6 Larynx

The Anatomy

The patterns of spread of carcinomas of the larynx depend on their site of origin and on well-defined anatomic barriers. A detailed understanding of laryngeal anatomy is therefore an essential part of the dissection of any laryngeal specimen. Take time to look over the figures and refresh your memory of laryngeal anatomy.

The most important thing to remember about laryngal anatomy is that the larynx is composed of three anatomic regions: the supraglottis, the glottis, and the subglottis. The supraglottis is the portion of the larynx superior to the ventricles. It is composed of the epiglottis, the arytenoids, the aryepiglottic folds, and the false cords. The glottis is composed of the true vocal cords and their anterior and posterior attachments, the anterior and posterior commissures. The subglottis begins 1 cm below the free edge of the vocal cords and extends inferiorly to the trachea. These three anatomic regions should be kept in mind throughout your description and dissection of the larynx.

The important mucosal landmarks to identify in the larynx are illustrated and include the mucosa of the epiglottis, the aryepiglottic folds, the false vocal cords, the ventricles, the true vocal cords, and the subglottis. Some specimens may also include the base of the tongue with its overlying mucosa. These mucosal surfaces cover the cartilaginous framework of the larynx. This framework includes the cartilage of the epiglottis, the thyroid cartilage, and the cricoid cartilage. The epiglottis is attached to the thyroid cartilage by the thyroepiglottic ligament. The shield-shaped thyroid cartilage forms the anterior and lateral walls of the larynx. The cricoid cartilage is shaped like a signet ring, and it forms the posterior wall of the larynx. Situated in the back of the larynx are the two arytenoid cartilages. These are pyramidal in shape and rest along the upper border of the cricoid cartilage. Although the hyoid bone is not technically part of the larynx, it is often included in laryngectomy specimens.

Three additional anatomic landmarks need to be defined because cancers that invade these landmarks frequently escape from the larynx. The *pre-epiglottic space* is the triangular space anterior to the base of the epiglottis. The pre-epiglottic space is filled with fatty connective tissue, and it is bounded posteriorly by the epiglottis, inferiorly by the thyroepiglottic ligament, anteriorly by the thyrohyoid membrane, and superiorly by the hyoepiglottic ligament. The *paraglottic space* is a less well-defined area composed of loose connective tissue, which lies between the thyroid cartilage and two membranes that form the structural base for the vocal folds, the conus elasticus and quadrangular membrane. The *anterior commissure* is the anterior dense ligamentous attachment of the true vocal cords to the thyroid cartilage. The thyroid cartilage lacks an internal perichondrium; therefore, carcinomas may invade the thyroid cartilage at the level of the anterior commissure. Carcinomas may also escape the larynx inferiorly via the cricothyroid membrane.

Finally, although the pyriform sinuses are technically part of the hypopharynx, one should be aware of them because they are frequently resected with the larynx. The pyriform sinuses are small pouches that extend inferiorly from the intersection of the aryepiglottic folds, glossoepiglottic folds, and pharyngeal wall. Depending on the size and location of the tumor, laryngeal

specimens may also include other portions of the hypopharynx (including the posterior pharyngeal wall and the pharyngo-esophageal junction) and the thyroid gland.

