Chapter 79 – Transcervical Approaches to the Cervical Spine

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The otolaryngologist is often involved in surgery to provide access to the cervical spine. This approach is usually carried out for the treatment of cervical spondylosis, and an orthopedic or neurologic surgeon is the primary surgeon. Rarely, a head and neck surgeon will be involved in the treatment of pathology involving the spine, such as infection or primary and metastatic neoplasms. Potential benefits for the primary surgeon include increased efficiency, decreased risk of injury to the vagus nerve or esophagus, decreased medicolegal risk, and follow-up care of voice and swallowing problems.

Familiarity with these approaches is also important for the treatment of conditions that do not involve the spine, such as deep neck infection, metastases to the retropharyngeal lymph nodes, cricopharyngeal achalasia, and Zenker's diverticulum. Surgical approaches to the cervical spine can be categorized as anterior cervical, lateral cervical, transoral, and transnasal approaches. This chapter focuses on transcervical approaches to the cervical spine. Transoral and transnasal approaches to the upper cervical spine are covered in Chapter 106.

ANATOMY

There are seven cervical vertebrae whose position in the neck depends on the length of the neck. It is useful to relate the position of the individual vertebrae to the cartilaginous and bony landmarks of the larynx and hyoid (Fig. 79-1). In general, C1 and C2 are at or above the level of the body of the mandible. C3 and C4 are at the level of the hyoid bone and the superior aspect of the thyroid cartilage. C5 and C6 are at the level of the posterior cricoid cartilage. C7 is at the lower limit of the neck and in some patients may be below the level of the clavicle. The vertebral bodies are covered anteriorly by the paraspinal muscles (longus capitis and longus colli). There is a visible separation of the paraspinal muscles in the midline. An angulation of the spine is often noted at the C5-C6 level. The cervical spine is bounded anteriorly by the pharynx superiorly and the esophagus inferiorly. Laterally, the cervical spine is bounded by the carotid sheath (Fig. 79-2). The superior laryngeal nerve courses across the neck deep to the carotid artery at the level of the thyrohyoid membrane and is in close association with the superior thyroid artery. The recurrent laryngeal nerve is situated in the tracheoesophageal groove superficial to the plane of the prevertebral fascia and enters the larynx at the cricothyroid joint. Lateral to the vertebral bodies, the vertebral artery courses within the vertebral canal of the lateral processes.

