

# ANATOMY

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# ANATOMY

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NECK

AREAS	BONES	ORGANS	MUSCLES	NERVES	VESSELS	OTHER
<ul style="list-style-type: none"> <li>• Anterior Triangle</li> <li>• Posterior Triangle</li> </ul>	<ul style="list-style-type: none"> <li>• Cervical Spine</li> <li>• Hyoid Bone</li> </ul>	<ul style="list-style-type: none"> <li>• Pharynx</li> <li>• Larynx</li> <li>• Oesophagus</li> <li>• Thyroid Gland</li> <li>• Parathyroid Glands</li> </ul>	<ul style="list-style-type: none"> <li>• Suboccipital</li> <li>• Suprahyoids</li> <li>• Infrahyoids</li> <li>• Scalenes</li> </ul>	<ul style="list-style-type: none"> <li>• Phrenic Nerve</li> <li>• Cervical Plexus</li> </ul>	<ul style="list-style-type: none"> <li>• Arterial Supply</li> <li>• Venous Drainage</li> <li>• Lymphatics</li> </ul>	<ul style="list-style-type: none"> <li>• Fascial Layers</li> </ul>

# Neck

# NECK

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Organs of the Neck

# Organs of the Neck

## ORGANS

- PHARYNX
- LARYNX
- OESOPHAGUS
- THYROID GLAND
- PARATHYROID GLANDS

# PHARYNX

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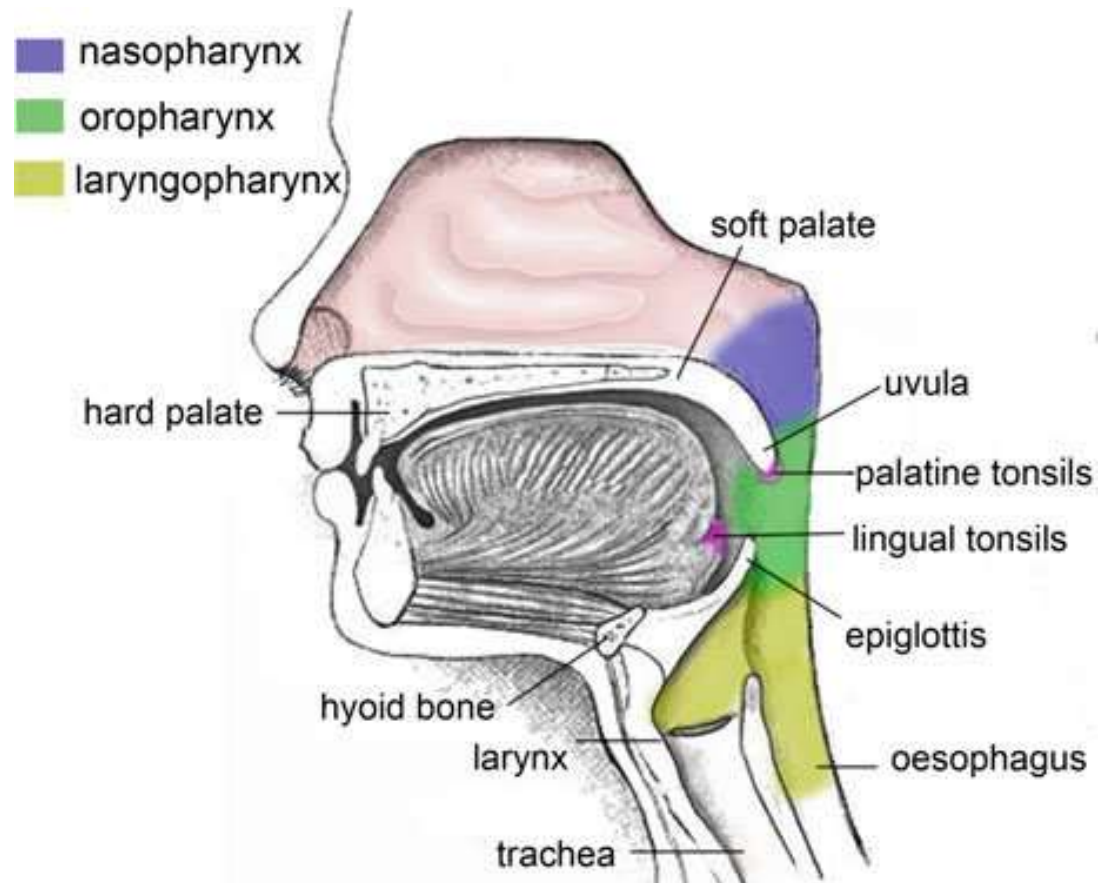
# PHARYNX

The **pharynx** is a muscular tube that connects the oral and nasal cavity to the larynx and oesophagus.

- It begins at the base of the skull, and ends at the inferior border of the **cricoid cartilage** (C6). The pharynx is comprised of three parts (superior to inferior):
- Nasopharynx
- Oropharynx
- Laryngopharynx.
- In this article, we shall look at the **anatomy of the pharynx** – its structure, neurovascular supply, and any clinical correlations.

# PHARYNX

Division





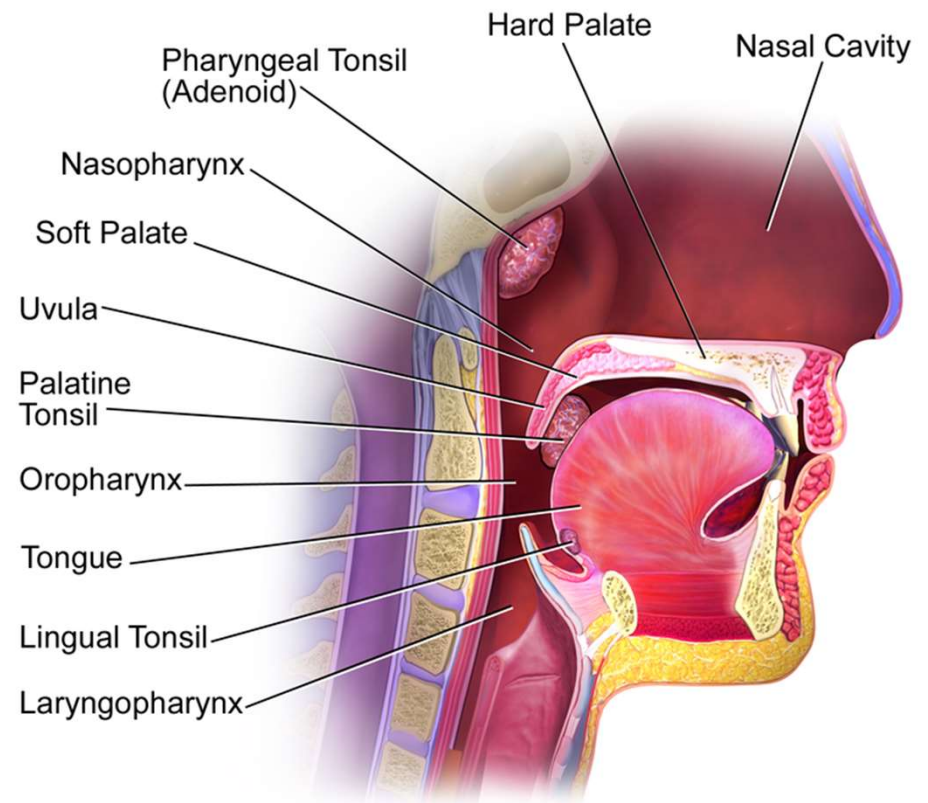
# PHARYNX

## Nasopharynx

- The **nasopharynx** is found between the base of the skull and the soft palate. It is continuous with the nasal cavity, and performs a respiratory function by conditioning inspired air and propagating it into the larynx.
- This part of the pharynx is lined with **respiratory epithelium**; ciliated pseudostratified columnar epithelium with goblet cells.
- The posterosuperior nasopharynx contains the **adenoid tonsils**, which enlarge between 3-8 years of age and then regress.

# PHARYNX

Soft Palate



Tonsils and Throat



# PHARYNX

## Clinical Relevance: Enlarged Adenoid Tonsils

- The **adenoid tonsils** can become pathologically enlarged due to viral infections of the upper respiratory tract. In the case of recurrent infections, they can become chronically enlarged. When enlarged, the adenoids can obstruct the opening of the Eustachian tube – which is located close to the adenoid tonsils in the nasopharynx.
- Chronic obstruction of the Eustachian tube prevents the equalising of pressure in the middle ear with the atmosphere and normal drainage of fluid. This can lead to chronic otitis media with effusion, colloquially known as **glue ear**. In this condition, the static fluid and negative pressure in the middle ear provide the ideal environment for infection.

# PHARYNX

## Oropharynx

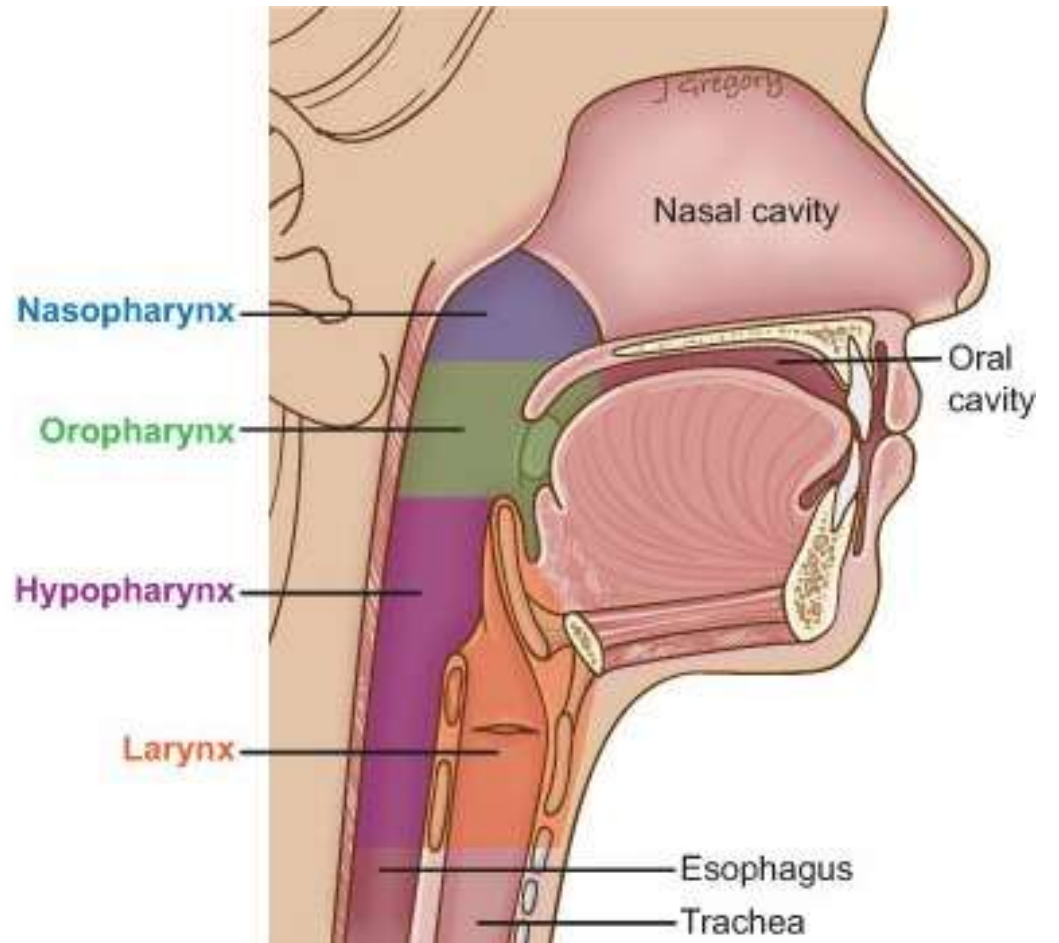
- The **oropharynx** is the middle part of the pharynx, located between the soft palate and the superior border of the epiglottis.

It contains the following structures:

- Posterior 1/3 of the tongue.
- Lingual tonsils – lymphoid tissue at the base of the tongue.
- Palatine tonsils – lymphoid tissue located in the tonsillar fossa (between the palatoglossal and palatopharyngeal arches of the [oral cavity](#)).
- Superior constrictor muscle
- **Waldeyer's ring** is the ring of lymphoid tissue in the naso- and oropharynx formed by the paired palatine tonsils, the adenoid tonsils and lingual tonsil.
- The oropharynx is involved in the voluntary and involuntary phases of **swallowing**.

Pharynx

Oropharynx



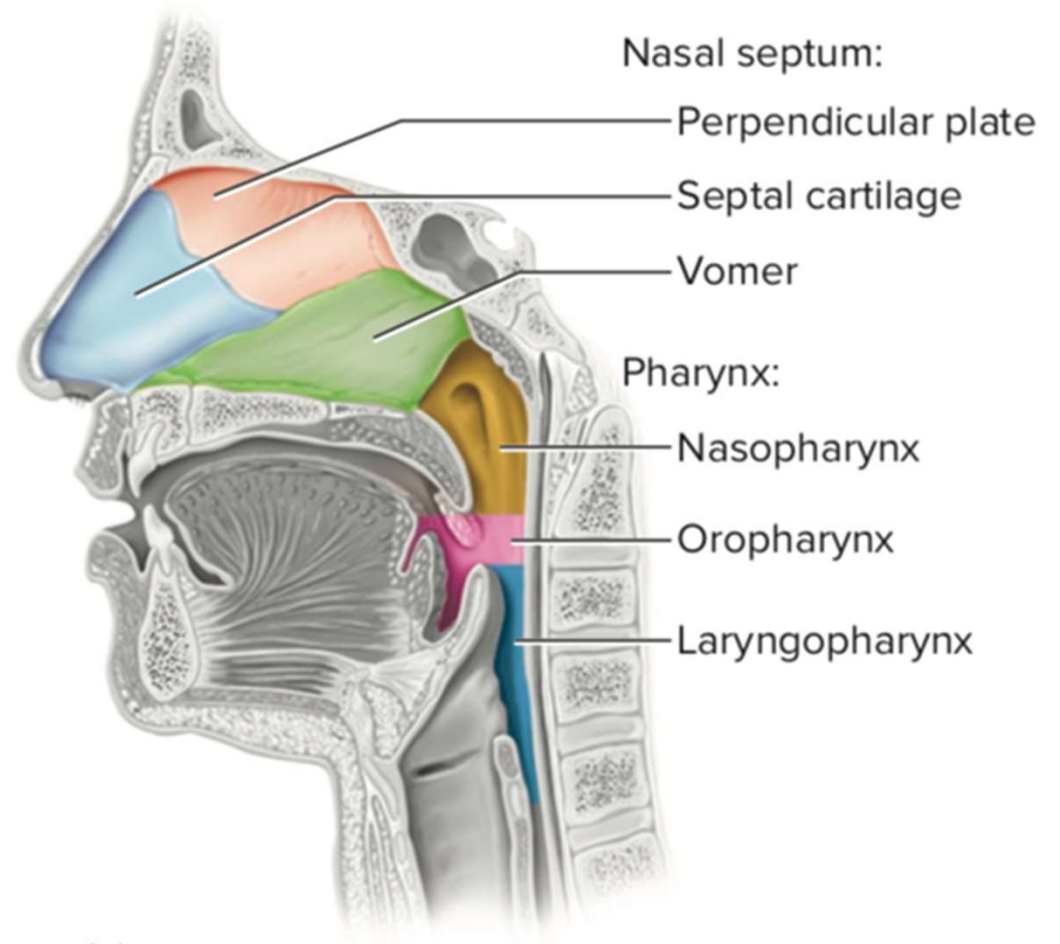
# PHARYNX

## Laryngopharynx

- The most distal part of the pharynx, the **laryngopharynx** is located between the superior border of the epiglottis and inferior border of the cricoid cartilage (C6). It is continuous inferiorly with the oesophagus.
- It is found posterior to the larynx and communicates with it via the laryngeal inlet, lateral to which one can find the **piriform fossae**.
- The laryngopharynx contains the middle and inferior **pharyngeal constrictors**.

