesn't give branches in the neck);
 - external carotid artery, gives many branches:
 - 1) superior thyroid artery;
 - 2) lingual artery;
 - 3) facial artery;
 - 4) sternocleidomastoid artery;
 - 5) occipital artery;
 - 6) posterior auricular artery;
 - 7) ascending pharyngeal artery;
 - 8) maxillary artery;
 - 9) superficial temporal artery.
2. Internal jugular vein (and its tributaries).
3. Vagus nerve.
4. Superior radix of ansa cervicis (separates from the hypoglossal nerve).

SUBMENTAL TRIANGLE

The submental triangle in the neck is situated underneath the chin. Its main content is the submental lymph nodes, which filter lymph draining from the floor of the mouth and parts of the tongue.

Boundaries:

- inferiorly — the hyoid bone;
- medially — the midline of the neck;
- laterally — the anterior belly of the digastric.

The base of the submental triangle is formed by the mylohyoid muscle, which runs from the mandible to the hyoid bone.

SUBMANDIBULAR (DIGASTRIC) TRIANGLE

The submandibular (digastric) triangle is situated underneath the body of the mandible. It contains the submandibular salivary gland, and lymph nodes. The facial artery and vein also pass through this area.

Boundaries:

- superiorly: body of the mandible;
- anteriorly: anterior belly of the digastric muscle;
- posteriorly: posterior belly of the digastric muscle.

OMOTRACHEAL (MUSCULAR) TRIANGLE

This anatomical area is actually having four boundaries. The omotracheal (muscular triangle) is also unique in containing no vessels of note. It does however contain some muscles and organs — the infrahyoid muscles, the pharynx, and the thyroid and parathyroid glands.

Boundaries:

- superiorly — the hyoid bone;
- medially — the midline of the neck;
- supero-laterally — the superior belly of the omohyoid muscle;
- infero-laterally — the inferior portion of the sternocleidomastoid muscle.

OMOCLAVICULAR (SUPRACLAVICULAR, SUBCLAVIAN) TRIANGLE

It contains the second part of the subclavian artery (in the interscalene space), the inferior part of the external jugular vein. These vessels are separated within it by the investing layer of deep cervical fascia. The trunks of the brachial plexus may be felt above and behind the triangle.

This triangle is clinically relevant, e.g. it is a common site for palpation of pathologically enlarged lymph nodes, as well as a site where the pulsations of great veins of the neck can be seen.

Boundaries:

- inferiorly — the clavicle;
- medially — the posterior border of the sternocleidomastoid muscle;
- superiorly — the inferior belly of the omohyoid muscle.

OMOTRAPEZOID (OCCIPITAL) TRIANGLE

Boundaries:

- inferiorly — the inferior belly of the omohyoid muscle;
- medially — the posterior border of the sternocleidomastoid muscle;
- laterally — the anterior border of the trapezius muscle.

The posterior triangle of the neck is covered by the investing layer of the cervical fascia, and the floor is formed by the prevertebral fascia, which encloses the splenius capitis, levator scapula, and the middle scalene muscle.

It contains:

- the accessory nerve, which is directed obliquely across the space from the sternocleidomastoideus muscle to the trapezius muscle;
- the supraclavicular nerves;
- the transverse cervical vessels (from the third part of the subclavian artery);
- the upper (supraclavicular) part of the brachial plexus.

Organs of the neck:

- thyroid gland;
- larynx;
- trachea;
- pharynx;
- esophagus.

THYROID GLAND

The thyroid gland consists of the right and left lobes connected by a narrow isthmus. It is a vascular organ surrounded by a sheath derived from the pretracheal layer of the deep cervical fascia. This sheath attaches the gland to the larynx and the trachea. Each lobe of the thyroid gland is pear shaped, with its apex directed upward as far as the oblique line on the lamina of the thyroid cartilage; its base lies below at the level of the fourth or fifth tracheal ring. The isthmus extends across the midline in front of the second, third, and fourth tracheal rings. A pyramidal lobe is often present, and it projects upward from the isthmus, usually to the left of the midline.

Relations of the Lobes. *Anterolaterally:* skin, fasciae, the sternothyroid muscle, the superior belly of the omohyoid muscle, the sternohyoid muscle, and the anterior border of the sternocleidomastoid muscle.