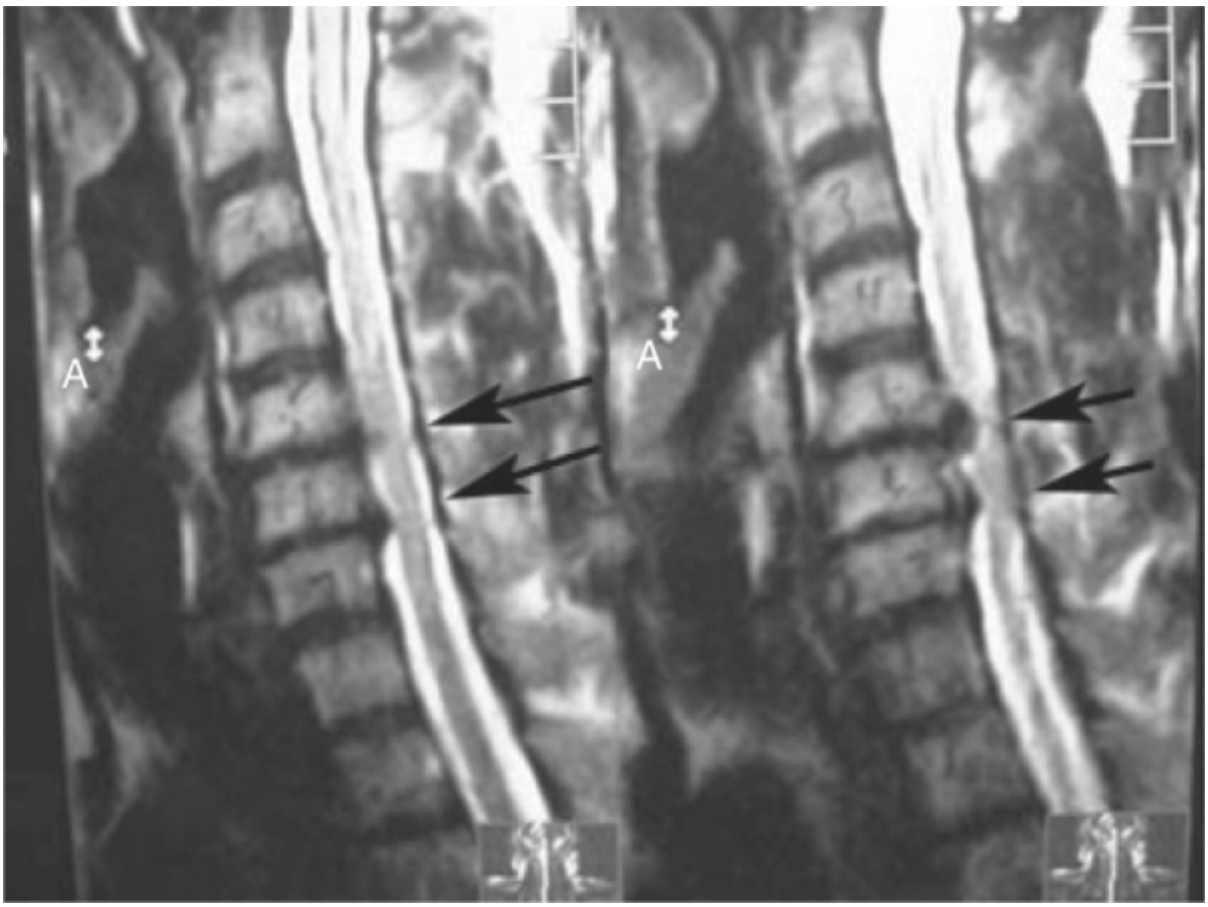

Figure 79-1 Preoperative magnetic resonance image (sagittal plane) demonstrating the relationships of the cervical vertebrae to palpable laryngeal landmarks, as well as significant spinal cord compression at the C5-C6 and C6-C7 levels *(arrows)*.

