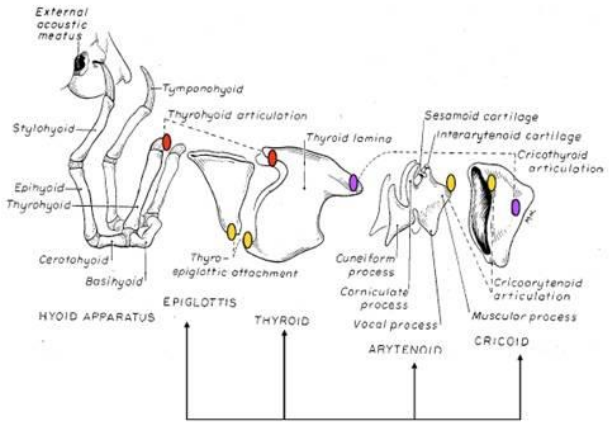
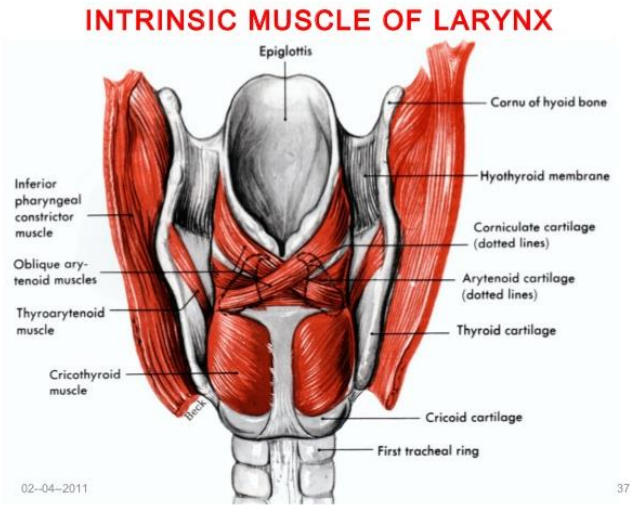
ANATOMY OF THE LARYNX

The larynx forms the communicating channel between the pharynx and the trachea, and it functions during breathing, vocalization, and deglutition. It is composed of cartilage and muscle and is lined with a mucous membrane composed of stratified squamous and pseudostratified columnar ciliated epithelium. The cricoid, thyroid, and epiglottic cartilages are unpaired, whereas the arytenoid cartilages are paired. The cricoid cartilage is shaped like a signet ring and is positioned rostral to the first tracheal ring and connected to the trachea by the cricotracheal membrane.1 The thyroid cartilage is the largest of the laryngeal cartilages and is situated just rostral to the cricoid cartilage. The arytenoid cartilages are positioned on either side of the cricoid cartilage and connected to it by the cricoarytenoid articulations. The articulation is a diarthrodial joint that allows the arytenoid cartilage to rotate dorsolaterally during abduction, and axially during adduction. Each arytenoid cartilage has a corniculate process that forms part of the dorsal border of the rima glottidis, a cuneate process, and a muscular process that serves as origin for the cricoarytenoideus dorsalis muscle.

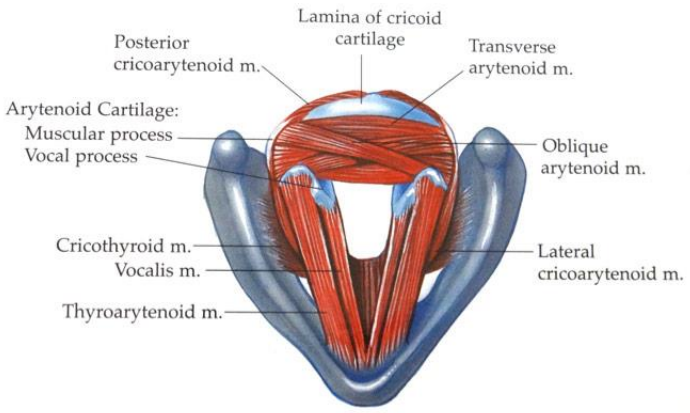
Bones of hyoid apparatus and laryngeal cartilages