Posterolaterally: the carotid sheath with the common carotid artery, the internal jugular vein, and the vagus nerve.

Posteromedially: the larynx, the trachea, the pharynx, and the esophagus. Associated with these structures is the cricothyroid muscle. In the groove between the esophagus and the trachea lies the recurrent laryngeal nerve.

The rounded posterior border of each lobe is related posteriorly to the superior and inferior parathyroid glands and the anastomosis between the superior and inferior thyroid arteries.

Relations of the Isthmus. *Anteriorly:* skin, fasciae, sternothyroid and sternohyoid muscles, anterior jugular veins.

Posteriorly: the second, third, and fourth rings of the trachea. The terminal branches of the superior thyroid arteries anastomose along its upper border.

Blood Supply:

- the superior thyroid artery (*the branch of the external carotid artery*);
- the inferior thyroid artery (*the branch of the thyrocervical trunk of the subclavian artery*);

– in some people (about 10 %), there is an additional thyroid ima artery. It comes from the brachiocephalic trunk of the aortic arch, supplying the anterior surface and isthmus.

Venous drainage is carried out by the superior, middle and inferior thyroid veins, which form a venous plexus (*plexus thyroideus impar*). The superior and middle thyroid veins drain into the internal jugular veins (Fig. 7).

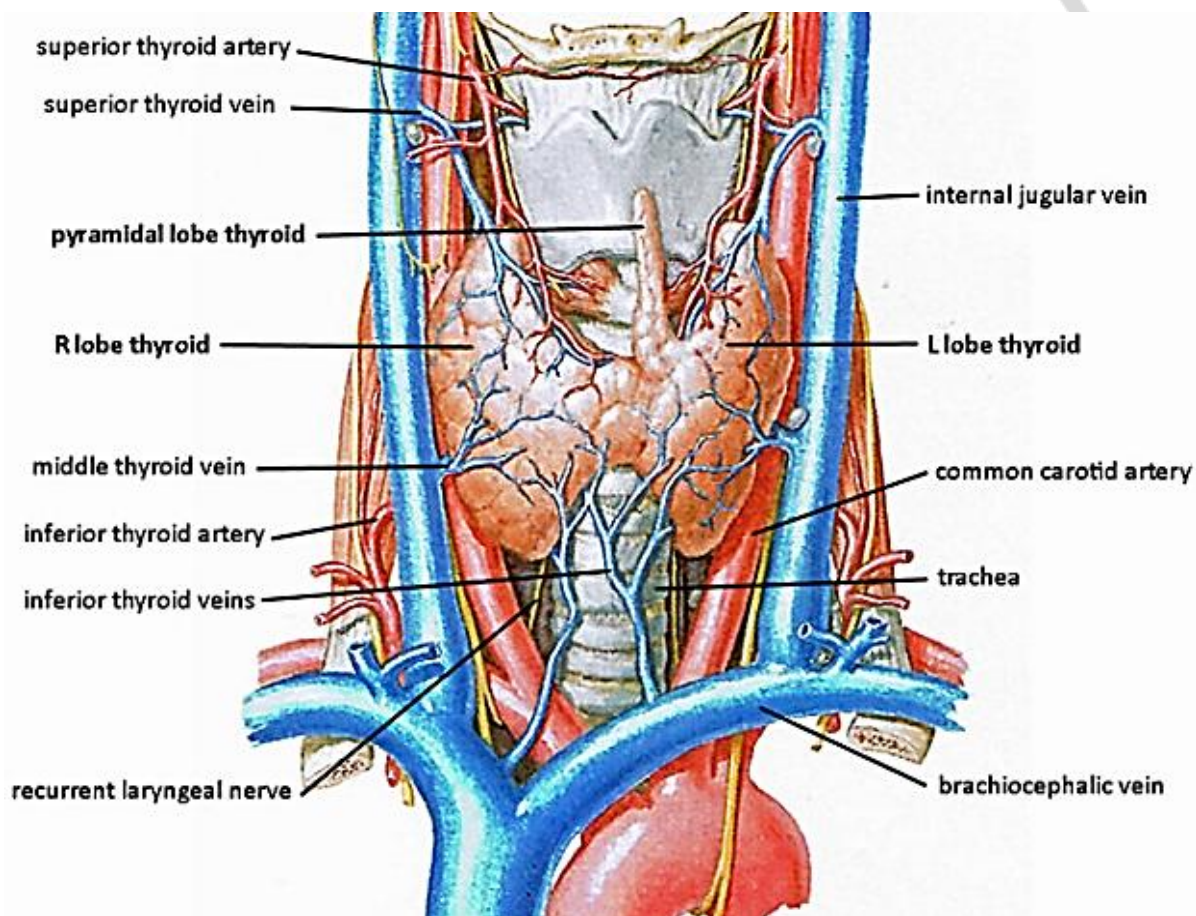


Figure 7. Blood supply of the thyroid gland

Nerve Supply: superior, middle, and inferior cervical sympathetic ganglia, vagus.

Lymph Drainage. The lymph from the thyroid gland drains mainly laterally into the deep cervical lymph nodes. A few lymph vessels descend to the paratracheal nodes.