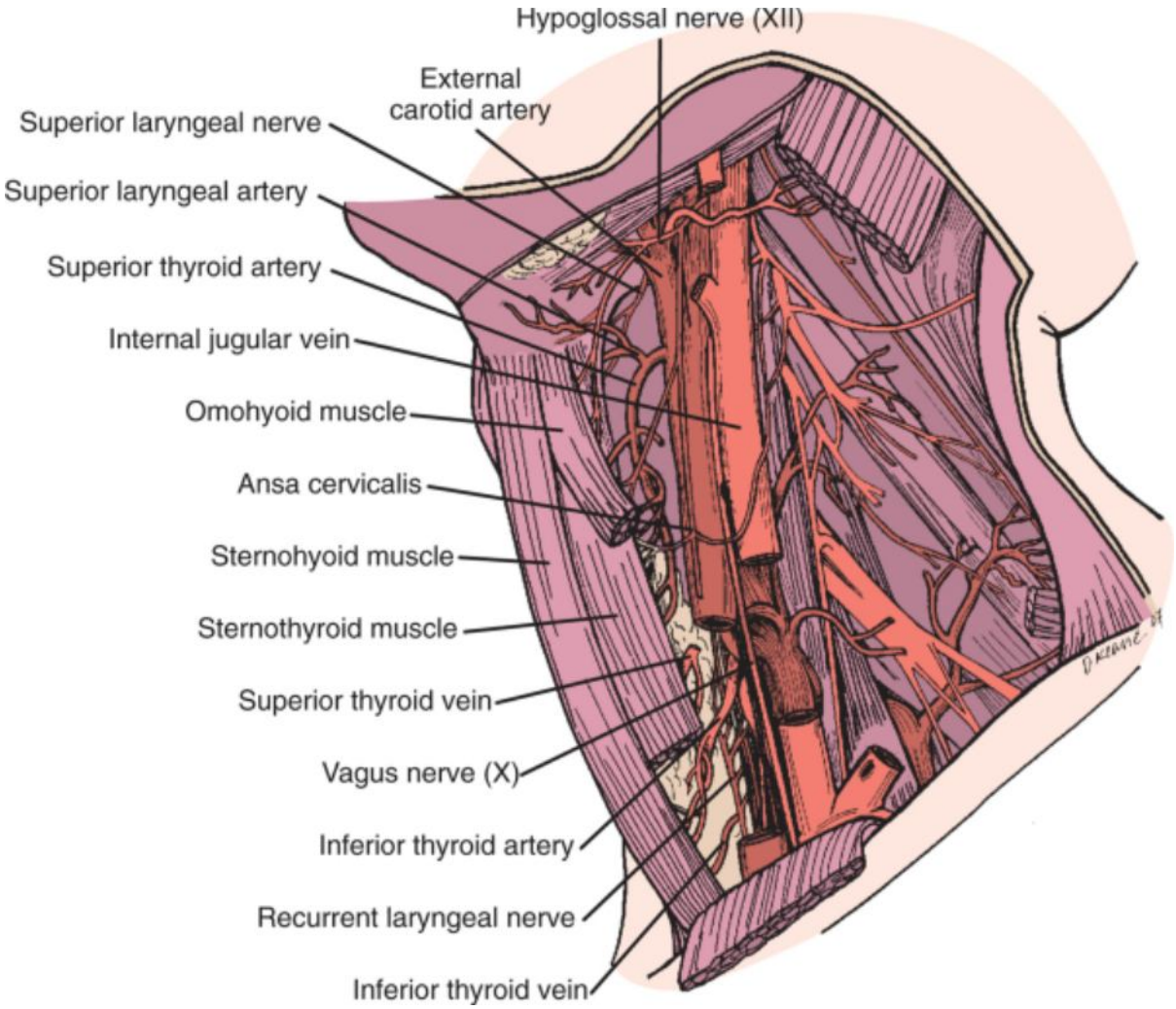

Figure 79-2 Key anatomic relationships with anterior approaches to the cervical spine include the carotid sheath laterally, the larynx and esophagus medially, the superior laryngeal nerve and superior thyroid artery superiorly, and the recurrent laryngeal nerve inferiorly.

There are three fascial planes in the retropharyngeal region: the buccopharyngeal, alar, and prevertebral fasciae.[1] The retropharyngeal space is bounded by the buccopharyngeal fascia anteriorly and the alar fascia posteriorly. The “danger space” is bounded by the alar fascia anteriorly and the prevertebral fascia posteriorly. The prevertebral space is located between the vertebral bodies and the prevertebral fascia. The retropharyngeal lymph nodes are located within the retropharyngeal space, anterior to the alar fascia. The lateral retropharyngeal lymph nodes (nodes of Rouvière) are situated just medial to the internal carotid artery at the level of the transverse process of the first cervical vertebra (atlas). Important landmarks for finding the retropharyngeal lymph nodes are the transverse process of the atlas, sympathetic trunk, superior sympathetic ganglion, and alar fascia (Fig. 79-3).