# Pharynx

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# PHARYNX

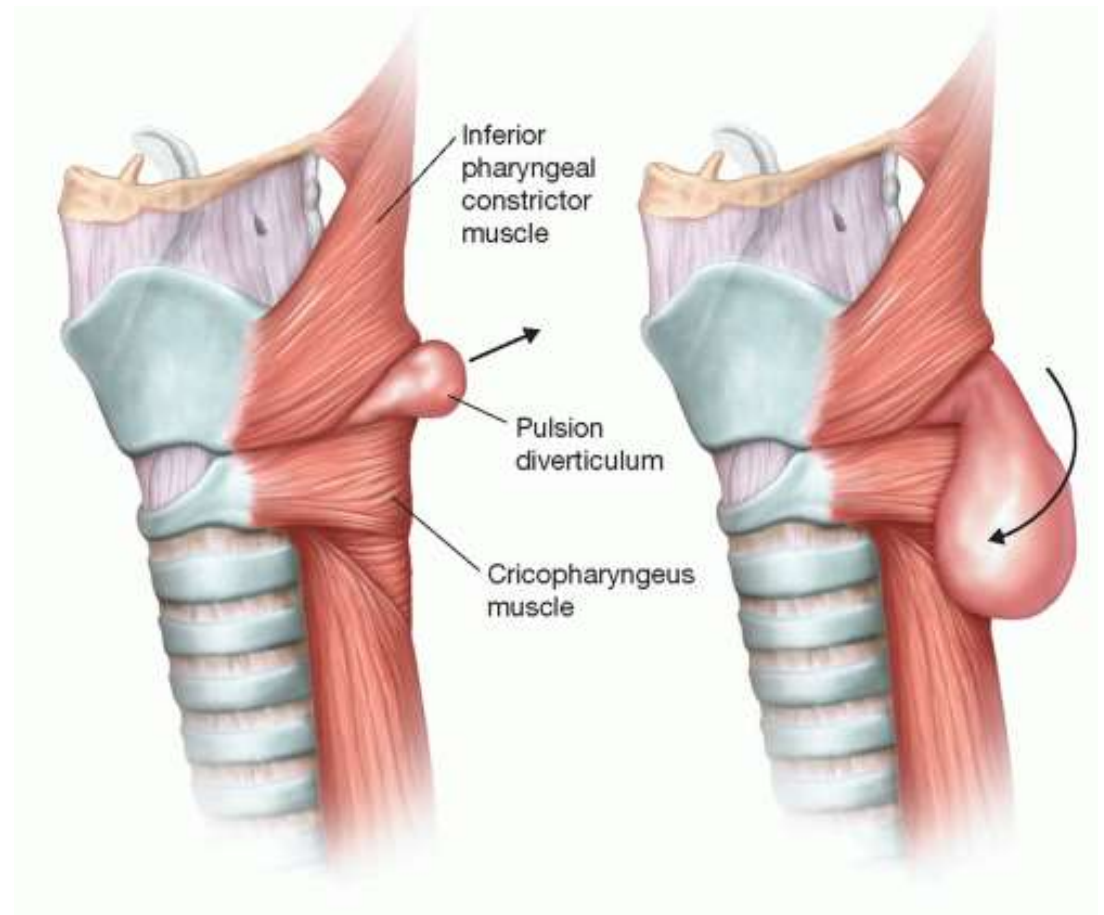
## Clinical Relevance: Pharyngeal Diverticulum (Pouch)

- The **inferior pharyngeal constrictor** is split into two parts; the Thyropharyngeus and the Cricopharyngeus. This area between the two is a weak area in the mucosa.
- Normally during **swallowing**, the Thyropharyngeus contracts as the Cricopharyngeus relaxes, allowing the bolus of food to be propelled into the oesophagus and preventing the Intraparyngeal pressure from rising.
- If this coordinated relaxation of the Cricopharyngeus does not occur, the intraparyngeal pressure tends to rise and pharyngeal mucosa forms a **midline diverticulum** in the area between the Thyropharyngeus and Cricopharyngeus. It is possible for food to accumulate here, leading to dysphagia.



# PHARYNX

## Pharyngeal Diverticulum



# PHARYNX

## Muscles

- There are two main groups of **pharyngeal muscles**; longitudinal and circular.
- The muscles of the pharynx are mostly innervated by the **vagus nerve** – the only exception being the Stylopharyngeus (glossopharyngeal nerve).

# PHARYNX

## Circular

- There are three circular pharyngeal constrictor muscles; the superior, middle and inferior **pharyngeal constrictors**. They are stacked like glasses, which form an incomplete muscular circle as they attach anteriorly to structures in the neck.
- The circular muscles contract **sequentially** from superior to inferior to constrict the lumen and propel the bolus of food inferiorly into the oesophagus.

# PHARYNX

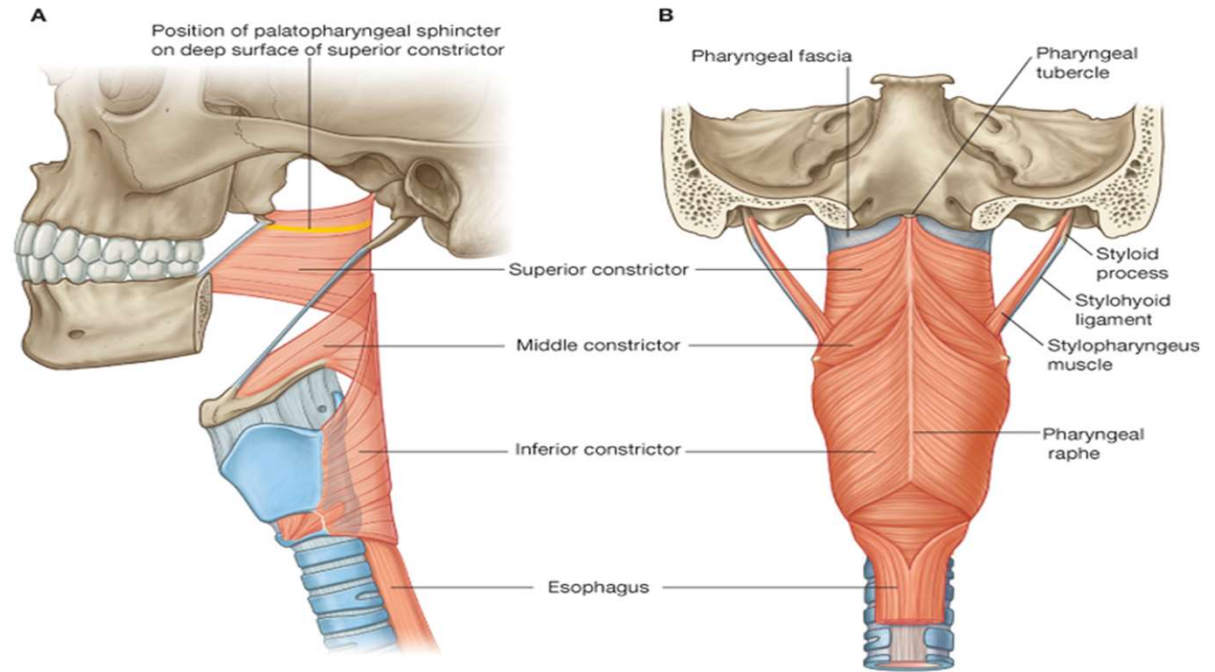
**Superior pharyngeal constrictor** – The uppermost pharyngeal constrictor. It is located in the oropharynx.

Originates from the pterygomandibular ligament, alveolar process of mandible and medial pterygoid plate and pterygoid hamulus of the sphenoid bone.

- Inserts posteriorly into to the pharyngeal tubercle of the occiput and the median pharyngeal raphe.

# Pharynx

## Superior Pharyngeal constrictor



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# PHARYNX

**Middle pharyngeal constrictor** – located in the laryngopharynx.

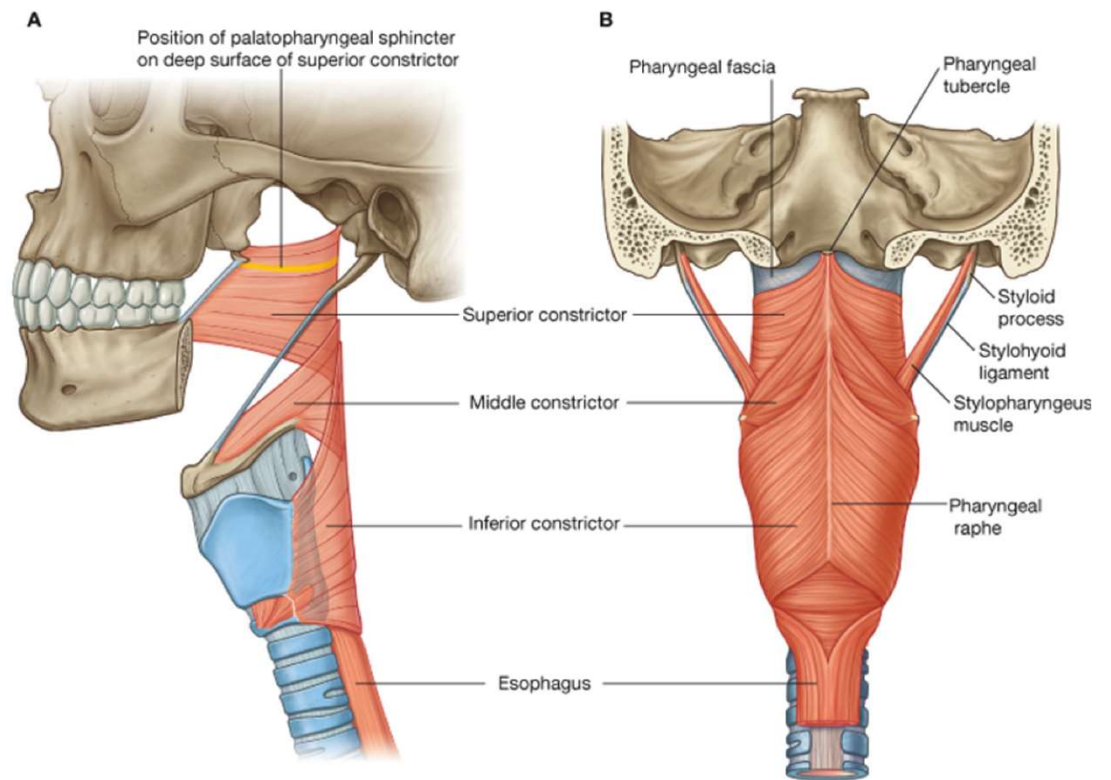
- Originates from the stylohyoid ligament and the horns of the hyoid bone.
- Inserts posteriorly into the pharyngeal raphe.

**Inferior pharyngeal constrictor** – located in the laryngopharynx. It has two components:

- Superior component (thyropharyngeus) has oblique fibres that attach to the thyroid cartilage.
  - Inferior component (cricopharyngeus) has horizontal fibres that attach to the cricoid cartilage.
- All pharyngeal constrictors are innervated by the **vagus nerve (CN X)**.

# Pharynx

## Middle Constrictor

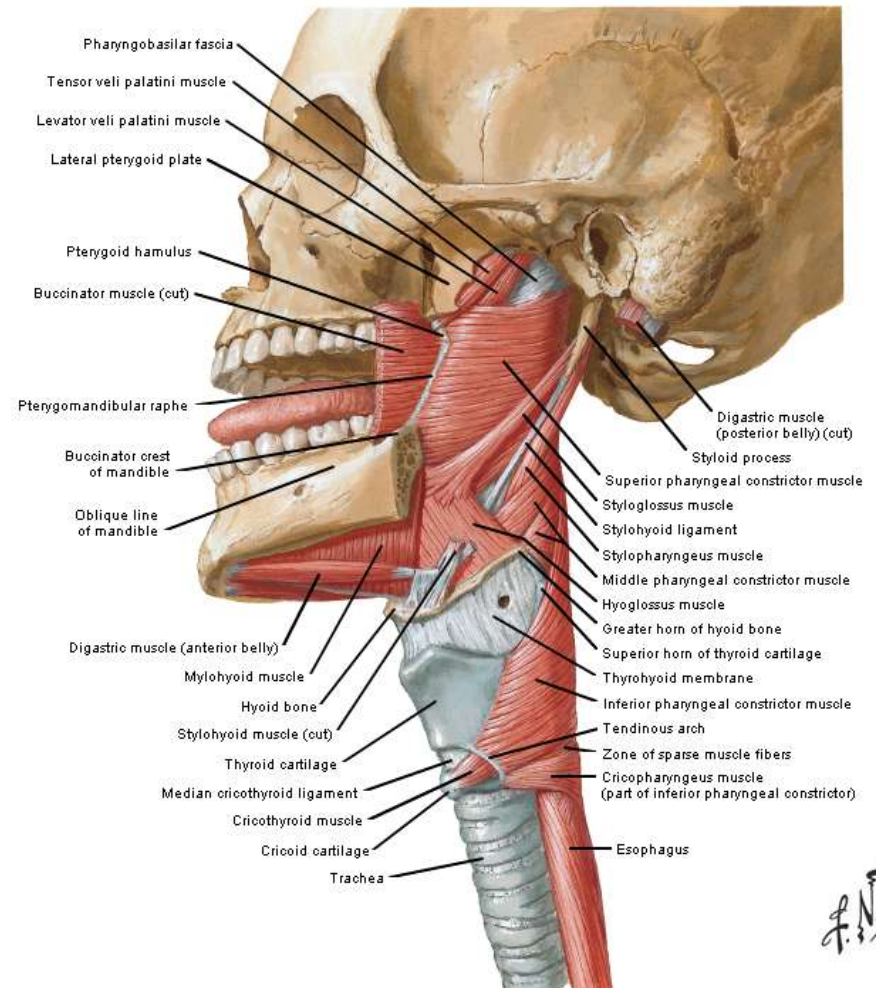


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# PHARYNX

## Constrictors

### Muscles of Pharynx: Lateral View



*F. Netter M.D.*  
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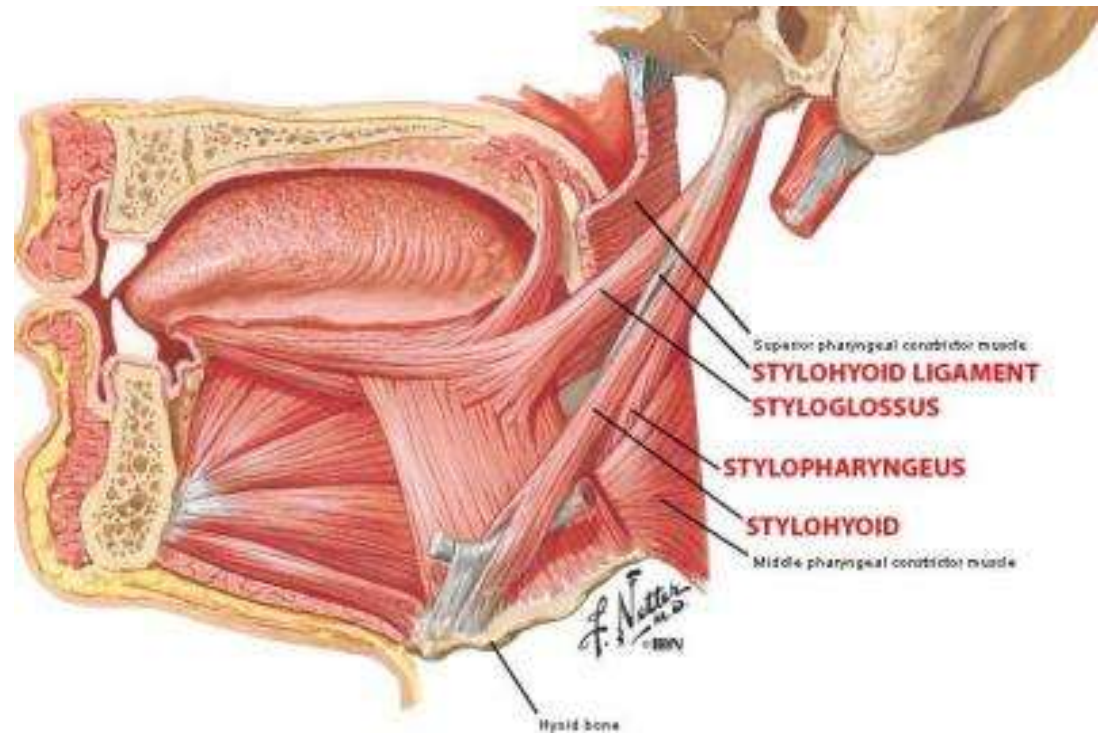
# PHARYNX