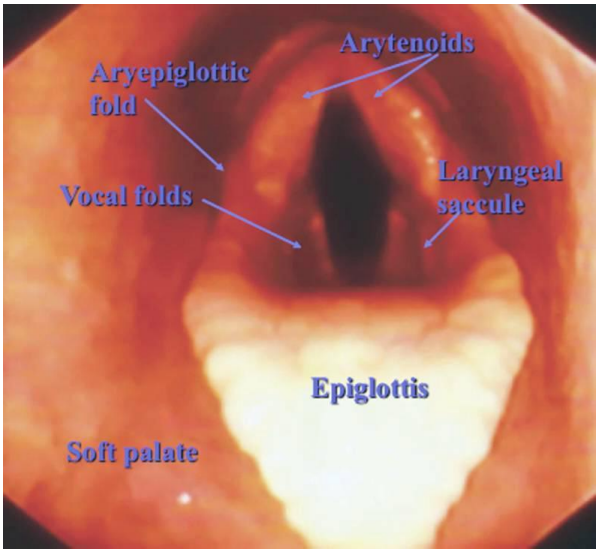
The epiglottis rests on the dorsal surface of the body of the thyroid cartilage and is held there by the thyroepiglottic ligaments. It consists of elastic cartilage and is shaped like an oblanceolate leaf. Contraction of the intrinsic laryngeal muscles produces changes in caliber of the rima glottidis by abducting and adducting the corniculate processes of the arytenoid cartilages and the vocal folds and therefore altering airway resistance. These muscles include the paired cricoarytenoideus dorsalis, thyroarytenoideus (ventricularis and vocalis muscles), and cricothyroideus and cricoarytenoideus lateralis muscles, plus the unpaired transverse arytenoideus muscle. The cricoarytenoideus dorsalis is the principal abductor muscle that widens the laryngeal aperture by abducting the



corniculate process of the arytenoid cartilage and tensing the vocal folds. Contraction of the arytenoid transversus muscle also provides arytenoid abduction by drawing the dorsomedial margins of the arytenoid cartilages together. The thyroarytenoideus, arytenoideus transversus, and cricoarytenoideus lateralis muscles adduct the corniculate processes of the arytenoid cartilages, narrowing the rima glottidis and protecting the lower airway during swallowing. The cricothyroideus muscle tenses the vocal folds during vocalization but receives efferent motor innervation from the external branch of the superior laryngeal nerve, a branch of the vagus nerve, whereas all other intrinsic laryngeal muscles receive motor innervation from the recurrent laryngeal branch of the vagus nerve.



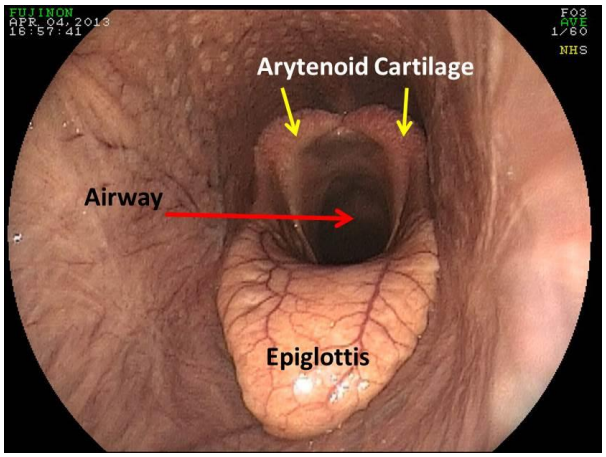
The extrinsic laryngeal muscles of the larynx include the thyrohyoideus, hyoepiglotticus, and sternothyroideus muscles and are involved in stabilization of the larynx and pharynx during exercise. The mucosa of the larynx is closely adhered to the cartilages and contains many different types of afferent receptors. The mucous membrane covering the epiglottic cartilage reflects off the lateral border of the epiglottis and blends with the mucous membrane covering the corniculate processes of the arytenoid cartilages, forming the aryepiglottic folds. The mucous membrane covers the vocal ligament, forms the vocal folds, and lines the lateral ventricles, forming the laryngeal saccules. These saccules are 2.5 cm deep with a capacity of 5 to 6 mL. They extend between the medial surface of the thyroid cartilage and the ventricularis and vocalis muscles.



