Chapter 47 – Horizontal Partial Laryngectomy

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Conservation partial laryngeal surgery is defined as removal of a portion of the larynx with preservation of the respiratory, sphincteric, and vocal functions of the larynx. Surgical procedures that eliminate one of these functions, such as near-total laryngectomy, which requires a permanent tracheostomy, are not described by the term *conservation* and are not discussed in this section. Conservation laryngeal surgery can be divided into two major categories, horizontal and vertical, the first of which is discussed in this chapter.

For nearly half a century supraglottic laryngectomy was the only standard horizontal partial laryngectomy, and it is appropriate for tumors confined to structures superior to the true vocal cords. The feasibility of this procedure is based on the fact that most laryngeal cancers do not cross the laryngeal ventricle until quite advanced. The procedure requires removal of the superior portion of the thyroid cartilage in continuity with the supraglottic structures and often the hyoid bone, as well as approximation of the inferior laryngeal remnant, which consists of the true vocal cords with both anterior and posterior attachments to the musculature of the tongue base.

In 1990 Laccourreye and coworkers reported their experience with a new type of horizontal partial laryngectomy that removes both the membranous true vocal cords and the entire thyroid cartilage (Table 47-1).[1] Preservation of the respiratory and sphincteric functions of the larynx relies on tight approximation of the cricoid cartilage to the hyoid bone and preservation of at least one innervated cricoarytenoid unit. The larynx is resected just superior to the cricoid and anterior to the arytenoids and closed by approximating the cricoid to the hyoid bone—a procedure termed *supracricoid partial laryngectomy* [SCPL]) with *cricohyoidopexy* (CHP). This procedure is appropriate for selected patients with (1) glottic cancer that extends onto the supraglottis, (2) supraglottic cancer that extends onto the true vocal cords, (3) cancer involving both entire membranous vocal cords, or (4) cancer that has infiltrated the paraglottic space and has fixed a vocal cord. All these situations have traditionally been managed by total laryngectomy, and specific criteria must be met for the procedure to result in a functional larynx. The epiglottis can be left in place when this operation is performed for glottic cancer and, in this situation, is incorporated into the closure (*supracricoid partial laryngectomy with cricohyoidoepiglottopexy* [SCPL-CHEP]). The cricoid cartilage, hyoid bone, and at least one functional (innervated) cricoarytenoid joint complex are preserved. Arytenoid sensation is preserved as well through intact superior laryngeal nerves bilaterally. Both procedures shorten the larynx significantly in the vertical dimension. Previous radiation therapy is not a contraindication to SCPL, as long as the structures required for reconstruction can be preserved.[2,3] The procedure cannot be performed if more than 10 mm of anterior subglottic extension exists anteriorly because the cricoid cartilage is used for closure (although a recent report suggests that the cricoid may spared with up to 15 mm of subglottic extension[2]). At least one arytenoid must be uninvolved, as well as the cricoarytenoid joint on the side of a fixed vocal cord, because reconstruction depends on intact cricoid cartilage.

The time until recovery is longer than with a traditional vertical partial laryngectomy, and a tracheostomy tube is required for about 3 weeks. The time course required for postoperative swallowing rehabilitation more closely parallels that for supraglottic laryngectomy as well, although nonirradiated patients with glottic cancer who are able to retain their epiglottis and both arytenoid cartilages swallow earlier. If properly selected, most patients can be decannulated and will be able to tolerate a regular diet. Horizontal partial laryngectomy, therefore, is suitable either for supraglottic cancer, including that involving the true vocal cords, or for extensive glottic cancer that might otherwise necessitate total laryngectomy.

Table 47-1   -- TYPES OF HORIZONTAL PARTIAL LARYNGECTOMY

Supraglottic
Extended supraglottic to include:
Tongue or arytenoid
Partial laryngopharyngectomy
Supracricoid with cricoepiglottohyoidopexy (epiglottis preserved)
Supracricoid with cricohyoidopexy (epiglottis resected)