Total Laryngectomy

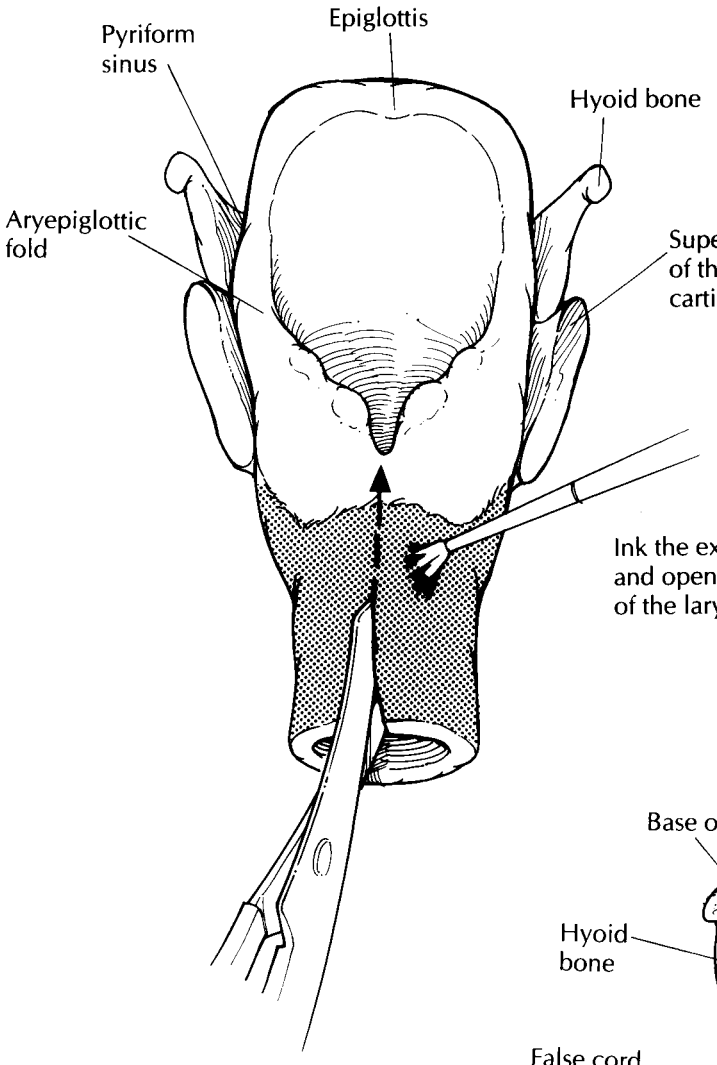
The easiest way to orient a total laryngectomy specimen is to identify the epiglottis. The epiglottis is present anteriorly at the most superior aspect of the larynx, and the flap of the epiglottis closes posteriorly. If the epiglottis is not present, then the thyroid cartilage can be used to orient the specimen. The superior horns of the thyroid cartilage are located superiorly and project posteriorly, while the V-shaped apex of the thyroid cartilage points anteriorly.

After the specimen has been oriented, ink the soft tissue and mucosal margins. The mucosal margins essentially form two rings. The inferior ring is formed by the trachea, and the superior ring is formed by the circular opening of the larynx into the pharynx. After the margins have been inked, cut through the posterior wall of the larynx in the midline using a pair of scissors. This posterior midline approach will fully expose the mucosal surfaces of the larynx without disrupting the anatomic structures located along its anterior and internal walls. The larynx can then be cracked open posteriorly by expanding the posterior opening with your thumbs. The easiest and safest way to do this is to push hard on the superior horns of the thyroid cartilage. The posterior aspect of the larynx can then be kept open using a small wooden stick. The opened larynx should be photographed to document the location and size of the tumor. Depending on the preferences of your laboratory, the larynx can be processed fresh or after fixation.