The laryngeal mucosa contains mechanoreceptors specialized in their sensory modalities for the detection of different stimuli, including transmural pressure changes, airflow, temperature, and laryngeal motion. These receptors receive afferent neural supply from the internal branch of the superior laryngeal nerve, a branch of the vagus nerve. This rich sensory supply is the main source of many respiratory reflexes that influence upper airway patency and breathing patterns. The larynx receives arterial blood supply from the caudal laryngeal and branches of the ascending pharyngeal arteries. Venous drainage is provided by the caudal laryngeal and ascending pharyngeal veins, which flow to the external jugular vein via the thyroid vein. The lymph chains that serve the laryngeal area include the retropharyngeal and the cranial and deep cervical lymph centers.

ARYTENOID CARTILAGES

The paired arytenoids are the most dynamic of the laryngeal cartilages (along with the epiglottis). The articulations with the cricoid cartilage allow complete closure of the glottis during swallowing (adduction) and maximal opening (abduction) during exercise.



Endoscopic appearance of the normal larynx during inhalation, showing maximal abduction of the arytenoid cartilages and a normal-appearing epiglottis.

These dynamics of the arytenoids make them vulnerable to injury, inflammation, and dysfunction and also dictate the impact their dysfunction has on performance. Therefore, the necessity for treatment becomes obvious for athletes. The body or laminar portion of the arytenoids, like the thyroid and cricoid cartilages, consists of hyaline cartilage, which is subject to ossification with age or trauma. However, the apex of the arytenoids, which curves upward and backward, forms a pitcher-shaped lip (from which the cartilages derive their name) that is readily observed on endoscopic examination.

ANATOMY OF LARYNGEAL HEMIPLEGIA

Laryngeal hemiplegia is a common upper respiratory disorder in horses that causes a decrease in airflow to the lungs and can cause exercise intolerance. It is caused by paralysis of one or both arytenoid cartilage, due to lack of innervation causing atrophy to the muscle that moves the arytenoid cartilage. The left arytenoid cartilage is the most common side affected (up to 95%).

In a normal horse, the arytenoids (commonly called flappers) allow maximal airflow into the trachea during abduction (the outward movement of the arytenoid cartilages to open the entrance into the trachea). Horses with laryngeal hemiplegia have paralysis of the arytenoid cartilage, which prevents them from abducting or opening their throat during inspiration. This leads to decreased airflow into the lungs due to obstruction from the paralyzed cartilage resulting in respiratory noise and exercise intolerance. A roaring or whistling sound occurs as the horse breathes in and the sounds are most evident as the horse begins to exercise.

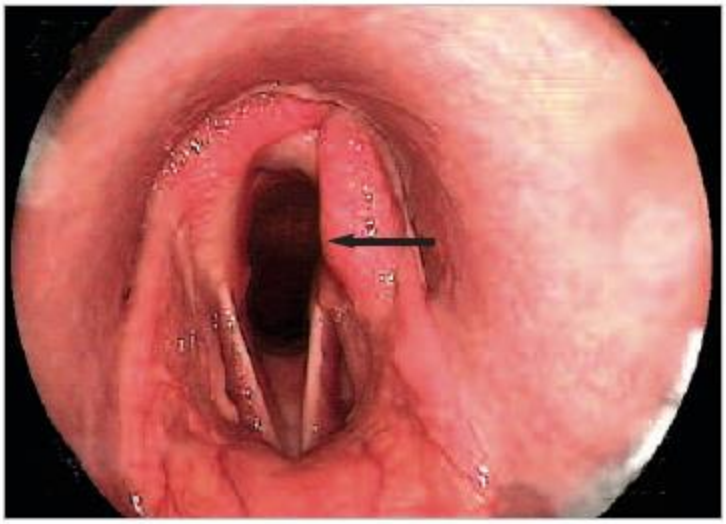


Figure 5. Recurrent laryngeal neuropathy (RLN). Grade 4 left RLN is present. The right corniculate process of the arytenoid cartilage is fully abducted, while the left corniculate process (*arrow*) of the arytenoid cartilage is drawn axially into the airway, resulting in a reduced rima glottidis cross-sectional area.