ANATOMIC CONSIDERATIONS

The supraglottic larynx is the portion of the larynx between the tip of the epiglottis superiorly and the laryngeal ventricles inferiorly (Fig. 47-1). Laterally, the supraglottic larynx includes the aryepiglottic folds. However, tumors that originate on the lateral aspect of the aryepiglottic fold (the medial wall of the piriform sinus) are considered hypopharyngeal tumors. Anteriorly, the supraglottic larynx includes the lingual surface of the epiglottis. Tumors arising in the adjacent vallecula and tongue base should be considered oropharyngeal. Posteriorly, the supraglottic larynx is limited by the arytenoid cartilage. Tumors in the postcricoid mucosa are also considered hypopharyngeal.
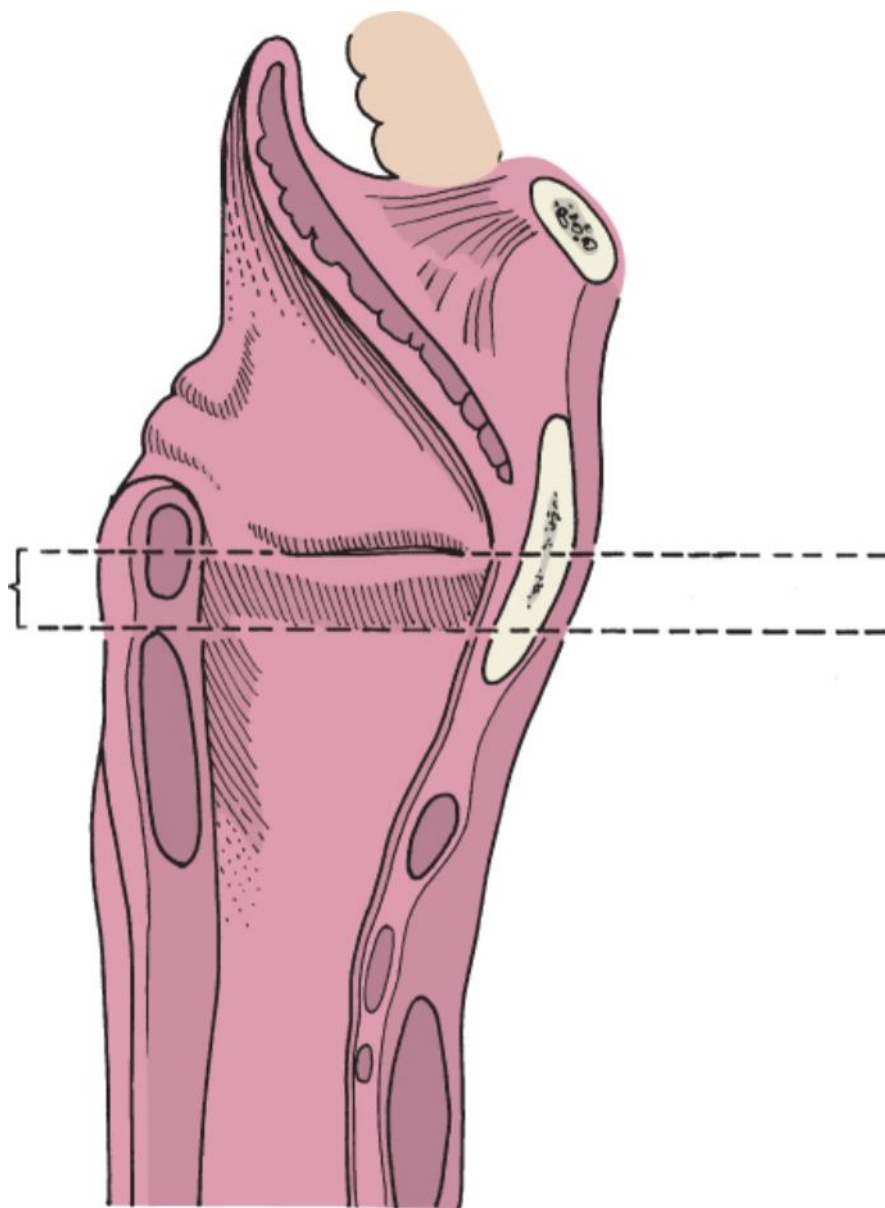

Figure 47-1 Sagittal view of the larynx. The inferior border of the supraglottic larynx is at a plane through the level of the true vocal cord.

Squamous cell carcinoma accounts for more than 95% of malignant tumors arising in the supraglottic larynx. Tumors that originate from minor salivary glands, such as acinic cell tumors, mucoepidermoid carcinoma, and adenocystic carcinoma, are encountered rarely. Other cell types that arise from connective tissue and the surrounding structures are also considered rare.

Abuse of both alcohol and tobacco is thought to play a major role in the development of supraglottic squamous cell carcinoma.[4–7] The relative percentage of supraglottic and glottic cancer varies from culture to culture. In Finland[8] and much of the rest of Europe,[9] two thirds of laryngeal cancers arise in the supraglottis and one third in the glottis. The ratio is reversed in the United States.[10]

The plan of management of squamous cell carcinoma of the supraglottic larynx must take into consideration the size and location of the primary cancer, as well as the general condition of the patient and the propensity for these cancers to metastasize to the cervical lymph nodes. The relative risk for metastatic cancer tends to be directly related to the size of the primary cancer—for instance, the risk to the cervical lymphatics can be estimated to be at least 20% for patients with lesions less than 2 cm in diameter[11] and may be as high as 80% in patients with

advanced supraglottic carcinoma.[12] It is estimated that metastatic disease in the contralateral neck may develop in as many as 40% of patients with metastasis to the lymph nodes in the ipsilateral neck. This observation is somewhat contentious in view of the fact that nearly half of tumors encountered in the supraglottic larynx are on or near the midline. At least 10% of patients with no evidence of ipsilateral metastases may eventually demonstrate contralateral metastases.[13,14]