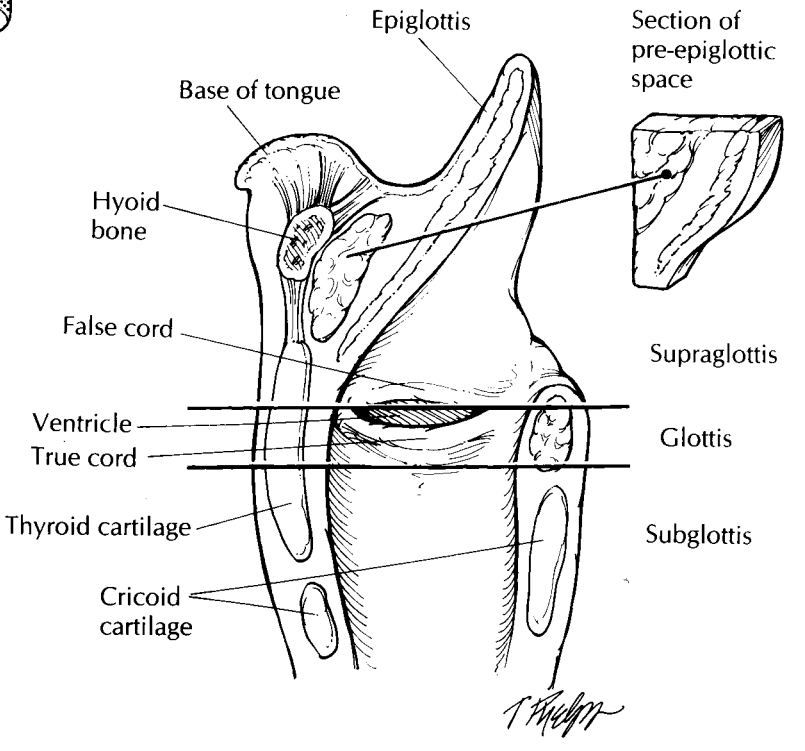
Continue your dissection by sampling the mucosal margins. Sampling the inferior mucosal margin is a relatively simple step. If this margin is not closely approached by tumor, it can be taken as a single shave section of the tracheal stump. If the tumor is close to the inferior margin, take perpendicular sections. Sampling the superior mucosal margin, on the other hand, is much more labor intensive. This mucosal margin spans a number of important laryngeal structures, and great care must be taken to sample the margin thoroughly and to designate each sampled margin as precisely as possible. As illustrated, the superior mucosal margin is formed (1) anteriorly by the mucosa of the base of the tongue, (2) laterally by the pyriform sinuses or lateral walls of the posterior hypopharynx, and (3) posteriorly by the posterior cricoid mucosa. Perpendicular sections of each of these three mucosal margins should be taken. Next, take the soft tissue margins. These can be taken as perpendicular sections from the anterior surface of the specimen and from any other areas where the soft tissues appear infiltrated by tumor.

Once all the margins are taken, turn your attention to the tumor. Keeping the three anatomic regions of the larynx (the supraglottis, glottis, and subglottis) in mind, carefully document the side, size, and exact location of any tumors. Also note whether the tumor is endophytic or exophytic. Submit sections of each identified tumor for histology to show its maximal depth of invasion as well as its relationship to grossly uninvolved mucosa. Next, carefully examine, document, and sample for histology the mucosa of the pyriform sinuses, the epiglottis, the aryepiglottic folds, the false cords, the ventricles, the true vocal cords, the anterior commissure, and the subglottis. In general, longitudinal sections are most informative. As illustrated, a single longitudinal section can be taken to include the false cord, the ventricle, and the true cord. Carefully examine the thyroid cartilage and the cricoid cartilage. These structures should be selectively sampled to document the presence or absence of tumor invasion. These sections may have to be submitted for decalcification. If a tracheostomy site is present it should be noted, and several sections of it should be submitted for histologic examination. Finally, remember the three additional anatomic landmarks discussed earlier. The pre-epiglottic space can be sampled by taking a midline section from the base of the epiglottis superiorly and anteriorly toward the hyoid bone. As illustrated, the paraglottic space is usually included in the histologic section of the true and false cords. Finally, a section of the anterior commissure should be submitted in cancers that involve the vocal cords.