## Longitudinal

- The **longitudinal muscles** are the stylopharyngeus, palatopharyngeus and salpingopharyngeus. They act to shorten and widen the pharynx, and elevate the larynx during swallowing.
- **Stylopharyngeus** – arises from the styloid process of the temporal bone, inserts into the pharynx.
  - Unlike the other pharyngeal muscles, it is innervated by the glossopharyngeal nerve (CN IX).
- **Palatopharyngeus** – arises from hard palate of the oral cavity, inserts into the pharynx.
  - Innervated by the vagus nerve (CN X).
- **Salpingopharyngeus** – arises from the Eustachian tube, inserts into the pharynx.
  - Innervated by the vagus nerve (CN X).
  - In addition to contributing to swallowing, it also opens the Eustachian tube to equalise the pressure in the middle ear.

Pharynx

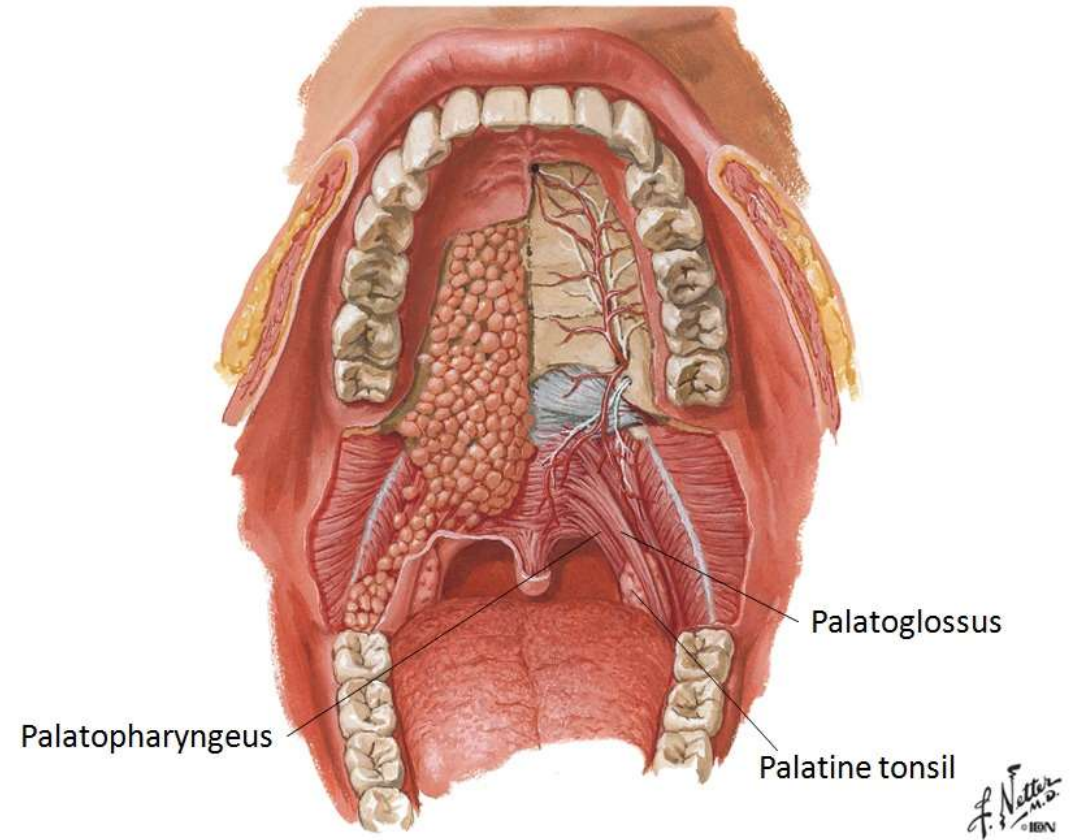
Stylopharynx



Pharynx

Palatopharyngeus

Roof of Mouth - Hard and Soft Palates  
Anterior View



# PHARYNX

## Innervation

- Motor and sensory innervation of the majority of the pharynx (except nasopharynx) is achieved by the **pharyngeal plexus**.
- The pharyngeal plexus, which mainly overlies the middle pharyngeal constrictor, is formed by:
  - Pharyngeal branches from the **glossopharyngeal** nerve (CN IX).
  - Pharyngeal branch of the **vagus** nerve (CN X).
  - Branches from the external laryngeal nerve.
  - Sympathetic fibres from the superior cervical ganglion.

# PHARYNX

## Sensory

- Each of the three sections of the pharynx have a different sensory innervation:

Nasopharynx	Maxillary nerve (CN V2)
Oropharynx	Glossopharyngeal nerve (CN IX)
Laryngopharynx	Vagus nerve (CN X)

# PHARYNX

## Motor

- All the muscles of the pharynx are innervated by the **vagus nerve** (CN X), except for the Stylopharyngeus, which is innervated by the glossopharyngeal nerve (CN IX).

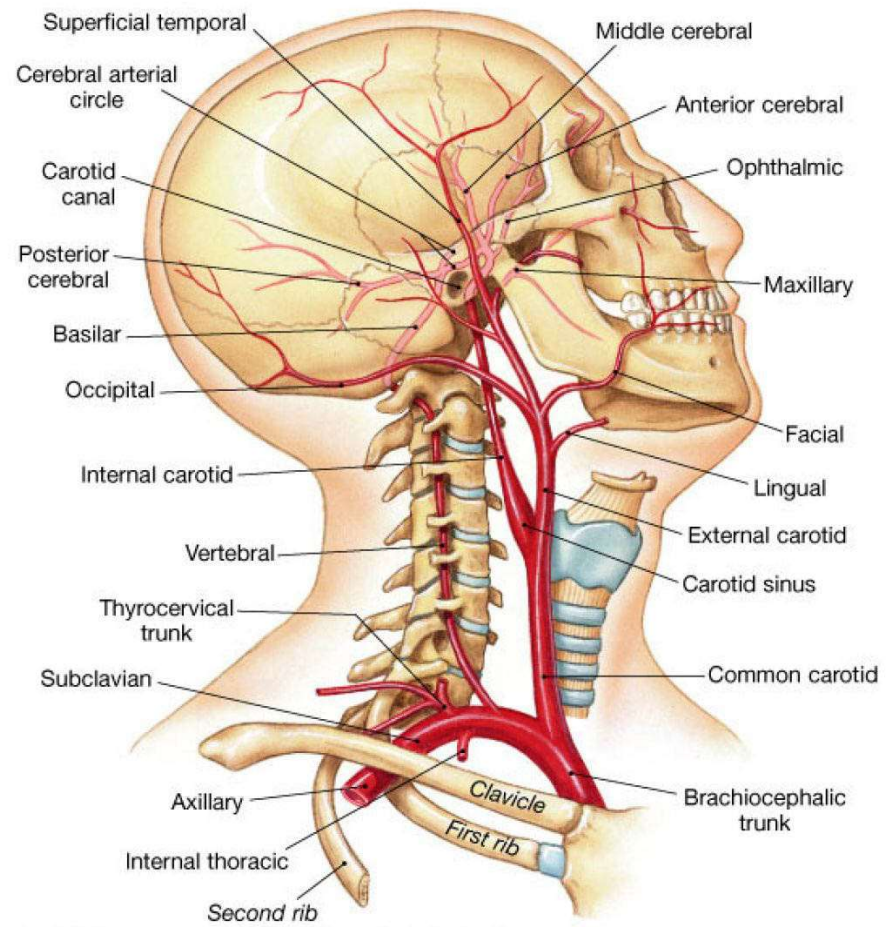
# PHARYNX

## Vasculature

- Arterial supply to the pharynx is via branches of the **external carotid** artery:
- Ascending pharyngeal artery
- Branches of the facial artery
- Branches of the lingual and maxillary arteries.
- Venous drainage is achieved by the **pharyngeal venous plexus**, which drains into the internal jugular vein.

# PHARYNX

## Vasculature







# NECK

## ORGANS

- PHARYNX
- LARYNX
- OESOPHAGUS
- THYROID GLAND
- PARATHYROID GLANDS

# NECK

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LAYRNX

# LARYNX

## **Contents**

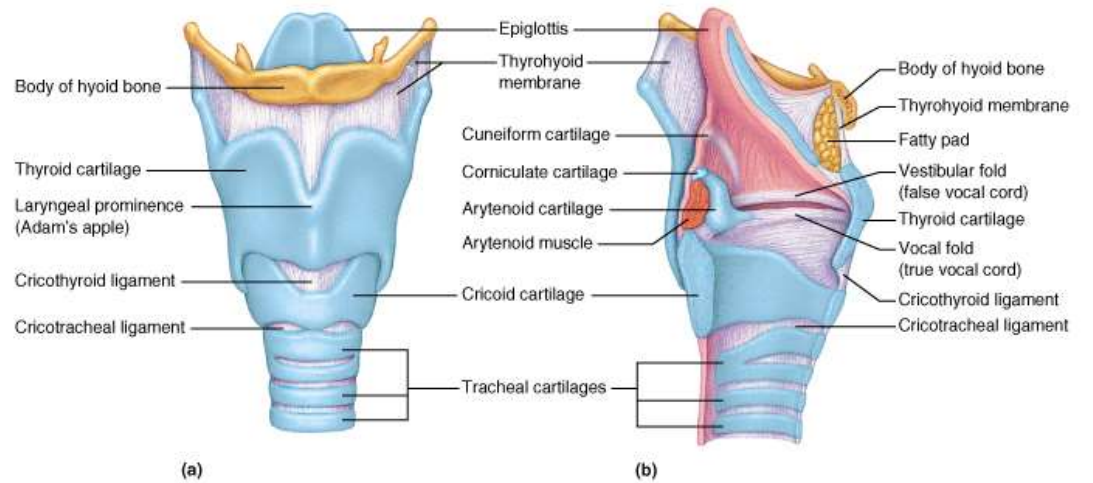
- 1 Anatomical Position and Relations
- 2 Anatomical Structure
- 3 Vasculature
- 4 Innervation
- 5 Clinical Relevance: Vocal Cord Paralysis

# LARYNX

- The **larynx** (voice box) is an organ located in the anterior neck. It is a component of the respiratory tract, and has several important functions, including phonation, the cough reflex, and protection of the lower respiratory tract.
- The structure of the larynx is primarily Cartilaginous, is held together by a series of ligaments and membranes. Internally, the laryngeal muscles move components of the larynx for **phonation** and breathing.
- In this article, we will discuss the **anatomy of the larynx** – its location, structure, vasculature and innervation. We shall also consider its clinical relevance.

# LARYNX

## Structure



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# LARYNX

## Anatomical Structure

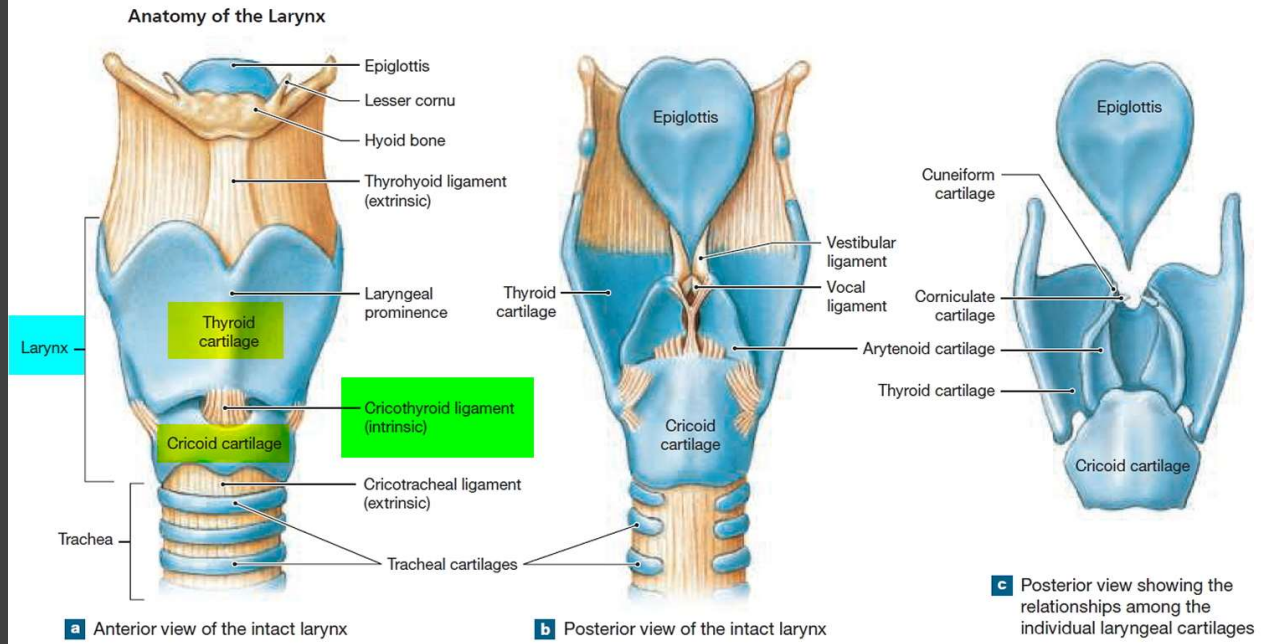
- The larynx is formed by a cartilaginous skeleton, which is held together by ligaments and membranes. The laryngeal muscles act to move the components of the larynx for phonation and breathing. *More information about each of these structures can be found in their respective sections.*

Anatomically, the internal cavity of the larynx can be divided into three sections:

- **Supraglottis** – From the inferior surface of the epiglottis to the vestibular folds (false vocal cords).
- **Glottis** – Contains vocal cords and 1cm below them. The opening between the vocal cords is known as rima glottidis, the size of which is altered by the muscles of phonation.
- **Subglottis** – From inferior border of the glottis to the inferior border of the cricoid cartilage.
- The interior surface of the larynx is lined by **pseudostratified ciliated columnar epithelium**. An important exception to this is the true vocal cords, which are lined by a stratified squamous epithelium.