Therapeutic alternatives for patients with squamous cell carcinoma of the supraglottic larynx include surgery, radiation therapy, or a combination of the two. It is generally agreed that patients with small, superficial cancers involving the supraglottic larynx may be treated by either surgery or radiation therapy with similar therapeutic efficacy.[15,16] Surgery improves the opportunity for disease control in patients with more advanced disease, such as evidence of deep invasion into cartilage or the preepiglottic space (Fig. 47-2). Cancer filling the preepiglottic space that approaches or involves the hyoid bone is a contraindication to SCPL because functional reconstruction (CHP or CHEP) depends on preservation of the hyoid bone. In the absence of involvement of the true vocal cords or arytenoids or extensive tongue base involvement, these tumors are amenable to standard supraglottic laryngectomy. Patients with extension of cancer to involve the tongue base or hypopharynx are at high risk for local recurrence. Accordingly, these patients are frequently treated with a combination of surgery and postoperative radiation therapy.[14,17]
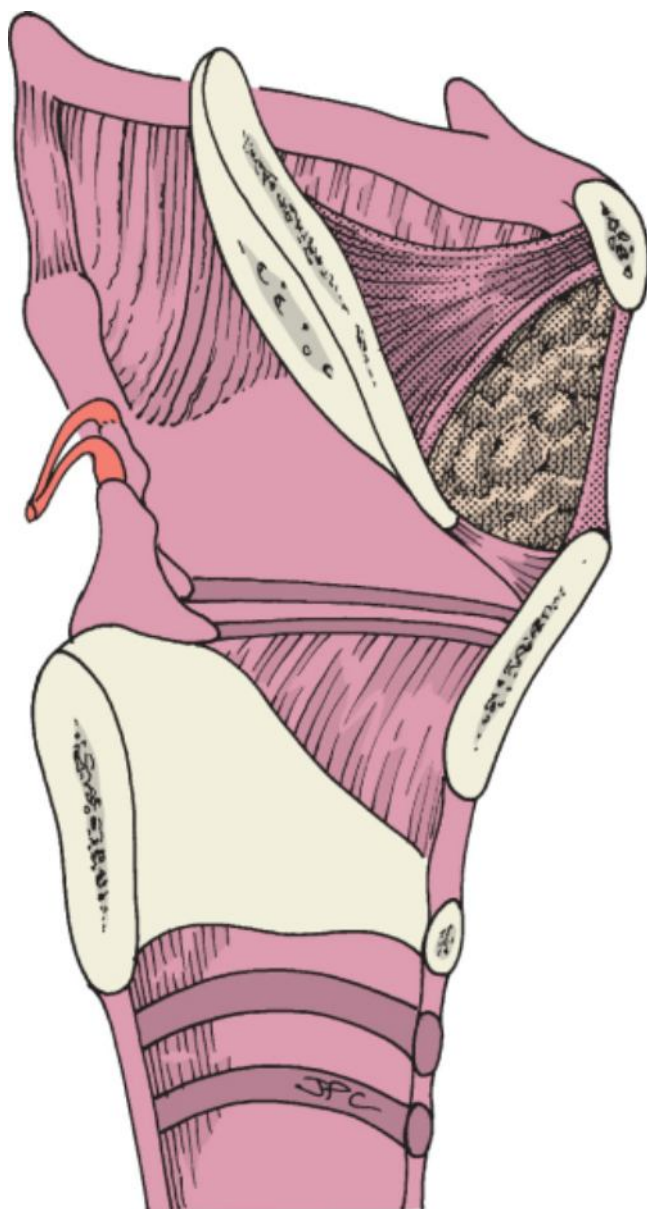

Figure 47-2 The preepiglottic space *(shaded area)* is bounded anteriorly by the thyrohyoid membrane. Superiorly, it is contained by the hyoepiglottic ligament. Tumor limited to the preepiglottic space is not a contraindication to supraglottic laryngectomy. However, tumor extension anterior to the preepiglottic space must be recognized and satisfactorily excised to ensure control of disease.

Patients with squamous cell carcinoma confined to the supraglottic larynx benefit from supraglottic laryngectomy, provided that their general health allows recovery from surgery. This procedure is highly effective in controlling

local disease and allows preservation of nearly normal vocal function and deglutition. In a retrospective review of more than 200 patients with carcinoma of the supraglottic larynx at the University of Pittsburgh, 72 of these patients were eligible for supraglottic laryngectomy.[14] Recurrent cancer in the larynx was not encountered; however, less than 2% of patients experienced recurrence in the base of the tongue. Recurrence in this area may indicate that it is more difficult to achieve adequate surgical margins in patients with extension of tumor into the vallecula, preepiglottic space, and base of the tongue.