All the nodes drain into the deep cervical nodes from where lymph passes to the jugular trunk. The jugular trunk enters the thoracic duct on the left and the right lymphatic duct on the right.

LARYNX

The larynx is an organ that provides a protective sphincter at the inlet of the air passages and is responsible for voice production. It is situated below the tongue and hyoid bone, between the major blood vessels of the neck, at the level of the 4th, 5th, and 6th cervical vertebrae. In children, it lies much

higher. In the elderly people its lower boundary reaches the level of the 7th cervical vertebra.

Above it opens into the laryngeal part of the pharynx, and below is continuous with the trachea. In front the larynx is covered by the infrahyoid strap muscles and at the sides by the thyroid gland. The framework of the larynx is formed by cartilages that are held together by ligaments joints and membranes, moved by muscles, and lined by the mucous membrane.

Blood Supply. *Upper* half of the larynx via the superior laryngeal branch of the superior thyroid artery.

Lower half of the larynx via the inferior laryngeal branch of the inferior thyroid artery.

Nerve supply. *Sensory Nerves:* above the vocal cords via the superior laryngeal nerve (branch of the vagus). Below the level of the vocal cords via the terminal part of the recurrent laryngeal nerve (inferior laryngeal nerve).

Motor Nerves: all the intrinsic muscles of the larynx except the cricothyroid muscle are supplied by the recurrent laryngeal nerve. The cricothyroid muscle is supplied by the superior laryngeal nerve of the vagus (Fig. 8).

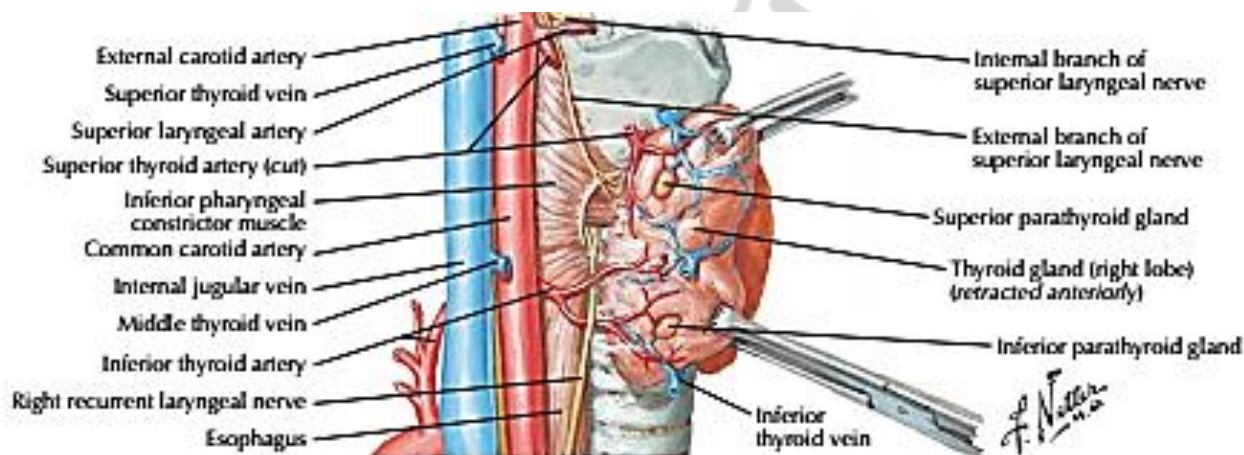


Figure 8. Nerve supply of the Larynx

Lymph Drainage. Lymphatic vessels of the larynx are divided into two groups: superior and inferior.