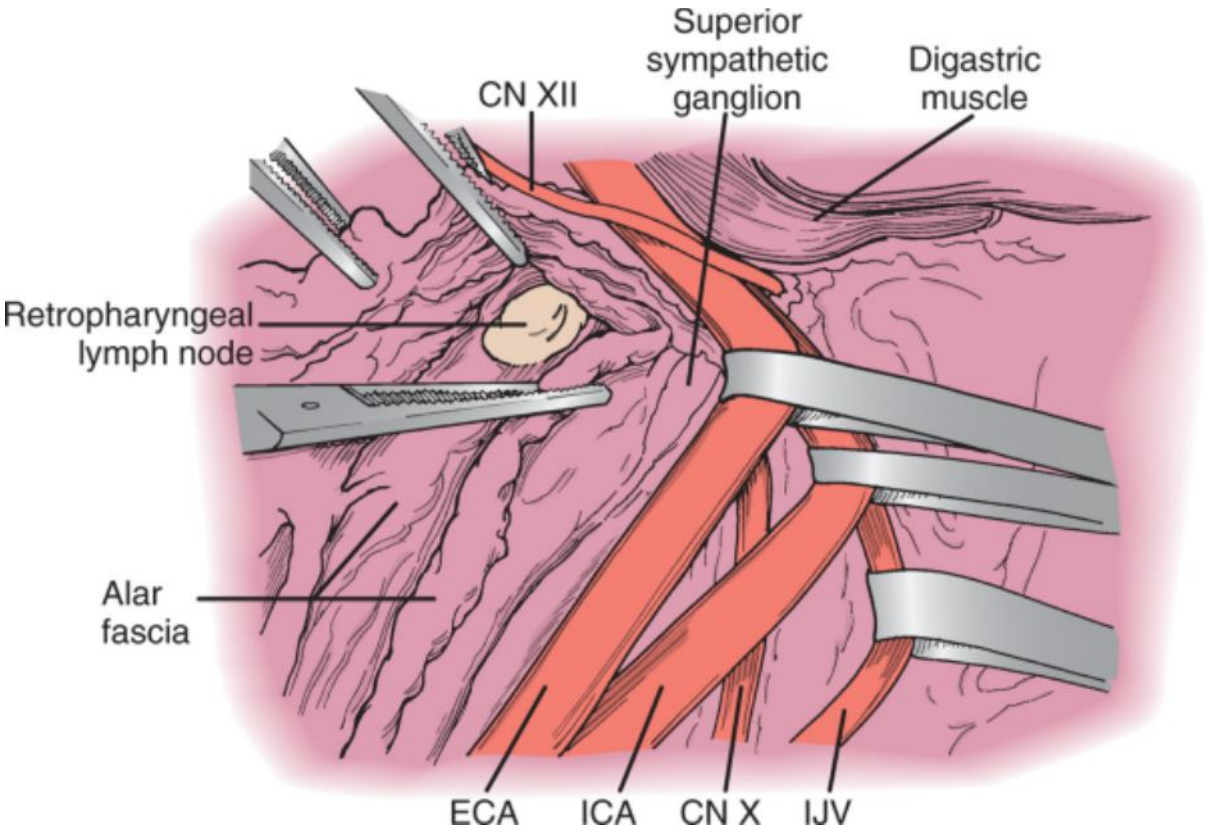

Figure 79-3 Important landmarks for finding the retropharyngeal lymph nodes are the transverse process of the atlas, sympathetic trunk, superior sympathetic ganglion, and alar fascia (left side of the neck). CN, cranial nerve; ECA, external carotid artery; ICA, internal carotid artery; IJV, internal jugular vein.

The carotid-vertebral space is the surgical window between the carotid artery and the vertebral artery (Fig. 79-4).[2] The transverse process of the first cervical vertebra is the most prominent of the vertebrae and is palpable deep to the superior attachment of the sternocleidomastoid muscle in patients who have a thin neck. It is a useful landmark for locating the lower cranial nerves (X, XI, XII), which are all anterior to the lateral process. From a lateral perspective, the superior aspect of the cervical spine is covered by the superior attachment of the sternocleidomastoid muscle and the anterior edge of the trapezius muscle. The muscles attach to the lateral processes of the vertebral bodies. The carotid sheath and sympathetic chain are anterior. The vertebral artery ascends within the vertebral canal but is exposed at the junction of C1 and C2, where it loops outside the canal. The artery maintains a course deep to the plane of the lateral processes.