Equally effective as open supraglottic laryngectomy has been endoscopic resection with use of the operating microscope and carbon dioxide laser. This technique, in experienced hands, has similar excellent rates of local control and avoids the need for a temporary tracheotomy. The reader is referred to the previous chapter for more in-depth discussion of endoscopic excision.

A patient with a supraglottic cancer that extends to involve the anterior commissure is a candidate for reconstruction with SCPL-CHP. As noted earlier, involvement of one arytenoid or fixation of a vocal cord is not a contraindication to the procedure, but it will probably result in prolongation of the postoperative recovery period, similar to the situation of SCPL performed after radiation therapy.

An important contribution of surgery to the management of patients with squamous cell carcinoma of the supraglottic larynx is that it affords the pathologist the opportunity to accurately stage the primary cancer and the status of the cervical lymphatics. This, in turn, results in improved accuracy in patient counseling with respect to decision making regarding the use of adjuvant therapy.

PATIENT SELECTION

Cancer involving the supraglottic larynx requires histologic confirmation. The infrequently encountered small superficial cancer confined to the suprahyoid epiglottis may be managed successfully by epiglottectomy with the CO_2 laser, or open excision via transhyoid or lateral pharyngotomy may be appropriate. Unfortunately, the asymptomatic nature of supraglottic tumors makes small lesions relatively unusual, with the majority of patients generally being found to have more extensive cancer at initial evaluation. Cancer confined to the supraglottic larynx anterior to the arytenoids may be ideally suited to supraglottic laryngectomy. Extension of the cancer to involve a single arytenoid may occasionally be considered for supraglottic laryngectomy, but bilateral involvement of the arytenoids is a strict contraindication to either supraglottic laryngectomy or SCPL and would require total laryngectomy because the sphincteric function of the larynx would be lost.

Cancer involving the aryepiglottic fold and medial wall of the piriform sinus can be treated by supraglottic laryngectomy. When the cancer extends to involve the anterior and lateral walls of the piriform sinus, supraglottic laryngectomy can be extended to include partial pharyngectomy, but involvement of the apex of the piriform sinus (indicating extension below the plane of the laryngeal ventricles) is a contraindication to supraglottic laryngectomy.

Supraglottic laryngectomy can also be extended to include the vallecula and base of the tongue. The propensity for cancer arising in the base of the tongue to infiltrate submucosally and involve large areas of muscle must be considered during the preoperative evaluation inasmuch as resection may create a significantly larger defect than initially anticipated. The extended supraglottic laryngectomy further compromises swallowing function and should be applied only to patients with good performance status. Consequently, supraglottic laryngectomy may not be applicable to many patients with involvement of the base of the tongue.

All patients undergoing either supraglottic laryngectomy or SCPL experience aspiration for some time. The magnitude and duration of this aspiration problem are directly related to the extent of the surgical resection, removal of the superior laryngeal nerve, and the patient's age, motivation, and general physical condition, especially underlying cardiopulmonary reserve. Accordingly, these factors must be carefully evaluated and considered in the preoperative planning.

PREOPERATIVE EVALUATION

The principal considerations in the decision-making algorithm regarding surgical management of a patient with carcinoma of the larynx are the history and physical examination, including assessment of the extent of the primary tumor, evaluation of the cervical lymphatics, and estimation of the patient's underlying cardiopulmonary reserve.

Every patient should undergo direct laryngoscopy as part of the preoperative evaluation. Further evaluation should also include assessment of the entire upper aerodigestive tract to rule out a synchronous second primary carcinoma. A second primary carcinoma arising in the lung is most common when supraglottic cancer is the index tumor. The primary cancer should be carefully evaluated for evidence of spread to contiguous structures, which would, in turn, affect the subsequent management plan. Spread to involve the tongue base, piriform sinus, true vocal cords, or arytenoid must be identified. Similarly, transglottic spread must be recognized. Involvement of the paraglottic space inferior to the plane of the laryngeal ventricle is a contraindication to supraglottic laryngectomy