# Larynx

## Anatomical Structure





# LARYNX

## Vasculature

- The arterial supply to the larynx is via the superior and inferior laryngeal arteries:
- **Superior laryngeal artery** – a branch of the superior thyroid artery (derived from the external carotid). It follows the internal branch of the superior laryngeal nerve into the larynx.
- **Inferior laryngeal artery** – a branch of the inferior thyroid artery (derived from the thyrocervical trunk). It follows the recurrent laryngeal nerve into the larynx.
- Venous drainage is by the **superior and inferior laryngeal veins**. The superior laryngeal vein drains to the internal jugular vein via the superior thyroid, whereas the inferior laryngeal vein drains to the left brachiocephalic vein via the inferior thyroid vein.



# LARYNX

Vasculature

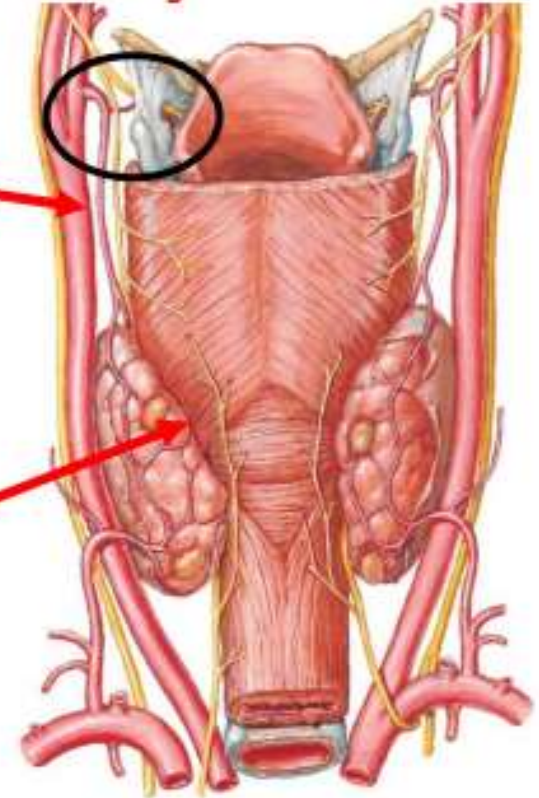
## Vessels of Larynx

Superior laryngeal a  
ECA – Superior  
thyroid

Accompanies the  
internal br. of  
superior laryngeal n.

Inferior laryngeal a  
Thyrocervical trunk  
– Inferior thyroid a

Accompanies the  
inferior laryngeal n.



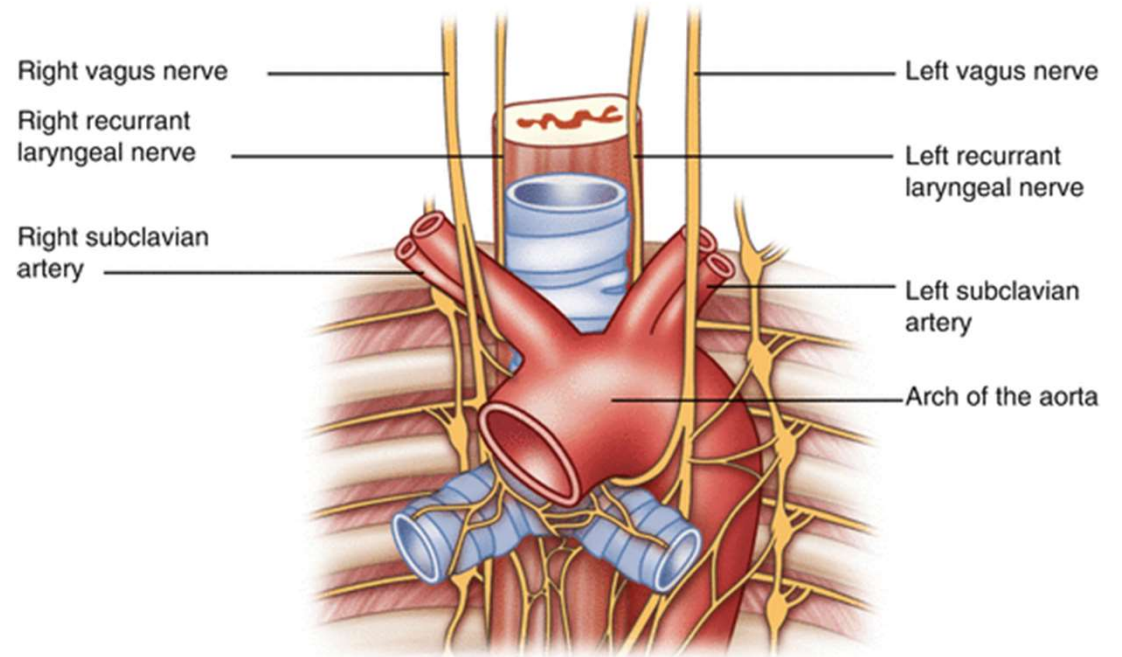
# LARYNX

## Innervation

- The larynx receives both motor and sensory innervation via branches of the **vagus nerve**:
- **Recurrent laryngeal nerve** – provides sensory innervation to the infraglottis, and motor innervation to all the internal muscles of larynx (except the cricothyroid).
- **Superior laryngeal nerve** – the internal branch provides sensory innervation to the supraglottis, and the external branch provides motor innervation to the cricothyroid muscle.

# Larynx

## Recurrent Laryngeal Nerve

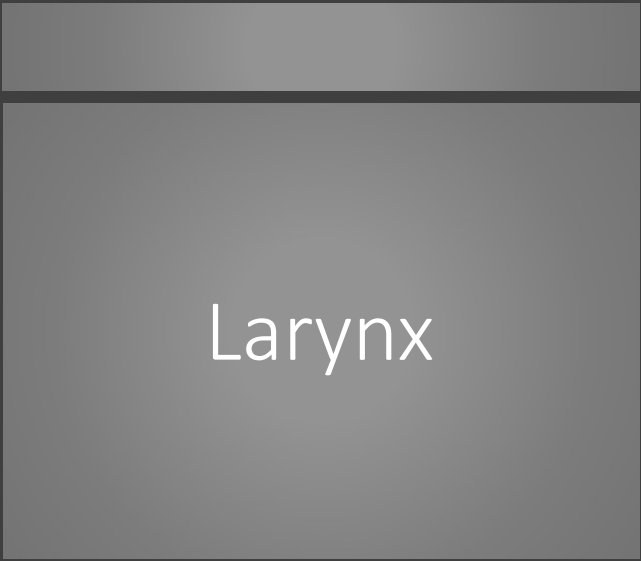




# LARYNX

## Clinical Relevance: Vocal Cord Paralysis

- The **vocal cords** are responsible for the production of speech. Their movement is controlled by the intrinsic muscles of the larynx – the majority of which are innervated by the recurrent laryngeal nerve (an exception is the cricothyroid muscle; innervated by the external laryngeal nerve).
- Due to its long course, the **recurrent laryngeal nerve** is susceptible to damage. Causes of RLN palsy include:
  - Apical lung tumour
  - Thyroid cancer
  - Aortic aneurysm
  - Cervical lymphadenopathy
  - Iatrogenic (particularly during thyroid surgery due to the close relationship with the inferior thyroid artery).



Laryngeal Cartilage

# LARYNX

## LARYNGEAL CARTILAGES

- The larynx (voice box) is an organ located in the anterior neck. It is a component of the respiratory tract, and has several important functions, including phonation, the cough reflex, and protection of the lower respiratory tract.
- There are nine cartilages located within the larynx; three unpaired, and six paired. They form the laryngeal skeleton, which provides rigidity and stability. In this article, we shall examine the anatomy of the laryngeal cartilages



# LARYNX

## Unpaired Cartilages

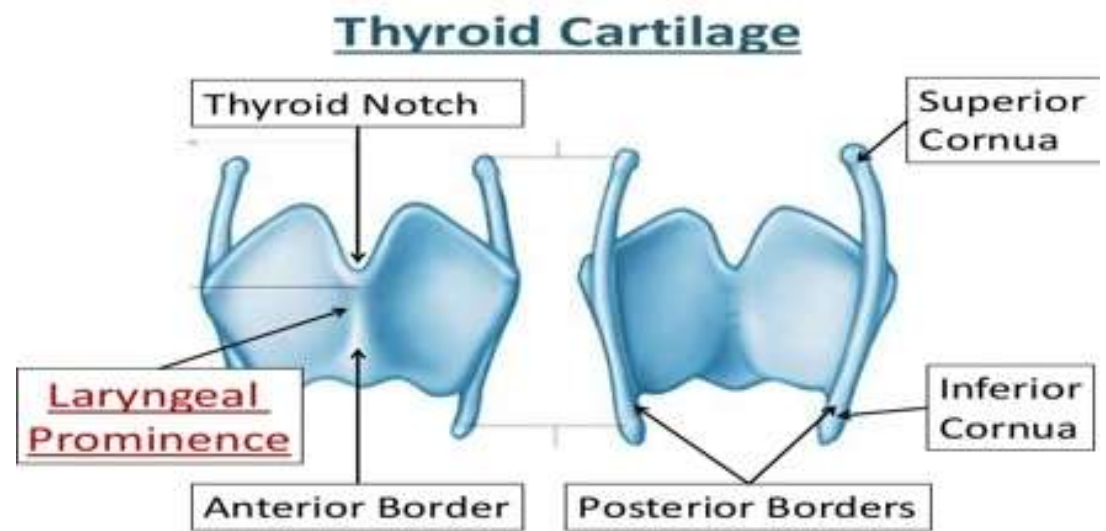
- The three unpaired cartilages are the **Epiglottis**, **Thyroid** and **Cricoid** cartilages.

### Thyroid Cartilage

- The thyroid cartilage is a large, prominent structure which is easily visible in adult males. It is composed of two sheets (laminae), which join together anteriorly to form the **laryngeal prominence** (Adam's apple).
- The posterior border of each sheet project superiorly and inferiorly to form the **superior** and **inferior horns** (also known as cornu). The superior horns are connected to the hyoid bone via the lateral thyrohyoid ligament, while the inferior horns articulate with the cricoid cartilage.

# Larynx

Thyroid cartilage







# LARYNX

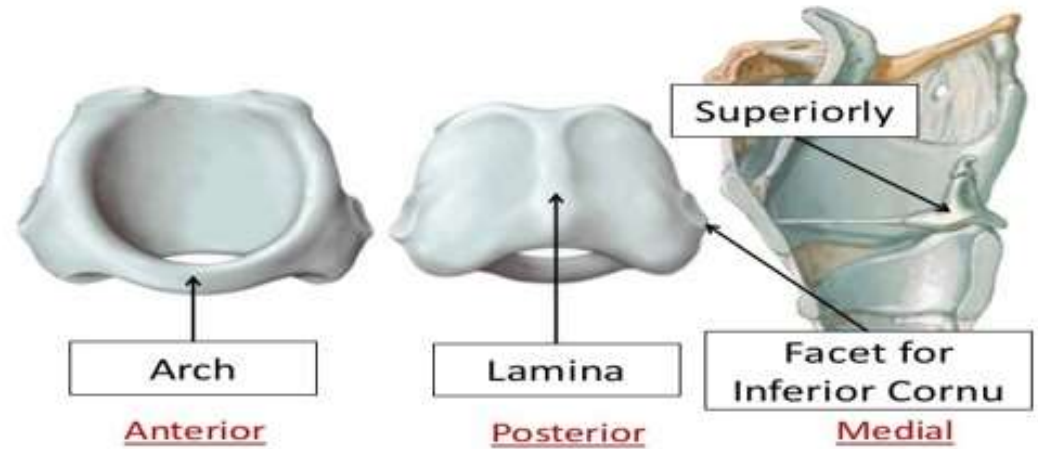
## Cricoid Cartilage

- The cricoid cartilage is a complete ring of **hyaline** cartilage, consisting of a broad sheet posteriorly and a much narrower arch anteriorly (said to resemble a signet ring in shape).
- The cartilage completely encircles the airway, marking the inferior border of the larynx at the level of C6. It articulates with the paired **arytenoid cartilages** posteriorly, as well as providing an attachment for the inferior horns of the thyroid cartilage.
- The cricoid is the only **complete** circle of cartilage in the larynx or trachea. This is of clinical relevance during emergency intubation – as pressure can be applied to the cricoid to occlude the oesophagus, and thus prevent regurgitation of gastric contents (known as cricoid pressure or Sellick's manoeuvre).

# LARYNX

## Cricoid Cartilage

### Cricoid Cartilage



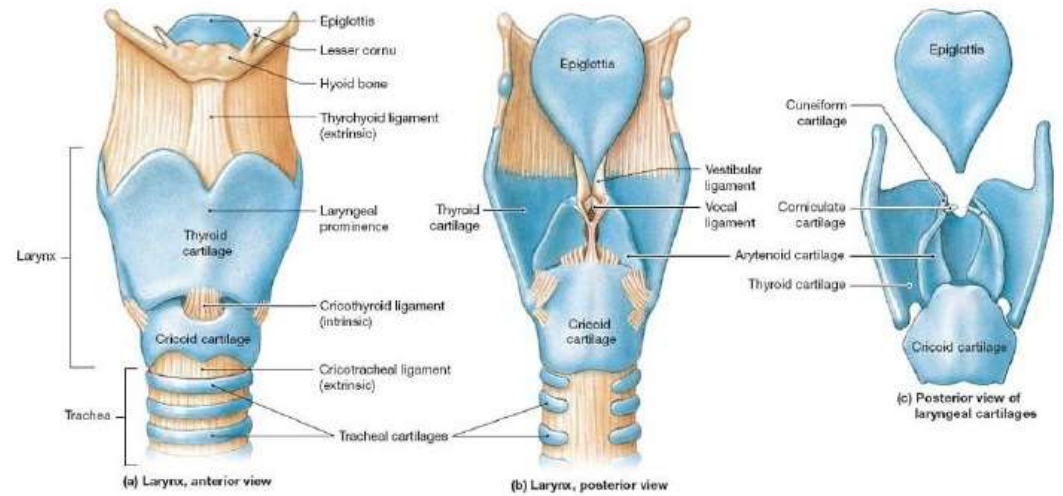
# LARYNX

## Epiglottis

- The epiglottis is a **leaf shaped** plate of **elastic cartilage** which marks the entrance to the larynx. Its 'stalk' is attached to the back of the anterior aspect of the thyroid cartilage. During swallowing, the epiglottis flattens and moves posteriorly to close off the larynx and prevent aspiration.