The superior vessels end in the superior deep cervical nodes. The inferior vessels reach the inferior deep cervical nodes. Some inferior vessels may end in the pretracheal and prelaryngeal nodes.

TRACHEA

The trachea is a mobile cartilaginous and membranous tube. It begins as a continuation of the larynx at the lower border of the cricoid cartilage at the level of the 6th cervical vertebra.

It descends in the midline of the neck. The fibroelastic tube is kept open by the presence of C-shaped cartilaginous rings of hyaline cartilage embedded in its wall.

Relations. *Anteriorly:* skin, fascia, isthmus of the thyroid gland (in front of the second, third, and fourth rings), inferior thyroid vein, jugular arch, thyroidea ima artery (if present), and the left brachiocephalic vein in children, overlapped by the sternothyroid and sternohyoid muscles.

Posteriorly: right and left recurrent laryngeal nerves and the esophagus.

Laterally: lobes of the thyroid gland and the carotid sheath with its contents.

Blood supply to the cervical part of the trachea via the branches of the inferior thyroid artery.

Nerve supply: by the recurrent laryngeal nerves.

Lymph drainage: pretracheal and paratracheal and the deep cervical nodes.

PHARYNX

The pharynx is located in the posterior part of the neck and extends from the base of the skull to the 6th cervical vertebra, where it continuous into the esophagus. On both sides of the lower part of the pharynx, thyroid gland lobes and common carotid arteries are located.

Blood supply: by the superior thyroid, pharyngeal ascending arteries (*branches of the external carotid artery*).

Nerve Supply: via pharyngeal plexus, which is formed by branches of the glossopharyngeal nerve, vagus nerve and sympathetic trunk.

Lymph drainage: the lymph vessels drain directly into the deep cervical nodes or indirectly, via the retropharyngeal or paratracheal nodes.

ESOPHAGUS

The esophagus is a muscular tube about 25 cm long, extending from the pharynx to the stomach. The length of the cervical part of the esophagus is 4.5–5 cm. It begins at the level of the cricoid cartilage, in front of the body of the 6th cervical vertebra and extends to the jugular notch of the sternum. It starts in the midline, but as it descends through the neck, it turns to the left side.

Relations in the neck. *Anteriorly:* the trachea. The tracheoesophageal groove is formed between the esophagus and the trachea; the recurrent laryngeal nerve ascends one on each side, in this groove.

Posteriorly: the prevertebral layer of the deep cervical fascia, the longus colli muscles, and the vertebral column.

Blood supply: by inferior thyroid arteries. The veins drain into the inferior thyroid veins.

Nerve Supply: via the recurrent laryngeal nerves and sympathetic trunks.

Lymph drainage: the lymph vessels drain into the deep cervical lymph nodes.

Lymph Node Levels of the Neck. The lymph nodes of the neck can be divided into seven levels:

– **Level I Submental and submandibular nodes** — below mylohyoid muscle and above the lower margin of the hyoid bone (or the carotid bifurcation).

– **Level II Upper jugular nodes** — between posterior belly of digastric muscles superiorly and hyoid bone inferiorly.

– **Level III Middle jugular nodes** — between the hyoid bone and cricoid cartilage.

– **Level IV Lower jugular nodes** — between the cricoid cartilage and the clavicle.

– **Level V Posterior cervical or accessory nodes** — within the posterior triangle (along the accessory nerves).

– **Level VI Visceral space lymph nodes** — midline group of cervical nodes from the hyoid bone to sternal manubrium that includes prelaryngeal, pretracheal, and paratracheal nodes.

– **Level VII: Superior mediastinal nodes** — between the carotid arteries, below the superior border of the sternum to the brachiocephalic vein inferiorly.