but not to SCPL (Fig. 47-3). Subglottic extension must be noted and measured with angled telescopes if SCPL is to be considered. Vocal cord fixation must be assessed and the functionality of the cricoarytenoid joint determined. Visual inspection and palpation of the supraglottis, true vocal cords, arytenoids, and vallecula help identify involvement in these regions. The surgeon must keep in mind that the true vocal cords and at least one arytenoid must not be involved for the patient to be considered a candidate for supraglottic laryngectomy, whereas the cricoid, hyoid, and at least one functional arytenoid must be preserved for SCPL (Fig. 47-4).
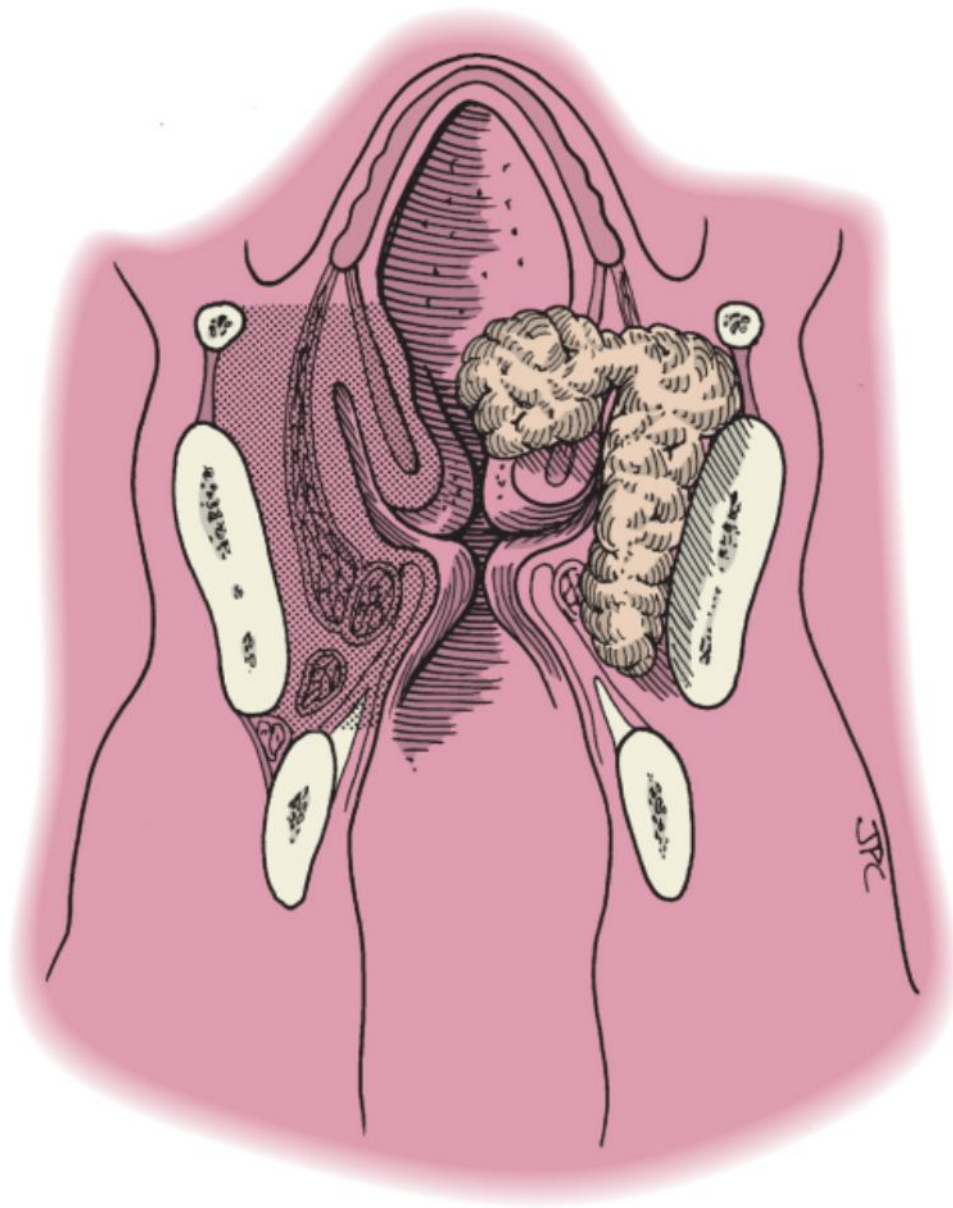