# LARYNX

## Epiglottis





# LARYNX

## Paired Cartilages

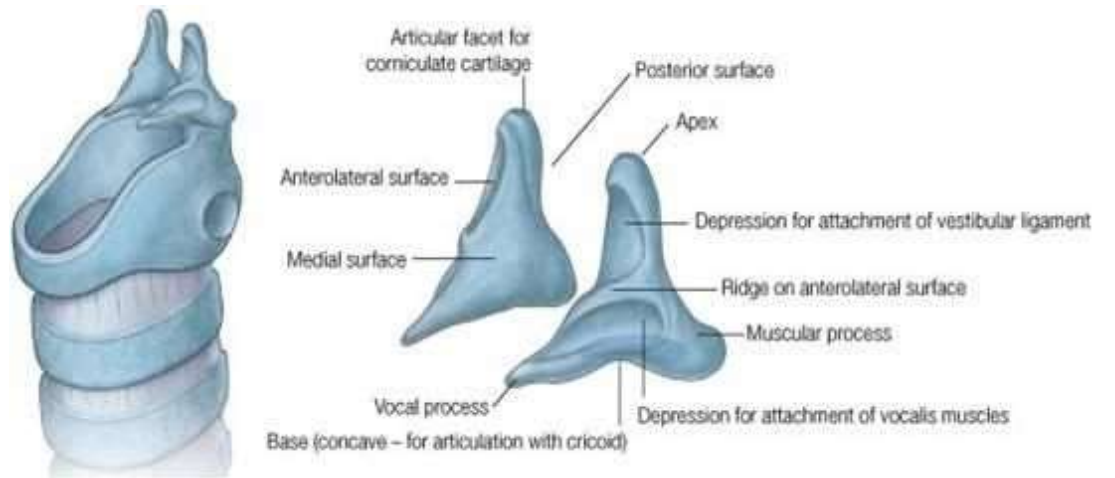
- There are three paired cartilages – the arytenoid, corniculate and cuneiform. They are situated bilaterally in the larynx.

## Arytenoid Cartilages

- The arytenoid cartilages are pyramidal shaped structures that sit on the **cricoid** cartilage. They consist of an apex, base, three sides and two processes, and provides an attachment point for various key structures in the larynx:
- **Apex** – articulates with the corniculate cartilage.
- **Base** – articulates with the superior border of the cricoid cartilage.
- **Vocal process** – provides attachment for the vocal ligament.
- **Muscular process** – provides attachment for the posterior and lateral cricoarytenoid muscles.

# LARYNX

## Arytenoids



# LARYNX

## Corniculate Cartilages

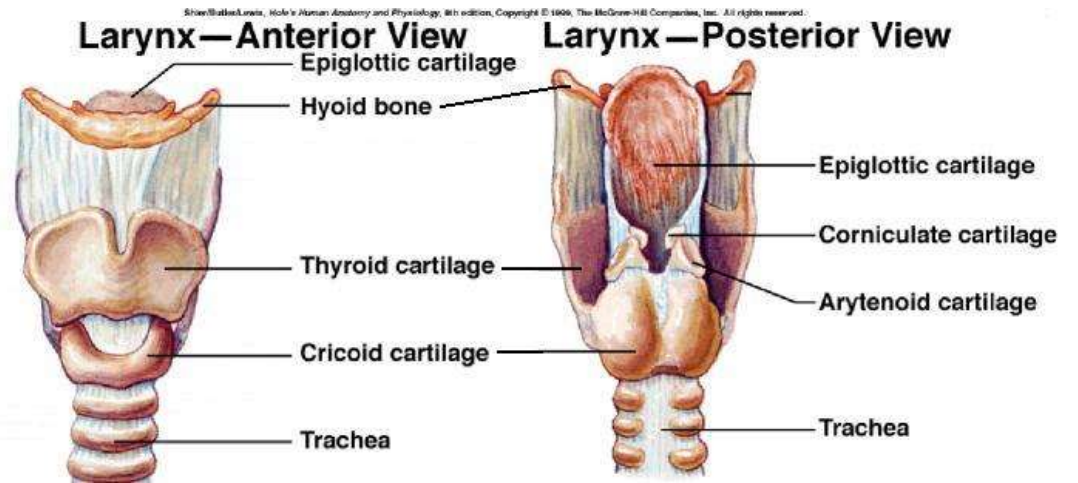
- The corniculate cartilages are minor cartilaginous structures. They articulate with the apices of the arytenoid cartilages.

## Cuneiform Cartilages

- The cuneiform cartilages are located within the ary-epiglottic folds. They have no direct attachment, but act to strengthen the folds.

# LARYNX

Corniculate







LARYNX

LARYNGEAL LIGAMENTS AND FOLDS

# LARYNX

## Contents

- 1 Membranes and Ligaments
- 2 Clinical Relevance: Cricothyroidotomy
- 3 Laryngeal Folds
  - 3.1 Vocal Folds
  - 3.2 Vestibular Folds

# LARYNX

- The **larynx** (voice box) is an organ located in the anterior neck. It is a component of the respiratory tract, and has several important functions; including phonation, the cough reflex, and protection of the lower respiratory tract.
- It contains numerous ligaments and folds; the **ligaments** support the cartilaginous skeleton of the larynx, whilst the folds are involved in airway protection and phonation.
- In this article, we shall look at the anatomy of the **laryngeal ligaments and folds**.

# LARYNX

## Membranes and Ligaments

- The laryngeal membranes and ligaments support the **cartilaginous skeleton** of the larynx.
- The **extrinsic ligaments** act to attach the components of the larynx to external structures (such as the hyoid and the cricoid cartilage). The intrinsic ligaments are responsible for holding the cartilages of the larynx together as one functional unit internally



# LARYNX

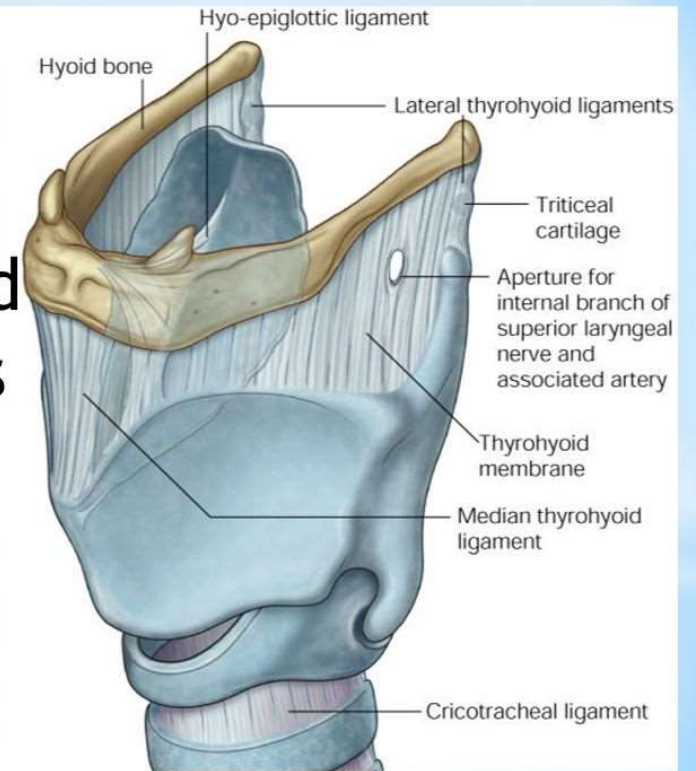
## Extrinsic:

- **Thyrohyoid membrane** – Spans between the superior aspect of the thyroid cartilage and the [hyoid bone](#). It is pierced laterally by the superior laryngeal vessels and internal laryngeal nerve (branch of the superior laryngeal nerve).
  - **Median thyrohyoid ligament** – Anteromedial thickening of the membrane.
  - **Lateral thyrohyoid ligaments** – Posterolateral thickenings of the membrane.
- **Hyo-epiglottic ligament** – Connects the hyoid bone to the anterior aspect of the epiglottis.
- **Cricotracheal ligament** – Connects the cricoid cartilage to the trachea.
- **Median cricothyroid ligament** – Anteromedial thickening of the cricothyroid ligament (see below), connecting the thyroid and cricoid cartilages.

# LARYNX

Thyrohyoid Membrane

## Thyrohyoid and cricothyroid membranes



# LARYNX

Hypo epiglottic Ligament

## EXTRINSIC

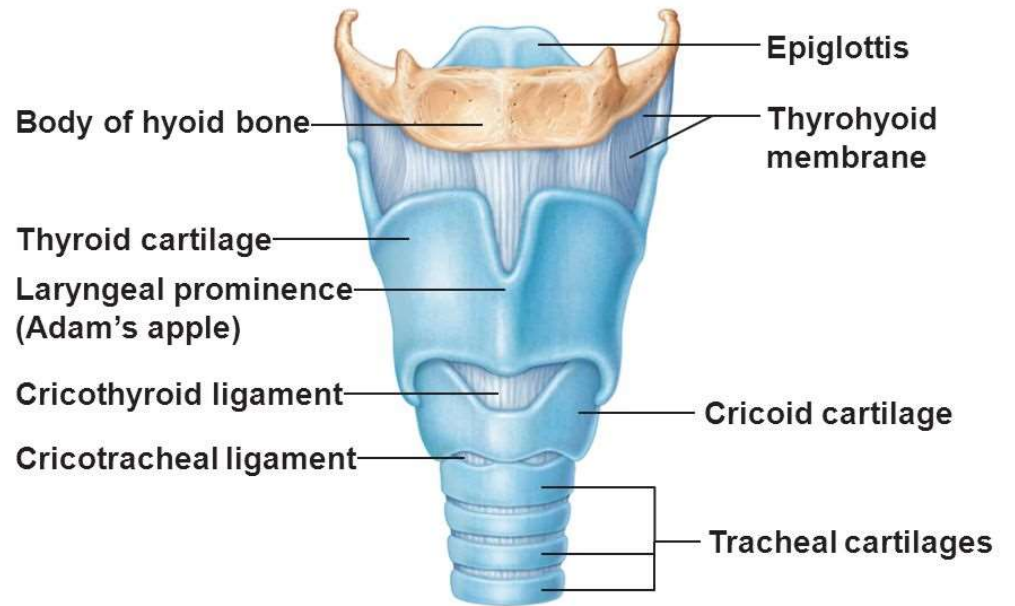
Hyo-epiglottic  
Ligament



Crico-Tracheal  
Ligament

# LARYNX

Cricotracheal Ligament



**(a) Anterior superficial view**



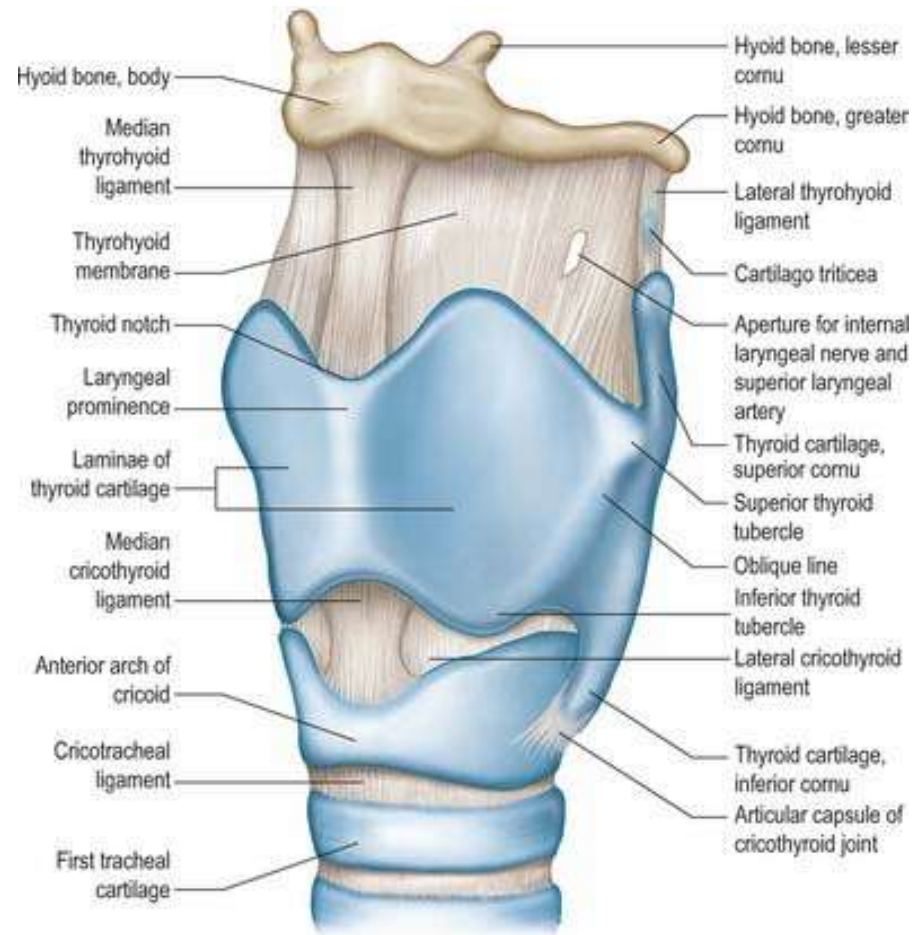
# LARYNX

## Intrinsic:

- **Cricothyroid ligament** – Originates from the cricoid cartilage and extends superiorly, where it terminates with a free (unattached) upper margin – which forms the vocal ligament. It is additionally attached anteriorly to the thyroid cartilage, and posteriorly to the arytenoid cartilage.
- **Quadrangular membrane** – Spans between the anterolateral arytenoid cartilage and the lateral aspect of the epiglottis. It has a free upper margin and lower margin. The lower margin is thickened to become the vestibular ligament.

# LARYNX

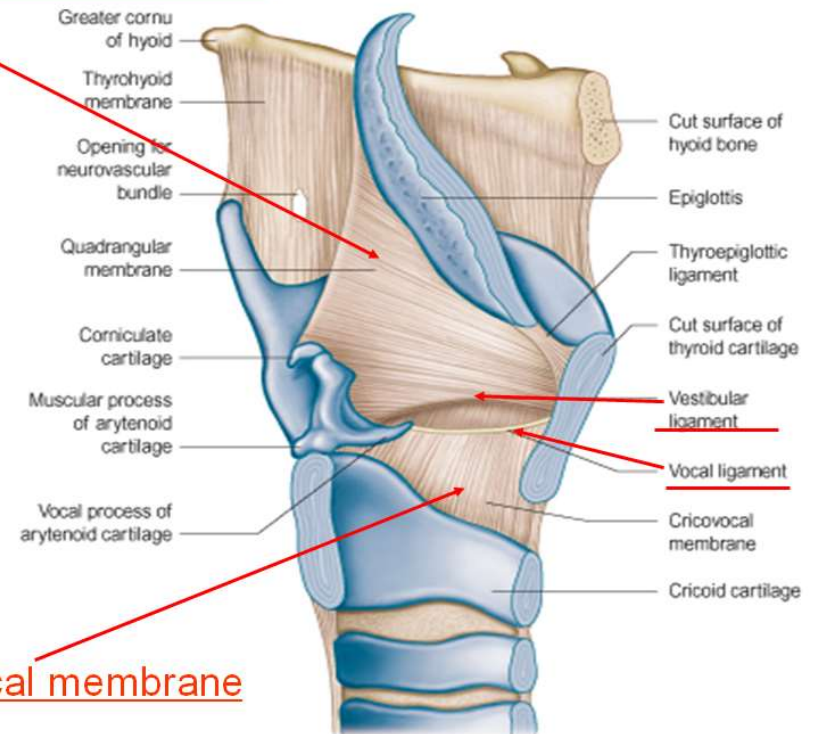
## Cricothyroid Ligament



# LARYNX

## Quadrangular Membrane

### Quadrangular membrane



# LARYNX

## Clinical Relevance: Cricothyroidotomy

- A **cricothyroidotomy** is an emergency procedure to provide a temporary airway. It is typically used in situations where there is an obstruction at or above the larynx (e.g foreign body, angioedema or facial trauma), and intubation has been unsuccessful.
- To perform the technique, the thyroid cartilage is palpated in the neck – below which there is a depression representing the **cricothyroid ligament**. A small incision is made in the midline of this ligament, and an endotracheal tube is inserted to secure the airway

# LARYNX

## Laryngeal Folds

- There are two important soft tissue folds located within the larynx – the vestibular folds and vocal folds. They play a crucial role in protection of the airway, breathing, and phonation.