TRACHEOSTOMY

Tracheostomy (tracheotomy) — creation of an opening in the anterior tracheal wall for insertion of a tube to relieve upper airway obstruction and facilitate ventilation.

Tracheostomy (tracheotomy) is one of the oldest surgical procedures known, with the first references 3000 to 4000 years ago.

Indications for tracheotomy are multiple and include the need to bypass the airway obstruction (asphyxia), caused by:

- benign or malignant laryngeal tumor;
- inflammatory diseases;
- vocal cord paralysis;
- congenital anomaly;
- laryngotracheal trauma, facial trauma;
- foreign object.

Additional indications for tracheotomy include the need to provide an airway for patients receiving mechanical ventilation for respiratory failure and for those with chronic aspiration secondary to inadequate cough. Tracheotomy may also allow for a more secure and comfortable airway for home ventilation in patients with neuromuscular or other chronic diseases.

Tracheostomy Classification:

- upper — an opening of the trachea above the isthmus of the thyroid gland;
- middle — at the level of the isthmus after its incision;
- lower — below the isthmus.

Instruments (in addition to common ones):

- single-toothed sharp tracheal hook by Shassaingnac;
- tracheal dilator Trousseau;
- tracheostomy tube (Luer's cannula).

Upper Tracheostomy Operative Technique. Steps of Procedure.

1. Anaesthesia (local or general).
2. Position the patient on the table with the extended neck.
3. Make an incision (6–8 cm) passing down from the inferior border of the thyroid cartilage, strictly at the neck midline (or make a horizontal skin incision midway between the cricoid cartilage and jugular notch).
4. Make an incision through skin and subcutaneous tissues. Superficial veins are ligated.
5. Identify midline raphe (“linea alba” of the neck) and cut it.
6. Retract muscles laterally.
7. Identify the isthmus of the thyroid and retract it inferiorly.
8. Identify the trachea.
9. Fix the first tracheal ring by a single-toothed sharp tracheal hook by Shsaignac (an alternative method is to place a 2-0 monofilament suture through the tracheal cartilage and use that for retraction).
10. Make a transvers incision in the anterior tracheal wall between the second and third tracheal rings (or vertical incision in the anterior tracheal wall through the second and third tracheal rings).
11. Introduce tracheal dilator into the trachea. A tracheostomy tube is introduced by the following three steps: sagittally; frontally; down.
12. Ensure haemostasis, close the wound.
13. Fix the tracheostomy tube to the neck.

Complications. Most complications result from not adequately palpating and recognizing the thyroid, cricoid, and tracheal cartilages and not confining the incision strictly to the midline:

- Hemorrhage: the anterior jugular veins located in the superficial fascia close to the midline should be avoided. If the isthmus of the thyroid gland is transected, secure the anastomosing branches of the superior and inferior thyroid arteries that cross the midline on the isthmus.
- Nerve paralysis: the recurrent laryngeal nerves may be damaged as they ascend the neck in the groove between the trachea and the esophagus.
- Pneumothorax: the cervical dome of the pleura may be pierced. This is especially common in children because of the high level of the pleura in the children’s neck.
- Esophageal injury: damage to the esophagus, located immediately posterior to the trachea.

CRICOTHYROIDOTOMY

In cricothyroidotomy (cricothyrotomy), a tube is inserted in the interval between the cricoid cartilage and the thyroid cartilage. A cricothyrotomy is generally performed by making a vertical incision on the skin of the neck just below the laryngeal prominence (Adam’s apple), then making another incision in the cricothyroid membrane, which lies deep to this point. The incision is made

through the following structures: the skin, the superficial fascia, the investing layer of deep cervical fascia, the pretracheal fascia (separate the sternohyoid muscles and incise the fascia), and the laryngeal wall. The cricothyroid membrane is cut and the tube is inserted (Fig. 9).