Figure 47-3 The paraglottic space *(shaded area)* describes the submucosal soft tissue of the larynx contained by the thyroid cartilage externally. Tumor of the supraglottic larynx may spread submucosally through the paraglottic space. If tumor extends across the plane of the true vocal cord, as demonstrated in this illustration, supraglottic laryngectomy would be contraindicated because one would cut across tumor at the level of the vocal cord.
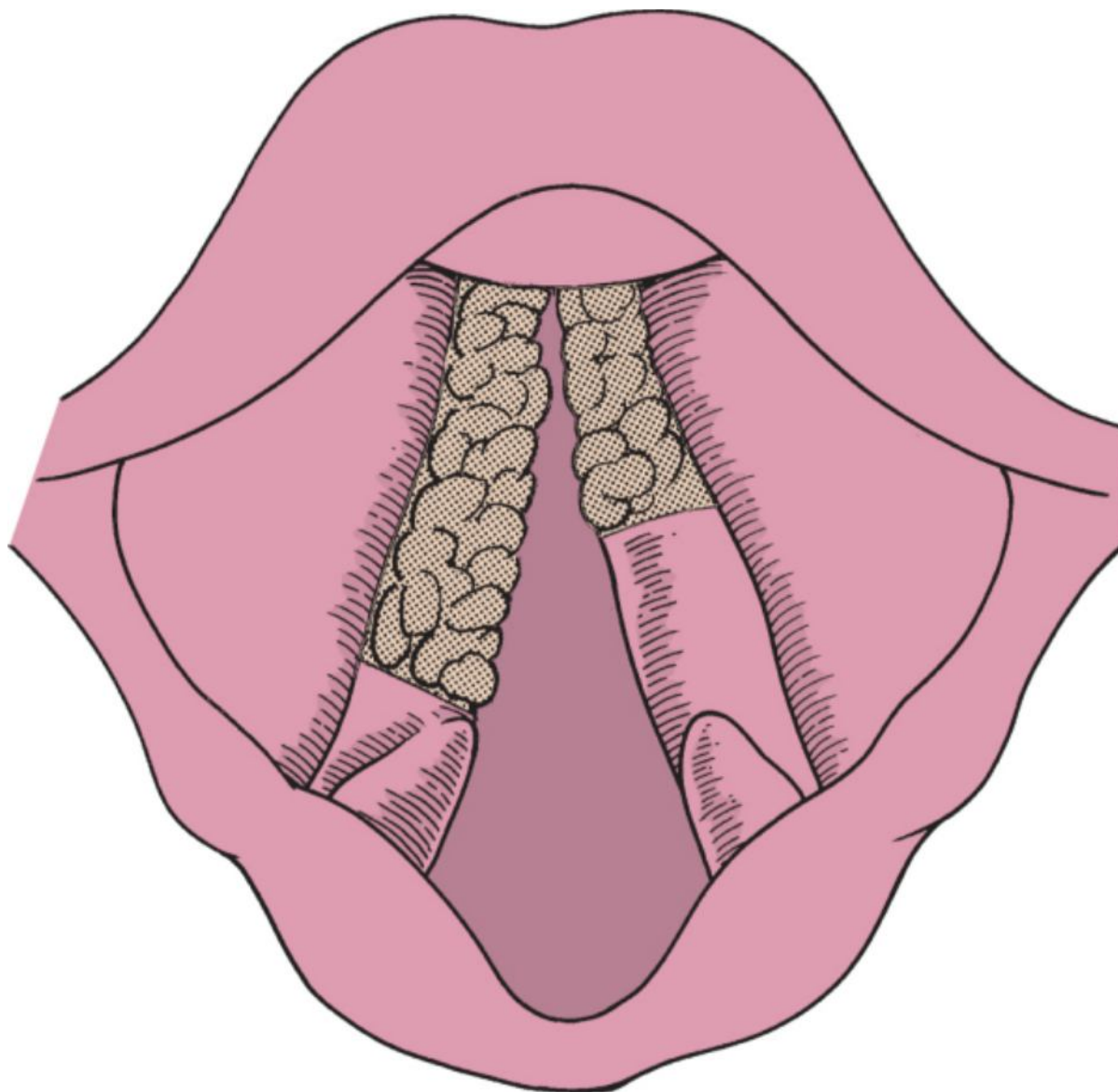
Figure 47-4 Maximal size of a transglottic tumor that can be excised via supracricoid partial laryngectomy. Note that only minimal involvement of the preepiglottic space is permitted.
(Redrawn from Pearson BW, Donald PJ: Larynx. In Donald P [ed]: Head and Neck Cancer: Management of the Difficult Case. Philadelphia, WB Saunders, 1984, pp 93-148.)