# LARYNX

## Vocal Folds

- The **vocal folds (true vocal cords)** are the more important of the two sets. Under the control of the muscles of phonation, they are abducted, adducted, relaxed and tensed to control the pitch of the sound created.
- Histologically, they are structured as follows (superficial to deep):
- **Non-keratinised stratified squamous epithelium** – Stratified layer provides extensive protection against foreign bodies which may accidentally enter the larynx.
- **Reinke's space** – This watery, amorphous layer is rich in glycosaminoglycans. Due to its fluidity, the epithelium is able to vibrate freely above it to create sound.
- **Vocal ligament** – Lies at the free upper edge of the cricothyroid ligament.
- **Vocalis muscle** – Exceptionally fine muscle fibres that lie lateral to the vocal ligaments.
- The vocal folds are relatively avascular, and appear white in colour. The space between the vocal folds is known as the **rima glottidis**.

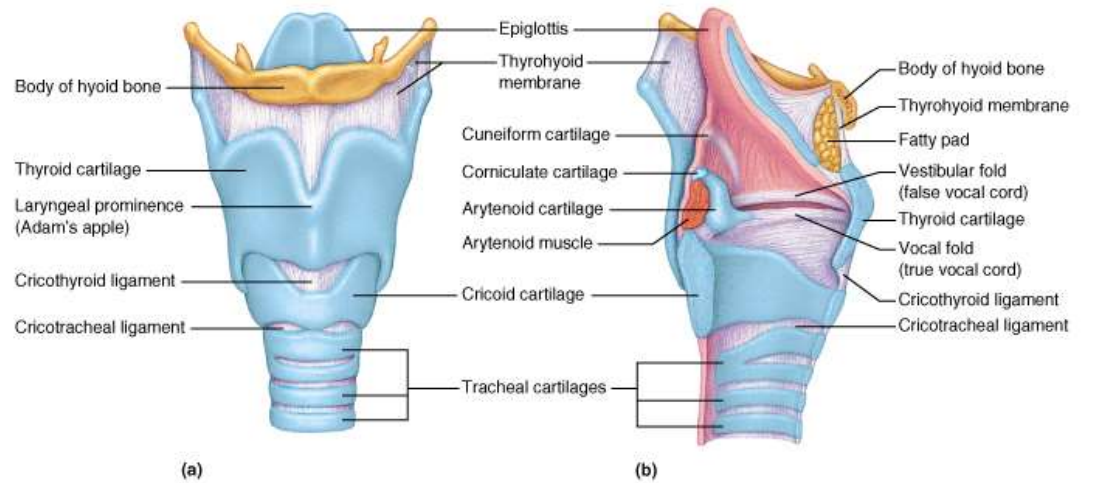
# LARYNX

## Vestibular Folds

- The **vestibular folds (false vocal cords)** lie superiorly to the true vocal cords. They consist of the vestibular ligament (free lower edge of the quadrangular membrane) covered by a mucous membrane, and are pink in colour. They are fixed folds, which act to provide protection to the larynx.

# LARYNX

## Vestibular Folds



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LAYRNX

- LAYRYNGEAL MUSCLES

# LARYNX

- The larynx (voice box) is an organ located in the anterior neck. It is a component of the respiratory tract, and has several important functions, including phonation, the cough reflex, and protection of the lower respiratory tract.
- The muscles of the larynx can be divided into two groups; the **external** muscles and the **internal** muscles. The external muscles act to elevate or depress the larynx during swallowing. In contrast, the internal muscles act to move the individual components of the larynx – playing a vital role in breathing and phonation.
- In this article, we shall look at the anatomy of the laryngeal muscles – their attachments, innervation and blood supply.

# LARYNX

## Extrinsic Muscles

- The extrinsic muscles act to move the larynx superiorly and inferiorly. They are comprised of the suprahyoid and infrahyoid groups, and the stylopharyngeus (a muscle of the pharynx).
- The supra- and infrahyoid muscle groups attach to the **hyoid bone**. This, in turn, is bound to the larynx by strong ligaments; allowing the whole of the larynx to be moved as one unit.
- As a general rule, the suprahyoid muscles and the stylopharyngeus **elevate** the larynx, whilst the infrahyoid muscles **depress** the larynx.

# LARYNX

## Intrinsic Muscles

- The intrinsic laryngeal muscles act on the individual components of the larynx. They control the shape of the **rima glottidis** (opening between the vocal folds and the arytenoid cartilages), and the length and tension of the vocal folds.
- All the intrinsic muscles of the larynx (except the cricothyroid) are innervated by the **inferior laryngeal nerve** – the terminal branch of the recurrent laryngeal nerve, itself a branch of the vagus nerve. The cricothyroid is innervated by the **external branch** of the superior laryngeal nerve – again derived from the vagus nerve.

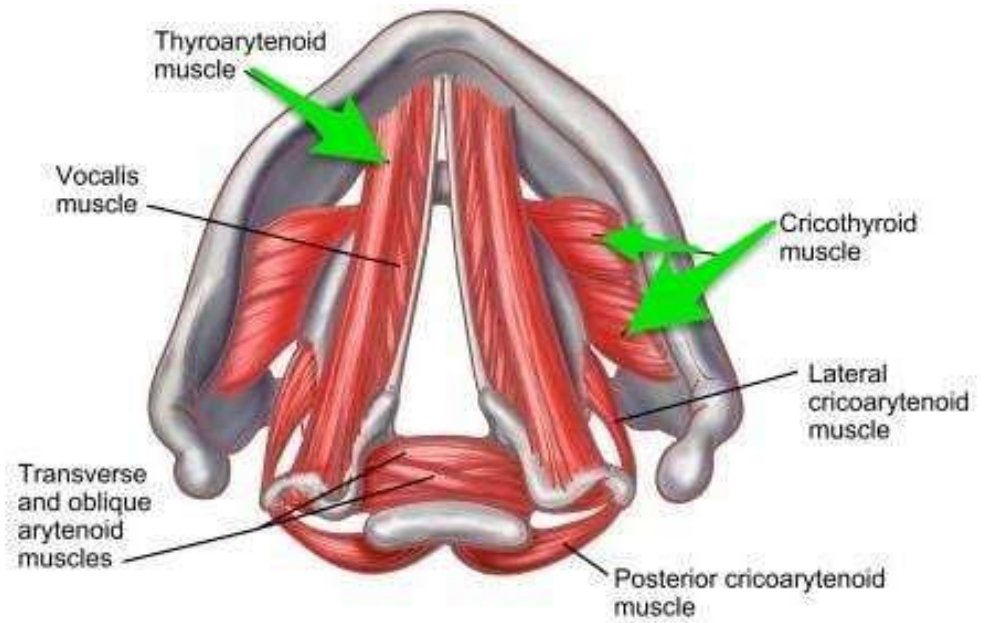
# LARYNX

## Cricothyroid

- The cricothyroid muscle stretches and tenses the vocal ligaments, and so is important for the creation of forceful speech. It also has a role in altering the tone of voice (along with the thyroarytenoid muscle), hence its colloquial name 'singer's muscle'.
- **Attachments:** Originates from the anterolateral aspect of the cricoid cartilage, and attaches to the inferior margin and inferior horn of the thyroid cartilage.
- **Actions:** Stretches and tenses the vocal ligament.
- **Innervation:** External laryngeal nerve (branch of superior laryngeal).

# LARYNX

Cricothyroid Muscle



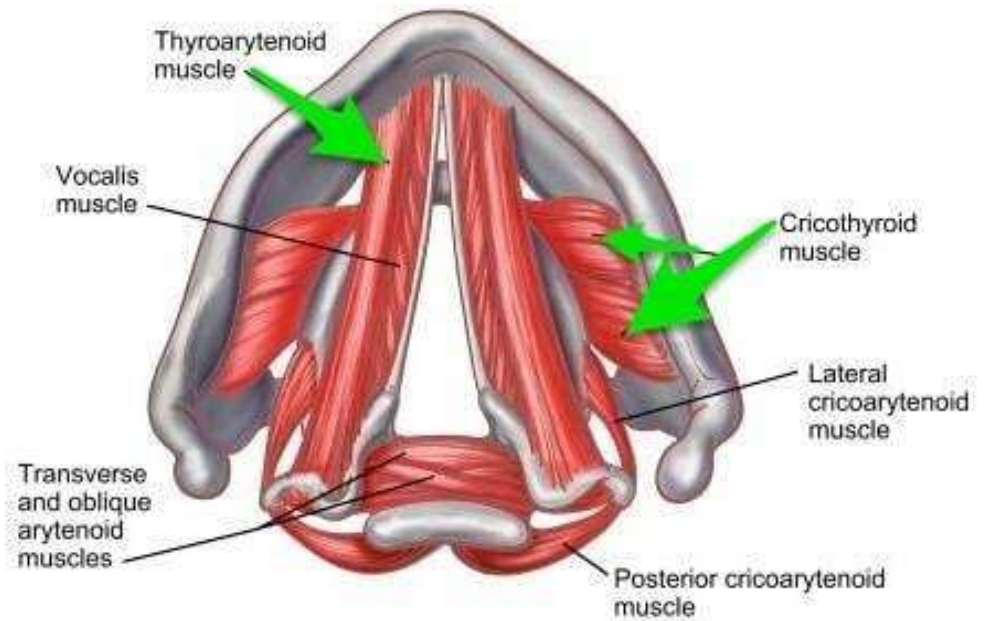
# LARYNX

## Thyroarytenoid

- The thyroarytenoid muscle acts to relax the vocal ligament, allowing for a softer voice.
- **Attachments:** Originates from the inferoposterior aspect of the angle of the thyroid cartilage, and attaches to the anterolateral part of the arytenoid cartilage.
- **Actions:** Relaxes the vocal ligament.
- **Innervation:** Inferior laryngeal nerve (branch of recurrent laryngeal).

# LARYNX

## Thyroarytenoid Muscle





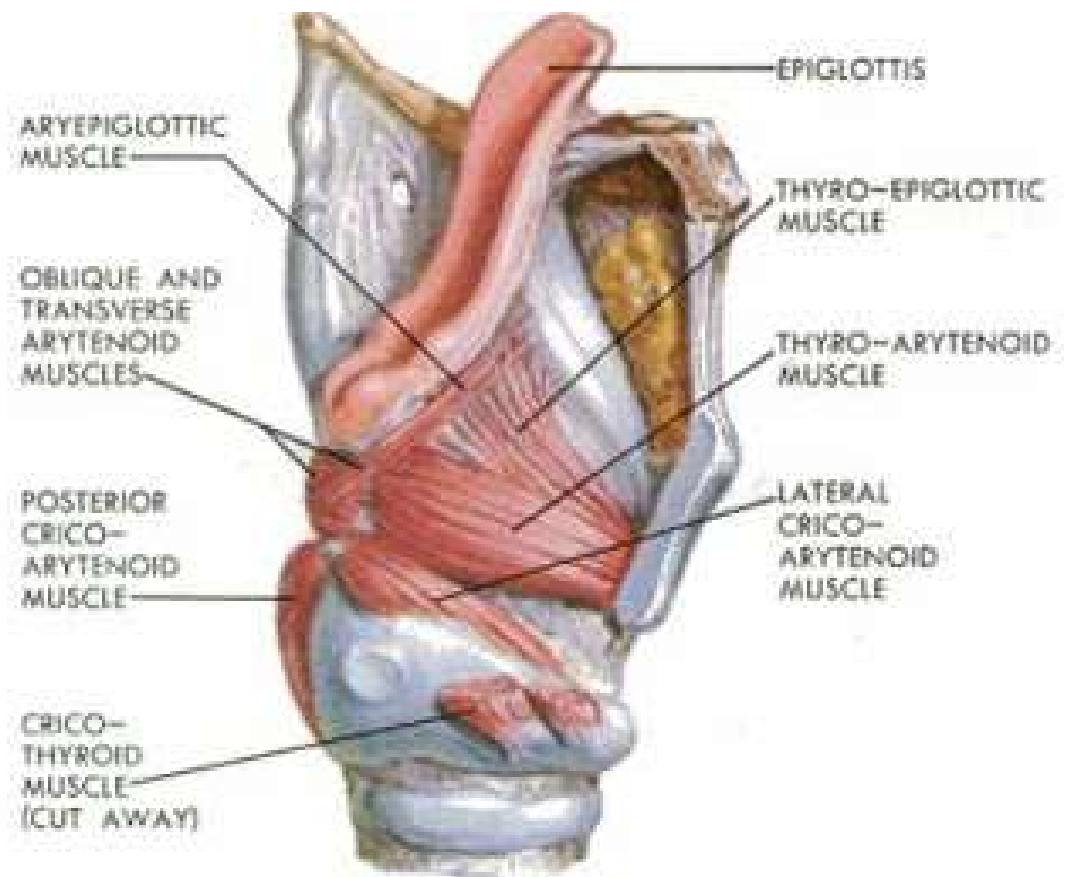
# LARYNX

## Posterior cricoarytenoid

- The posterior cricoarytenoid muscles are the sole abductors of the vocal folds, and thus the only muscle capable of widening the rima glottidis.
- **Attachments:** Originates from the posterior surface of the cricoid cartilage, and attaches to the muscular process of the arytenoid cartilage.
- **Actions:** Abducts vocal folds.
- **Innervation:** Inferior laryngeal nerve (branch of recurrent laryngeal).

# Larynx

## Cricoarytenoid Muscle



# LARYNX

## Lateral cricoarytenoid

- The lateral cricoarytenoid muscles are the major adductors of the vocal folds. This narrows the rima glottidis, modulating the tone and volume of speech.
- **Attachments:** Originates from the arch of the cricoid cartilage, and attaches to the muscular process of the arytenoid cartilage.
- **Actions:** Adducts the vocal folds.
- **Innervation:** Inferior laryngeal nerve (branch of recurrent laryngeal).