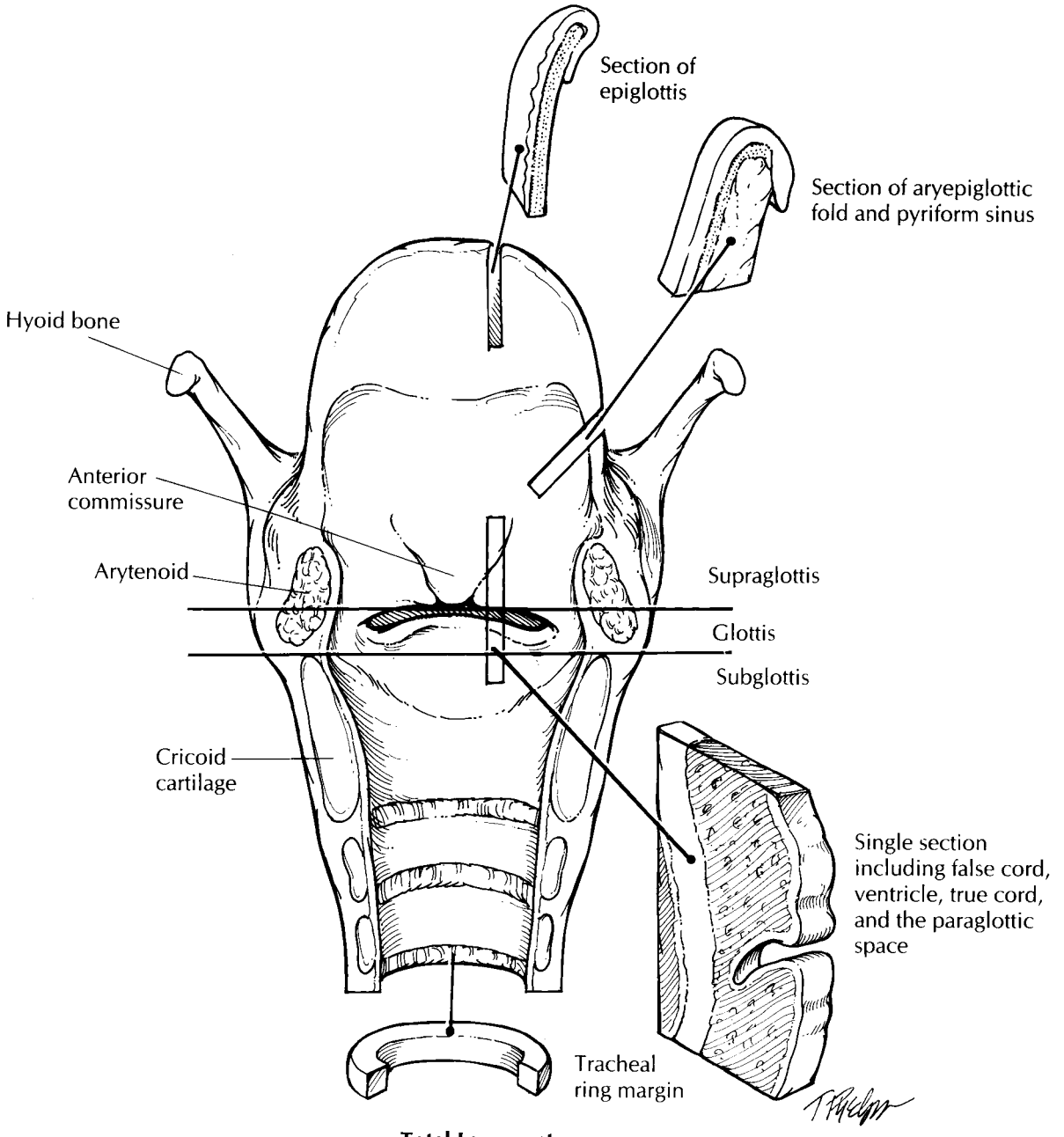
If any organs were removed along with the larynx, their presence should be documented. Be especially diligent in your search for the thyroid gland. Often, only a portion of the gland is removed with the larynx, and it may be embedded within the anterior soft tissues and



Ink the exposed soft tissues, and open the posterior surface of the larynx.



Although this is a plane of section you will not see, we find this diagram helpful, because it demonstrates the anatomy and the location of the pre-epiglottic space.