Computed tomography (CT) has been demonstrated to be an excellent aid in the identification of tumor extension to the paraglottic space (Fig. 47-5). Extension of tumor anteriorly into the base of the tongue is best identified with magnetic resonance imaging (MRI).
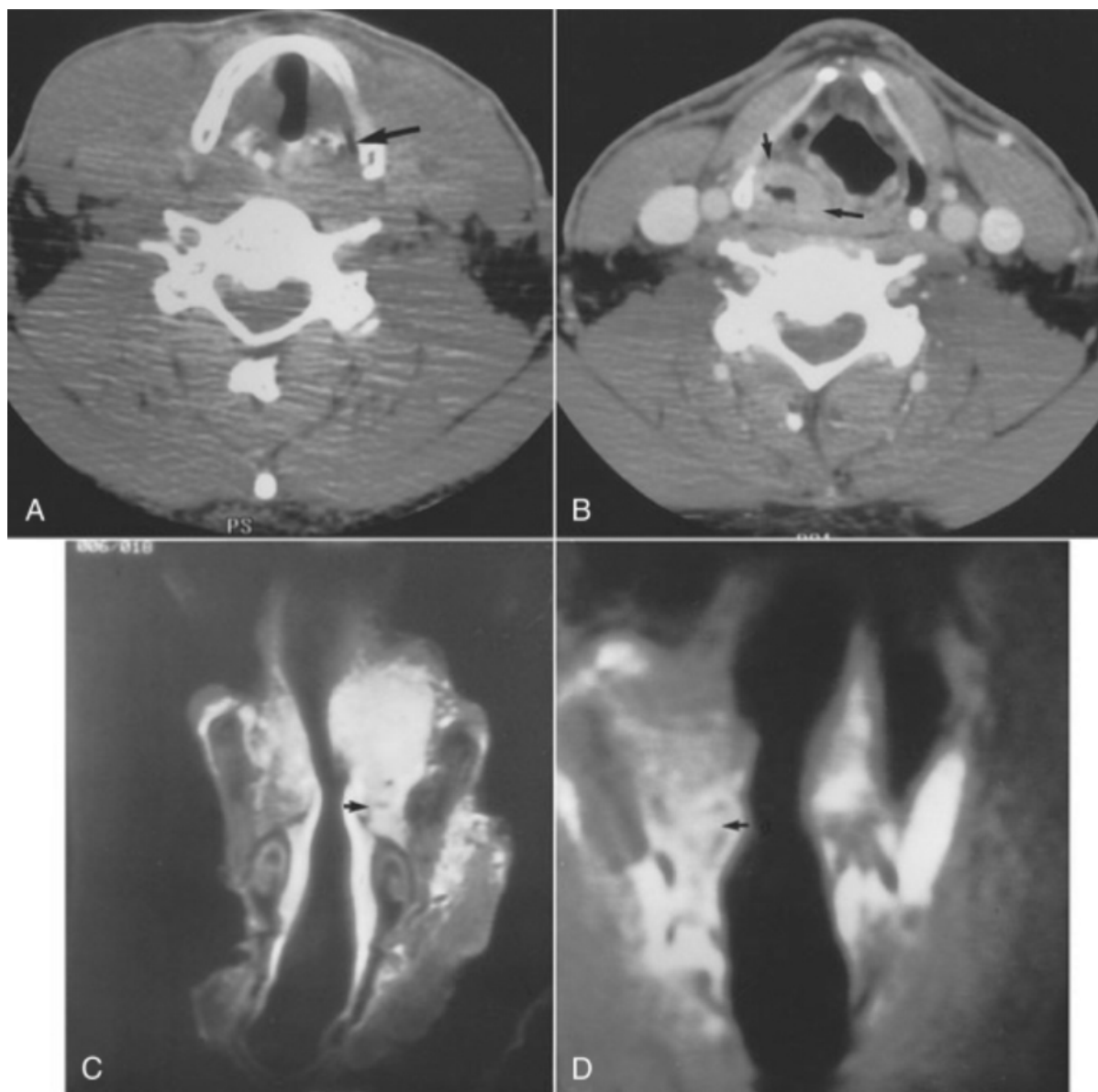
Figure 47-5 **A**, Axial computed tomography scan demonstrating tumor in the paraglottic space displacing the true vocal cords toward the midline. The air within the piriform sinus on the normal side *(arrow)* is absent on the involved side. Involvement of the mucosa of the true vocal cords cannot be ruled out on this scan. **B**, Involvement of the arytenoid and the piriform sinus *(arrows)* by tumor is a contraindication to supraglottic laryngectomy. **C**, This laryngectomy specimen was imaged in the coronal plane. A supraglottic tumor with extension medial to the true vocal cord in the paraglottic space is demonstrated *(arrow)*. **D**, Carcinoma extending lateral to the true vocal cord in the paraglottic space *(arrow)* is displayed on this coronal image.

Evaluation of cervical metastases has traditionally been accomplished by palpation. Imaging with either CT or MRI is now generally agreed to be more sensitive than physical examination. Nodes greater than 1 cm and those with a hypodense center should be considered highly suspicious for metastatic cancer. Appropriate treatment of the neck should be integrated with the plan for treatment of the primary cancer. In our department, this requires concurrent bilateral neck dissection in most patients.

We previously reviewed and reported observations made in a series of 202 patients treated for squamous cell carcinoma of the supraglottic larynx.[14] At the time of the review, patients with carcinoma of the supraglottic larynx were routinely treated by resection of the primary tumor (via either supraglottic laryngectomy or total laryngectomy as indicated) and ipsilateral modified radical neck dissection on the side of predominant cancer involvement. Postoperative radiation therapy was frequently administered to patients with evidence of ipsilateral metastases. The contralateral (unoperated) side of the neck was the most common site of failure. This observation was similar for patients with epiglottic (midline) lesions and those with aryepiglottic fold and false vocal cord (lateral) lesions. When neck dissection demonstrated histologic evidence of cervical metastasis in the ipsilateral neck, the recurrence rate in the contralateral neck was 26%, as opposed to a recurrence rate of 13% when no metastases were identified in the ipsilateral neck. Overall, recurrence manifested by tumor in the contralateral (unoperated) neck was observed in 16% of patients treated by surgery on the ipsilateral neck and postoperative radiation

therapy and in 19% of patients treated by surgery on the ipsilateral neck only.