# LARYNX

## Transverse and Oblique Arytenoids

- The transverse and oblique arytenoids muscles adduct the arytenoid cartilages, closing the posterior portion of rima glottidis. This narrows the laryngeal inlet.
- **Attachments:** Spans from one arytenoid cartilage to the opposite arytenoid.
- **Actions:** Adducts the arytenoid cartilages.
- **Innervation:** Inferior laryngeal nerve (branch of recurrent laryngeal)





ANATOMY

NECK



# NECK

## Organs of the Neck

- **PHARYNX**
- **LARYNX**
- **OESOPHAGUS**
- **THYROID GLAND**
- **PARATHYROID GLANDS**

# OESOPHAGUS

## Contents

- 1 Anatomical Course
- 2 Anatomical Structure
  - 2.1 Muscular layers
  - 2.2 Oesophageal Sphincters
- 3 Anatomical Relations
- 4 Vasculature
- 5 Innervation
- 6 Lymphatics
- 7 Clinical Relevance: Disorders of the Oesophagus
  - 7.1 Barrett's Oesophagus
  - 7.2 Oesophageal Carcinoma
  - 7.3 Oesophageal Varices



# OESOPHAGUS

- The **oesophagus** is a fibromuscular tube, approximately 25cm in length, that transports food from the pharynx to the stomach.
- It originates at the inferior border of the cricoid cartilage (C6) and extends to the cardiac orifice of the stomach (T11).
- In this article we shall examine the anatomy of the **oesophagus** – its structure, vascular supply and clinical correlations

# OESOPHAGUS

## Anatomical Course

- The **oesophagus** begins in the neck, at the level of C6. Here, it is continuous superiorly with the laryngeal part of the pharynx (the laryngopharynx).
- It descends downward into the superior mediastinum of the thorax, positioned between the trachea and the vertebral bodies of T1 to T4. It then enters the abdomen via the **oesophageal hiatus** (an opening in the right crus of the diaphragm) at T10.
- The abdominal portion of the oesophagus is approximately 1.25cm long – it terminates by joining the cardiac orifice of the **stomach** at level of T11.

# OESOPHAGUS

## Anatomical Structure

- **Muscular layers**
- The oesophagus consists of an internal circular layer and an external longitudinal layer of **muscle**. Furthermore, the external longitudinal layer is composed of different muscle types in each third of the oesophagus:
- **Superior third** – voluntary striated muscle
- **Middle third** – voluntary striated and smooth muscle
- **Inferior third** – smooth muscle
- Food is transported through the oesophagus by **peristalsis** – a rhythmic contractions of the muscles, which propagates down the oesophagus. Hardening of these muscular layers can interfere with peristalsis and cause difficulty in swallowing (dysphagia).

# OESOPHAGUS

## Oesophageal Sphincters

- There are two sphincters present in the oesophagus, known as the upper and lower oesophageal sphincters. They act to prevent the entry of air and the reflux of gastric contents respectively.

### Upper Oesophageal Sphincter

- The upper sphincter is an anatomical, striated muscle sphincter at the junction between the pharynx and oesophagus. It is produced by the **cricopharyngeus** muscle. Normally, it is constricted to prevent the entrance of air into the oesophagus.

# OESOPHAGUS

## Lower Oesophageal Sphincter

- The lower oesophageal sphincter is a physiological sphincter located in the **gastro-oesophageal junction** (junction between the [stomach](#) and oesophagus). The gastro-oesophageal junction is situated to the left of the **T11 vertebra**, and is marked by the change from oesophageal to gastric mucosa.
- The sphincter is classified as a physiological (or functional) sphincter, as it does not have any specific sphincteric muscle. Instead, the sphincter is formed from four phenomena:
- The oesophagus enters the stomach at an **acute angle**.
- The walls of the intra-abdominal section of the oesophagus are **compressed** when there is a positive intra-abdominal pressure.
- The  **folds of mucosa**  present aid in occluding the lumen at the gastro-oesophageal junction.
- The right crus of the diaphragm has a **“pinch-cock”** effect.

# OESOPHAGUS

## Anatomical Relations

- The anatomical relations of the oesophagus give rise to four **physiological constrictions** in its lumen – is these areas where food/foreign objects are most likely to become stuck. They can be remembered using the acronym 'ABCD':
- Arch of aorta
- Bronchus (left main stem)
- Cricoid cartilage
- Diaphragmatic hiatus
- The table below lists the anatomical relations of the oesophagus:

# OESOPHAGUS

## RELATIONS

	<b>Anterior</b>	<b>Posterior</b>	<b>Right</b>	<b>Left</b>
<b>Cervical and thoracic</b>	<ul style="list-style-type: none"><li>•Trachea</li><li>•Left recurrent laryngeal nerve</li><li>•Pericardium</li></ul>	<ul style="list-style-type: none"><li>•Thoracic vertebral bodies</li><li>•Thoracic duct</li><li>•Azygous veins</li><li>•Descending aorta</li></ul>	<ul style="list-style-type: none"><li>•Pleura</li><li>•Terminal part of azygous vein</li></ul>	<ul style="list-style-type: none"><li>•Subclavian artery</li><li>•Aortic arch</li><li>•Thoracic duct</li><li>•Pleura</li></ul>
<b>Abdominal</b>	<ul style="list-style-type: none"><li>•Left vagus nerve</li><li>•Posterior surface of the heart</li></ul>	<ul style="list-style-type: none"><li>•Right vagus nerve</li><li>•Left crus of the diaphragm</li></ul>		

# OESOPHAGUS

## Vasculature

- In respect to its arterial and venous supply, the oesophagus can be divided into its thoracic and abdominal components.
- Thoracic
- The thoracic part of the oesophagus receives its arterial supply from the branches of the **thoracic aorta** and the **inferior thyroid artery** (a branch of the [thyrocervical trunk](#)). Venous drainage into the systemic circulation occurs via branches of the azygous veins and the inferior thyroid vein.



# OESOPHAGUS

## Abdominal

- The abdominal oesophagus is supplied by the **left gastric artery** (a branch of the coeliac trunk) and left inferior phrenic artery. This part of the oesophagus has a mixed venous drainage via two routes:
- To the portal circulation via left gastric vein
- To the systemic circulation via the azygous vein.
- These two routes form a **porto-systemic anastomosis**, a connection between the portal and systemic venous systems.

# OESOPHAGUS

## Innervation

- The oesophagus is innervated by the **oesophageal plexus**, which is formed by a combination of the parasympathetic **vagal trunks** and sympathetic fibres from the **cervical** and **thoracic sympathetic trunks**.
- Two different types of nerve fibre run in the vagal trunks. The upper oesophageal sphincter and upper striated muscle is supplied by fibres originating from the **nucleus ambiguus**. Fibres supplying the lower oesophageal sphincter and smooth muscle of the lower oesophagus arise from the **dorsal motor nucleus**.

# OESOPHAGUS

## Lymphatics

- The **lymphatic drainage** of the oesophagus is divided into thirds:
- **Superior third** – deep cervical lymph nodes.
- **Middle third** – superior and posterior mediastinal nodes.
- **Lower third** – left gastric and celiac nodes

# OESOPHAGUS

## Clinical Relevance: Disorders of the Oesophagus

### Barrett's Oesophagus

- Barrett's oesophagus refers to the **metaplasia** (reversible change from one differentiated cell type to another) of lower oesophageal squamous epithelium to gastric columnar epithelium. It is usually caused by chronic acid exposure as a result of a malfunctioning lower oesophageal sphincter. The acid irritates the oesophageal epithelium, leading to a metaplastic change.
- The most common symptom is a long-term burning sensation of indigestion.
- It can be detected **via endoscopy** of the oesophagus. Patients who are found to have it will be monitored for any cancerous changes.

# OESOPHAGUS

## Oesophageal Carcinoma

- Around 2% of malignancies in the UK are oesophageal carcinomas. The clinical features of this carcinoma are:
- Dysphagia – difficulty swallowing. It becomes progressively worse over time as the tumour increases in size, restricting the passage of food.
- Weight loss
- There are two major types of oesophageal carcinomas: squamous cell carcinoma and adenocarcinoma.
- **Squamous cell carcinoma** – the most common subtype of oesophagus cancer. It can occur at any level of the oesophagus.
- **Adenocarcinoma** – only occurs in the inferior third of the oesophagus and is associated with Barrett's oesophagus. It usually originates in the metaplastic epithelium of Barrett's oesophagus.



# OESOPHAGUS

## Oesophageal Varices

- The abdominal oesophagus drains into both the **systemic** and **portal** circulation, forming an anastomosis between the two.
- Oesophageal varices are abnormally dilated **sub-mucosal veins** (in the wall of the oesophagus) that lie within this anastomosis. They are usually produced when the pressure in the portal system increases beyond normal, a state known as **portal hypertension**. Portal hypertension most commonly occurs secondary to chronic liver disease, such as cirrhosis or an obstruction in the portal vein.
- The varices are predisposed to bleeding, with most patients presenting with **haematemesis** (vomiting of blood). Alcoholics are at a high risk of developing oesophageal varices.



# ANATOMY

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NECK





# NECK

## ORGANS OF THE NECK

- PHARYNX
- LARYNX
- OESOPHAGUS
- THYROID GLAND
- PARATHYROID GLANDS

# THYROID GLAND

## Contents

1 Anatomical Location

1.1 Clinical Relevance: Thyroglossal Cysts

2 Vascular Supply

3 Innervation

4 Lymphatic Drainage

5 Clinical Relevance: Recurrent Laryngeal Nerve

# THYROID GLAND

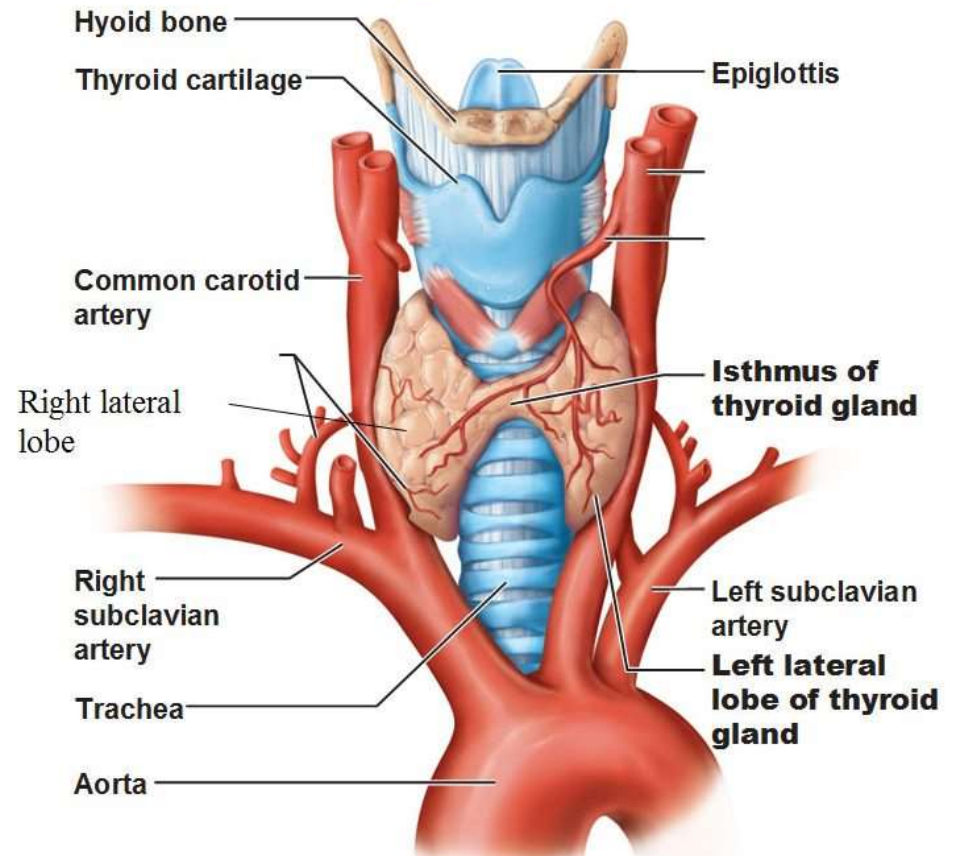
## Anatomical Location

- The thyroid gland is located in the **anterior neck**, spanning between the C5 and T1 vertebrae. It is an **endocrine** gland, divided into two lobes which are connected by an **isthmus**. It is said to have a butterfly shape.
- It lies behind the sternohyoid and sternothyroid muscles, **wrapping** around the cricoid cartilage and superior tracheal rings. It is inferior to the thyroid cartilage of the **larynx**. The gland is in the **visceral compartment** of the neck, along with the trachea, oesophagus and pharynx. The compartment is bound by pretracheal fascia.
- During **development**, the thyroid gland initially forms in the floor of the primitive pharynx, near the base of the tongue. It **descends** down the neck to lie in its adult anatomical position.

# Thyroid Gland

Anatomical location

## The Thyroid Gland



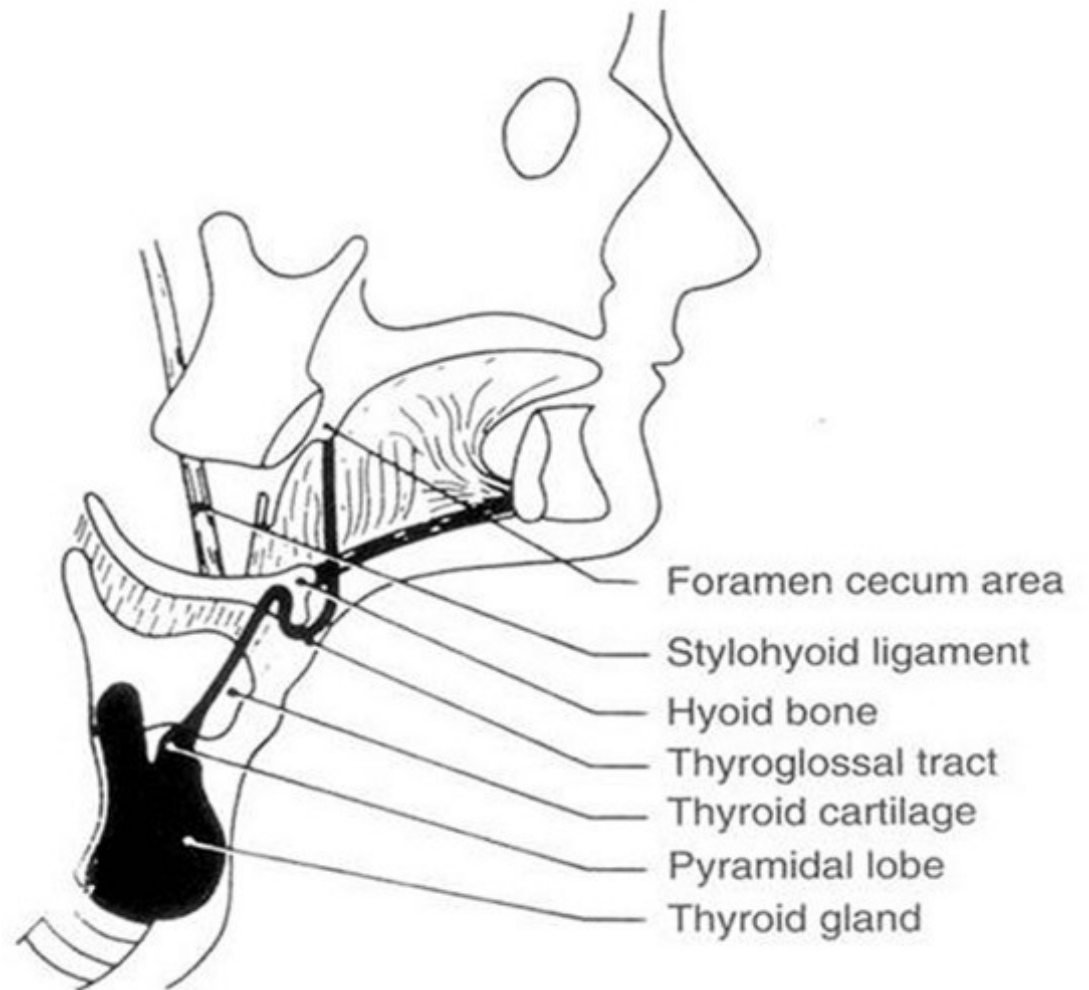
# THYROID GLAND

## Clinical Relevance: Thyroglossal Cysts

- As the thyroid gland descends during development, it moves through a duct called the **thyroglossal duct**. This duct normally fuses and regresses in the adult.
- However, in 50% of individuals, the distal portion of the duct continues as a **pyramidal lobe** – effectively an extra piece of thyroid tissue. This does not have any clinical consequences.
- Other portions of the duct may persist as **thyroglossal cysts**. These present with a mass in the midline of neck, and can be excised surgically.