Total Laryngectomy

1. Orient the specimen. The epiglottis is present anteriorly at the most superior aspect of the larynx, and the flap of the epiglottis closes posteriorly.
2. Ink the margins, and then cut through the posterior wall of the larynx in the midline. Open the larynx by pushing hard on the superior horns of the thyroid cartilage.
3. Submit sections of the inferior (tracheal) and superior (base of tongue, pyriform sinus or lateral hypopharyngeal wall, and posterior cricoid) mucosal margins and anterior and posterior soft tissue margins.
4. Describe and submit sections of the tumor, keeping the three anatomic regions of the larynx in mind: the supraglottis, the glottis, and the subglottis.
5. Submit a section from both sides to include the false cords, the ventricles, and the true cords. Submit sections of the pyriform sinuses, the epiglottis, the aryepiglottic folds, the anterior commissure, the subglottis, the thyroid cartilage, the cricoid cartilage, and the hyoid bone. Submit sections of the pre-epiglottic space, the paraglottic space, and the anterior commissure.

strap muscles. If the thyroid gland is present, examine it as described in the thyroid section (see Chapter 36) and remember to look for parathyroid glands. If a radical neck dissection is attached, it can be removed and examined separately as described in the section on radical neck dissections (see Chapter 10).

Subtotal Laryngectomies

Portions of the larynx can also be resected. For example, a *hemilaryngectomy* is a voice-preserving procedure in which either the left or right thyroid cartilage, true vocal cord, false cord, and ventricle are removed in continuity. A *supraglottic laryngectomy* is a procedure performed for tumors of the supraglottic larynx in which the supraglottis is removed with a horizontal incision through the ventricles. The approach to these subtotal laryngectomy specimens should follow that for total laryngectomy. In addition, the new margins created by the procedure need to be sampled.

Important Issues to Address in Your Surgical Pathology Report on the Larynx*

General

- What procedure was performed, and what structures/organs are present?
- What is the exact location of the tumor? Specifically, what is the probable site of tumor origin (glottis, supraglottis, subglottis), and what compartments and structures (e.g., glottis, supraglottis, subglottis, hypopharynx, pre-epiglottic space, thyroid cartilage) does it involve by direct extension? Does the tumor cross the midline to involve both sides of the larynx?
- What are the tumor's size, grade, type, and growth pattern (exophytic or endophytic)? What is the depth of deepest tumor invasion?
- Is there perineural and/or vascular invasion?
- Are any soft tissue or mucosal margins involved?

Supraglottic Cancers

- If the hyoid bone is attached, is the tumor above or below the level of the hyoid?
- Does the tumor involve the false cord, the epiglottis, the aryepiglottic folds, and/or the arytenoids?
- Does the inferior edge of the tumor involve the anterior commissure and/or the roof of the ventricle?
- If the aryepiglottic fold is involved, how far down the pyriform sinus does the tumor extend?
- How far does the cancer extend superiorly toward the base of the tongue?
- Does the cancer involve the pre-epiglottic space?
- Does the tumor invade the cartilaginous framework?

Glottic Cancers

- Does the tumor involve one vocal cord or both, and what is the length of the cord involvement?
- Is the anterior commissure involved? If so, does the tumor extend anteriorly into the thyroid cartilage?
- How far inferiorly below the free edge of the true vocal cords does the tumor extend (in millimeters)?
- Does the tumor extend superiorly into the ventricle, false cord, or base of the epiglottis?
- Does the cancer involve the paraglottic space?

Subglottic Cancers

- What is the superior extent of the tumor? Does it involve the true vocal cord?
- What is the inferior extent of the tumor? How close is the tumor to the inferior margin?
- What is the maximal depth of invasion? Does the carcinoma penetrate the conus elasticus and extend into the paraglottic space?

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*Modified from Kirchner JA, Carter D. The larynx. In: Sternberg SS, ed. *Diagnostic Surgical Pathology*, 2nd ed. New York: Raven Press; 1994:907–908.