Because of these observations, we now recommend routine bilateral neck dissection in all patients with squamous cell carcinoma of the supraglottic larynx, including patients treated by endoscopic resection, as well as those treated by either partial or total laryngectomy. The site of the lesion (lateral versus midline) does not change this recommendation. When preoperative assessment demonstrates no evidence of cervical metastasis, bilateral selective neck dissection with removal of lymph nodes from zones II, III, and IV is appropriate. Whether to dissect level IIB is a current area of investigation.

When preoperative assessment indicates cervical adenopathy, concurrent bilateral neck dissection is performed. In these circumstances we prefer to modify one neck dissection to preserve the internal jugular vein if possible. An alternative to preservation of the internal jugular vein is reconstruction of this vein with a saphenous vein bypass graft. We have not found this necessary inasmuch as nodes less than 3 cm can routinely be dissected free of the carotid sheath with an adequate margin. When no cervical adenopathy is present, selective neck dissection is performed.

The parameters by which the patient's underlying cardiopulmonary reserve is to be estimated remain contentious. Arterial blood gas analysis and pulmonary spirometry serve as rough estimates of underlying chronic obstructive pulmonary disease, but there is no known objectively defined parameter with which to select patients for supraglottic laryngectomy. Probably the most accurate predictor of pulmonary function is the individual patient's history of exercise tolerance. A patient who is unable to walk up two flights of stairs should be considered a poor candidate for supraglottic laryngectomy. Bedridden persons afflicted with carcinoma of the supraglottic larynx should not be offered supraglottic laryngectomy. Similarly, patients unable to ambulate because of advanced degenerative joint disease or lower extremity fractures should be considered poor candidates for supraglottic laryngectomy. This reflects the clinical observation that every patient undergoing horizontal partial laryngectomy can be expected to aspirate. Such aspiration can be partially controlled through a cuffed tracheotomy tube, aggressive pulmonary physiotherapy, and a highly skilled and energetic nursing staff. The ability to cough and ambulate cannot be underestimated in the successful convalescence of these patients. Similarly, advanced age, in and of itself, is not an absolute contraindication to supraglottic laryngectomy, although in general, patients older than 65 years, even when in reasonably good health, often do not adapt well to this surgery.

A relative contraindication to horizontal partial laryngectomy is the planned use of high-dose postoperative radiation therapy after bilateral radical or modified radical neck dissection. Accordingly, patients with obvious advanced bilateral cervical metastases who require bilateral radical or modified neck dissection may be poor candidates for voice-sparing surgery because the combination of horizontal laryngectomy with bilateral radical or modified neck dissection and postoperative radiation therapy frequently results in severe, incapacitating edema of the residual arytenoid mucosa and an incompetent glottis. This complication may be avoided, however, by communicating to the radiation oncologist the need to irradiate the neck metastasis only, thus sparing the remaining laryngeal structures. Conversely, patients discovered to have histologic evidence of cervical metastasis after selective neck dissection seem to tolerate postoperative radiation therapy reasonably well when histologic findings indicate that radiation therapy is necessary.

Either supraglottic laryngectomy or SCPL may be accomplished in patients who have failed previous treatment with full-course radiation therapy. Voice-sparing procedures in this setting, however, increase the risk for postoperative complications and recurrent disease. Before undertaking partial laryngectomy in a patient who has previously undergone radiation therapy, the surgeon must be doubly aware that submucosal spread of cancer beyond the confines of the planned procedure is an absolute contraindication to supraglottic laryngectomy. Clinical examination may be inadequate for this task inasmuch as recurrent cancer is frequently submucosal. CT or MRI may detect spread of tumor to the paraglottic space or involvement of the thyroid or cricoid cartilage. The routine use of frozen section for control of surgical margins is mandatory. Postoperatively, the risk for wound dehiscence and fistula formation is somewhat increased because of the radiation-induced fibrosis, reduced resistance to bacterial inoculation, and prolonged wound healing. We perform supraglottic laryngectomy *selectively* in patients with discrete, well-defined lesions of the supraglottic larynx who have failed previous radiation therapy or in patients in whom previous radiation therapy has been used for control of other primary tumors and supraglottic carcinoma ensued as a metachronous primary tumor. Although others have reported successful performance of SCPL in patents who have failed radiation therapy, one must also consider total laryngectomy in such cases because of the risk for unrecognized submucosal spread beyond the surgical margins.

Patients must be counseled that if at the time of surgery the cancer is found to be more extensive than was thought, total laryngectomy may be necessary. The consent form signed by the patient should include permission for a possible total laryngectomy, at which time a primary tracheoesophageal puncture is carried out for vocal rehabilitation.

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