# Thyroglossal cyst

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# THYROID GLAND

## Vascular Supply

- The thyroid gland secretes hormones directly into the blood. Therefore it needs to be **highly vascularised**. Blood supply to the thyroid gland is achieved by two main arteries; the superior and inferior thyroid arteries. These are **paired** arteries arising on both the left and right.
- The **superior thyroid artery** is the first branch of the external carotid artery. After arising, the artery descends toward the thyroid gland. As a generalisation, it supplies the **superior and anterior** portions of the gland.
- The **inferior thyroid artery** arises from the thyrocervical trunk (which in turn is a branch of the subclavian artery). The artery travels superomedial to reach the inferior pole of the thyroid. It tends to supply the **postero-inferior** aspect.
- In a small proportion of people (around 10%), there is an additional artery present; the **thyroid ima artery**. It comes from the brachiocephalic trunk of the arch of aorta, supplying the anterior surface and isthmus.
- Venous drainage is carried out by the superior, middle and inferior thyroid veins, which form a **venous plexus**. The superior and middle veins drain into the **internal jugular veins**, whereas the inferior drains into the **brachiocephalic** vein.

# Thyroid Gland

## Vascular supply

## Blood Supply of the Thyroid Gland

### Arterial supply

#### 1. Superior thyroid artery:

- ❑ is a branch of external carotid artery.
- ❑ Runs downwards and forwards with intimate relation to the external laryngeal nerve.
- ❑ Divides into anterior and posterior branches

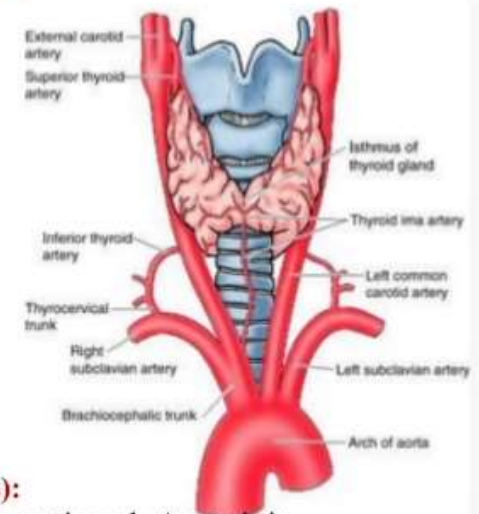
#### (2) Inferior thyroid artery:

- ❑ Is a branch of the thyrocervical trunk from the subclavian artery
- ❑ Runs first upwards, then medially and finally downwards to reach the lower pole of the thyroid lobe.
- ❑ Its terminal part is intimately related to the recurrent laryngeal nerve

#### (3) Thyroidea ima artery (in 3% individuals):

- ❑ Arises from the brachiocephalic artery or the aortic arch. Ascends in front of the trachea to reach the isthmus.

- (4) **Accessory thyroid arteries** : come from the tracheal and esophageal vessels.



Mohamed el fiky



# THYROID GLAND

## Innervation

- The thyroid gland is innervated by branches derived from the **sympathetic trunk**. However, these nerves do not control endocrine secretion – release of hormones is regulated by pituitary gland.

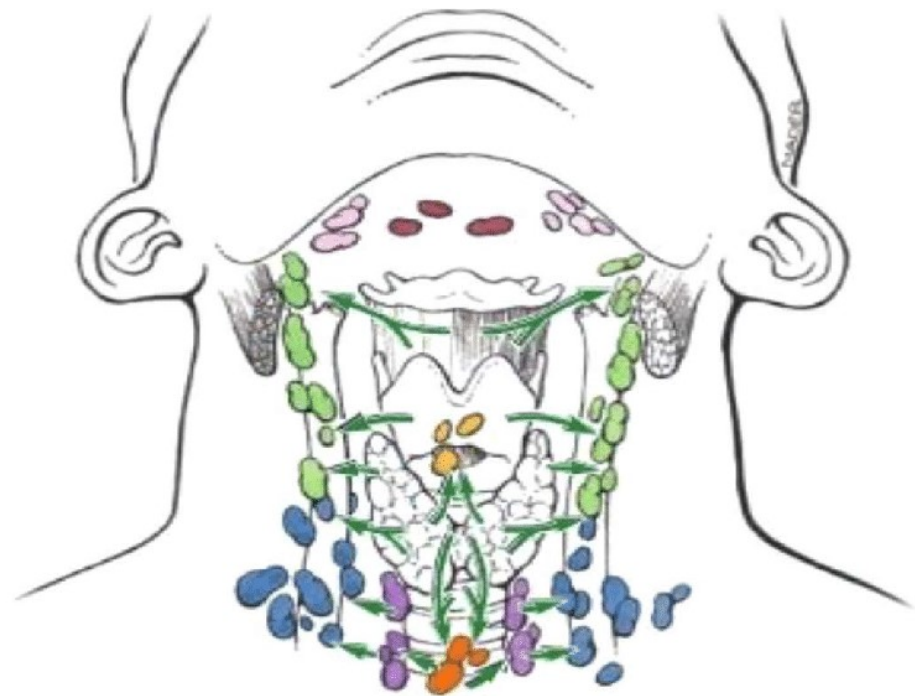
# THYROID GLAND








## Lymphatic Drainage

- The lymphatic drainage of the thyroid is multidirectional and extensive. It drains initially into **peri-thyroid nodes**, and from there into **prelaryngeal, pretracheal and paratracheal** nodes. Laterally, the gland drains into the superior and inferior **deep cervical** nodes.

Thyroid

Lymphatics



- |  |  |
|--|--|
|  Superior deep cervical |  Prelaryngeal |
|  Inferior deep cervical |  Paratracheal |
|  Submental              |  Pretracheal  |
|  Submandibular          |  |

# THYROID GLAND

## Clinical Relevance: Recurrent Laryngeal Nerve

- There are two recurrent laryngeal nerves; one left and one right. They arise from their respective **vagus nerves**, and descend into the chest.
- In the chest, they hook around the subclavian artery (right RL nerve), or the arch of aorta (left RL nerve). The nerves then ascend back up the neck, running between the **trachea** and **oesophagus**. They pass underneath the **thyroid gland** to innervate the larynx.
- During surgery on the thyroid gland, care must be taken not to **ligate** or damage the recurrent laryngeal nerves.



# ANATOMY

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NECK

# NECK

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ORGANS OF THE NECK



# NECK

## ORGANS OF THE NECK

- PHARYNX
- LARYNX
- OESOPHAGUS
- THYROID GLAND
- PARATHYROID GLANDS



# PARATHYROID

## Contents

1 Anatomical Location

2 Vascular Supply

3 Lymphatics

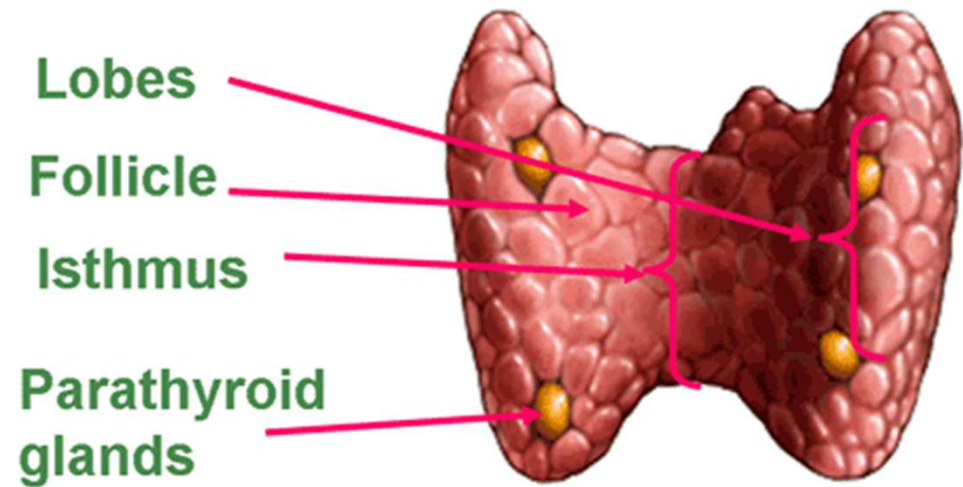
4 Nerves

5 Clinical Relevance: Surgical Damage to Parathyroid Glands

# Parathyroid Gland

Anatomy

## THYROID



# PARATHYROID GLANDS

- The parathyroid glands are small endocrine glands located in the anterior neck. They are responsible for the production of **parathyroid hormone**, which acts to control calcium levels in the body.
- This article will consider the anatomical location, vessels and nerves of the parathyroid glands, as well as some clinical correlations.

# PARATHYROID GLANDS

## Anatomical Location

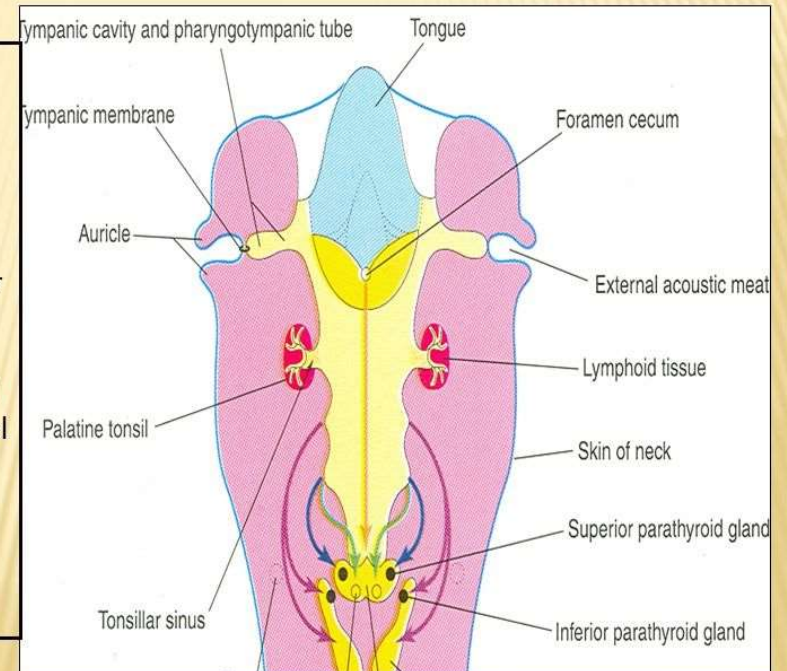
- The parathyroid glands are located on the posterior aspect of the lateral lobes of the [thyroid gland](#). They are flattened and oval in shape, situated external to the gland itself, but within its sheath.
- The majority of people have four parathyroid glands, although variation in number is common. Anatomically, the glands can be divided into two pairs:
- **Superior parathyroid glands** – Derived embryologically from the fourth pharyngeal pouch. They are located approximately 1cm superior to the entry of the inferior thyroid arteries into the thyroid gland (at level of the inferior border of the cricoid cartilage).
- **Inferior parathyroid glands** – Derived embryologically from the third pharyngeal pouch. Although inconsistent in location between individuals, the inferior parathyroid glands are usually found near the inferior poles of the thyroid gland. In a small percentage of people, the glands can be found as far inferiorly as the superior mediastinum.

# Parathyroid Glands

## Development

### DEVELOPMENT OF THE PARATHYROIDS

As the thymus primordium develops, it descends downward to the thorax, behind the sternum in superior mediastinum, So, it draws the inferior **parathyroid bud** to a lower level than the superior parathyroid. Both parathyroid glands lie behind the **thyroid gland**.



# PARATHYROID GLANDS

## Vascular Supply

- The posterior aspect of the thyroid gland is supplied by the **inferior thyroid arteries**. Thus its branches also supply the nearby parathyroid glands. Collateral circulation is delivered by the superior thyroid arteries, thyroid ima artery, and laryngeal, tracheal and oesophageal arteries.
- The parathyroid veins drain into the **thyroid plexus of veins**.

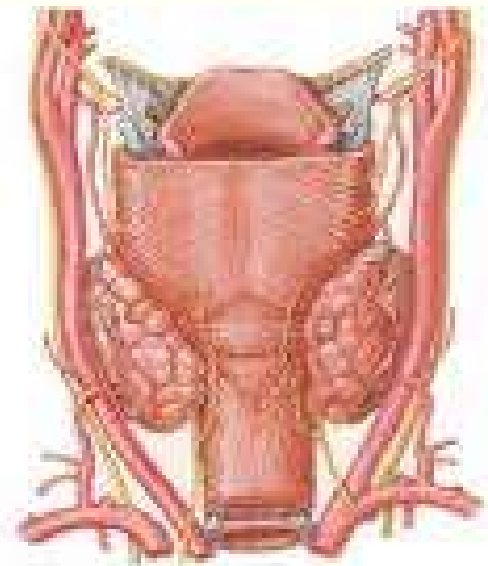
# Parathyroid Gland

## Vascular Supply

### Parathyroid gland

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- **Blood supply :**  
Inferior thyroid artery.
- **Veins and lymphatics**  
are associated with  
that of thyroid gland.
- **Nerves –** Sympathetic  
& parasympathetic.



# PARATHYROID GLANDS

## Lymphatics

- The lymphatic vessels of the parathyroid glands drain (along with those of the thyroid gland) into the **deep cervical** lymph nodes and **paratracheal** lymph nodes.



# PARATHYROID GLANDS

## Nerves

- The parathyroid glands have an extensive supply of nerves, derived from **thyroid branches** of the cervical ([sympathetic](#)) ganglia.
- It is important to note that these nerves are **vasomotor**, not secretomotor – endocrine secretion of parathyroid hormone is controlled hormonally.

# PARATHYROID GLANDS

## Clinical Relevance: Surgical Damage to Parathyroid Glands

- The inconsistency in location of the parathyroid glands between individuals increases their risk of being damaged or removed inadvertently during neck surgery (i.e. **thyroidectomy**).
- Removal of all the parathyroid glands would cause decreased **serum calcium** levels (hypocalcaemia), in turn leading to tetany (severe muscle twitches and cramps). Without urgent treatment this will result in death.
- In order to try and prevent parathyroid damage, surgeons may preserve the **posterior** part of the thyroid gland during thyroidectomy. If this is not possible, the parathyroid glands are carefully located prior to removal of the thyroid tissue