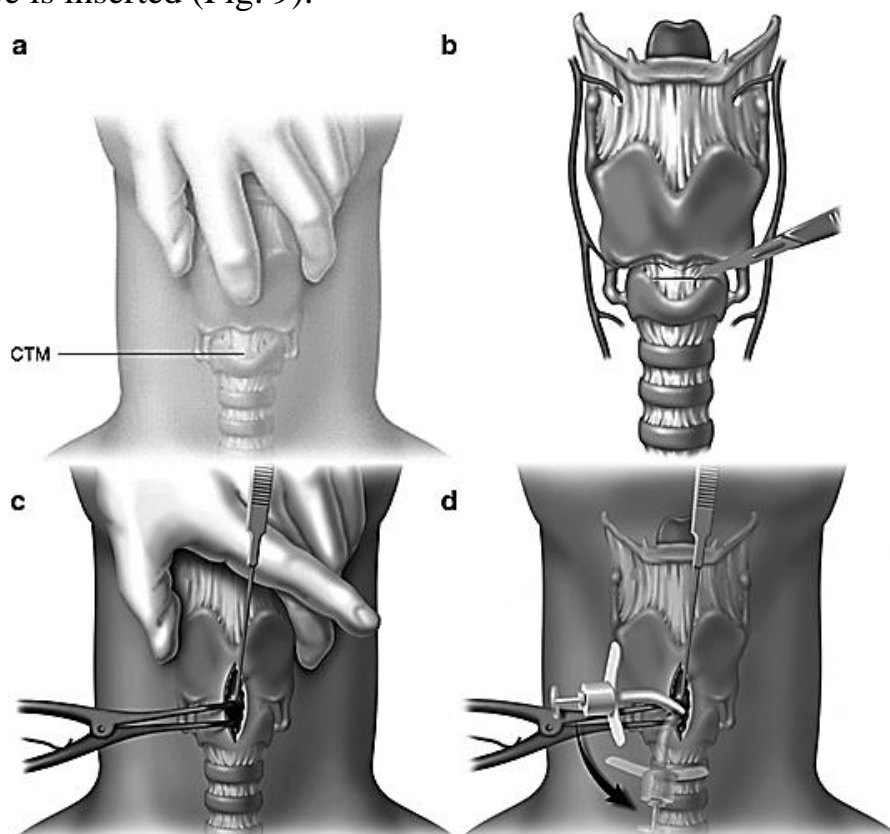


Figure 9. Cricothyrotomy

A needle cricothyrotomy is performed in the similar way, but instead of making a scalpel incision, a large over-the-needle catheter is inserted (10- to 14-gauge). This is a much simpler procedure, particularly if to use specially designed kits.

THYROID GLAND SURGERY

Indications:

- thyroid gland tumors;
- hyperthyroidism.

Types of thyroid surgery:

- lobectomy (removes only one of the two lobes);
- subtotal thyroidectomy (removes the thyroid gland but leaves a small amount of thyroid tissue near the parathyroid gland. This preserves some thyroid function);
- total thyroidectomy (removes the entire thyroid gland and the thyroid tissue. This surgery is appropriate when nodules, swelling, or inflammation affects the entire thyroid gland, or when cancer is present).

Steps of Procedure:

1. Anaesthesia (local or general).
2. Position the patient on the table with the extended neck.
3. Make a collar incision (the incision should be done in a curvilinear fashion within a skin crease approximately 2 cm or 2 finger-breadths above the superior edge of the clavicle and sternal notch, between the anterior margins of the sternocleidomastoid muscles).
4. Make incision through the subcutaneous fat to the platysma.
5. Identify the cervical linea alba and the strap muscles (sternohyoid and sternothyroid).
6. Release the superior pole of the thyroid gland.
7. Identify the parathyroid glands on the posterior aspect of the thyroid lobe.
8. Identify the recurrent laryngeal nerves,
9. Remove the thyroid gland.
10. Obtain hemostasis in the thyroid bed.
11. Close the wound in layers.

Alternative techniques/methods:

- minimally invasive video-assisted thyroidectomy (the approach uses endoscopes and endoscopic instrumentation through a 15–20 mm incision);
- robotic-assisted thyroidectomy (using a 4–6 cm axillary incision and an 8 mm medial skin incision. The surgeon introduces robotic arms to perform the thyroidectomy and then follows the same steps as during a conventional thyroidectomy).

Complications:

- injury to the recurrent laryngeal nerve;
- bleeding in the neck;
- infection;
- vocal cord motion abnormalities (voice change);
- hypoparathyroidism — or low blood levels of calcium can occur if the parathyroids are injured or removed;
- tracheal/esophageal injury.

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