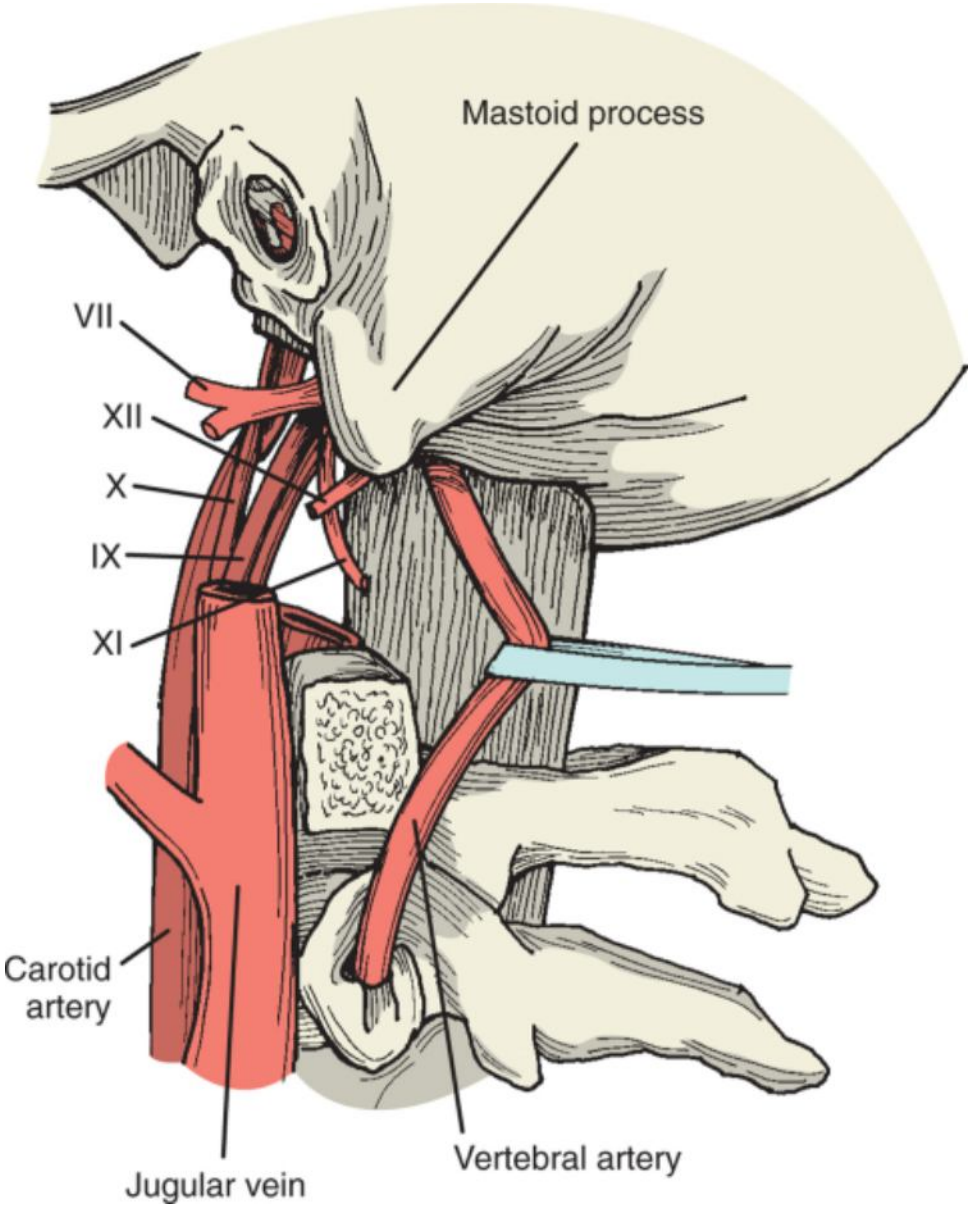

Figure 79-4 The left carotid-vertebral space. The vertebral artery has been mobilized posteriorly and the internal jugular vein ligated.

PATIENT SELECTION

Cervical spondylosis (see Fig. 79-1) is the most common indication for an anterior approach to the cervical spine. Patients may have intractable pain or sensory and motor loss from spinal cord compression. Revision surgery is sometimes necessary when the plating hardware becomes infected or displaced. Bulky hardware may also contribute to postoperative dysphagia and may be removed electively to improve swallowing function. Large osteophytes occur most commonly at the C4 to C6 levels in approximately 12% to 30% of the elderly and may be associated with symptomatic dysphagia and aspiration (Fig. 79-5).[3] It can be difficult to demonstrate that the patient's symptoms are due to an osteophyte, however, because dysphagia is frequently multifactorial in these patients. Extensive calcification of the anterior longitudinal ligaments with resultant dysphagia can develop in patients with Forestier's disease, or diffuse idiopathic skeletal hyperostosis (Fig. 79-6).[4] The calcifications usually span multiple levels. Rarely, infection of the vertebral bodies (osteomyelitis from adjacent infection or hematogenous seeding of the vertebral body, e.g., tuberculosis) may require surgery. Malignancies metastatic to the vertebral bodies are usually treated with palliative radiation therapy but may require surgery for stabilization of the cervical spine.

Figure 79-5 Lateral cervical spine radiograph demonstrating a large osteophyte at the C4 level *(arrow)*.

Figure 79-6 Forestier's disease, or diffuse idiopathic skeletal hyperostosis, is characterized by extensive calcification of the anterior longitudinal ligaments *(arrows)*.

The same surgical approach between the larynx and the carotid sheath is used to treat other pathologic processes in the neck. Infection of spaces deep in the neck may result in a retropharyngeal abscess. Although most cricopharyngeal myotomies for Zenker's diverticulum are now performed endoscopically, an anterior cervical approach to the cervical spine provides the necessary exposure of the cricopharyngeus and inferior pharyngeal constrictor muscle for performance of a myotomy. Neoplasms of the soft palate, pharynx, thyroid, and skull base may metastasize to the retropharyngeal lymph nodes.[5] Although survival is poor in patients with squamous cell carcinoma metastatic to the retropharyngeal lymph nodes,[6] retropharyngeal lymphadenectomy may be beneficial in selected patients with other types of neoplasms (esthesioneuroblastoma, thyroid cancer).

Lateral approaches are almost exclusively performed for neoplastic disease. Neoplasms may originate within the spinal tissues, extend to the spine from adjacent tissues, or be metastatic to the spine (Fig. 79-7). The most common neoplasms requiring surgical therapy that we have encountered include chondrosarcomas, chordomas, and meningiomas.

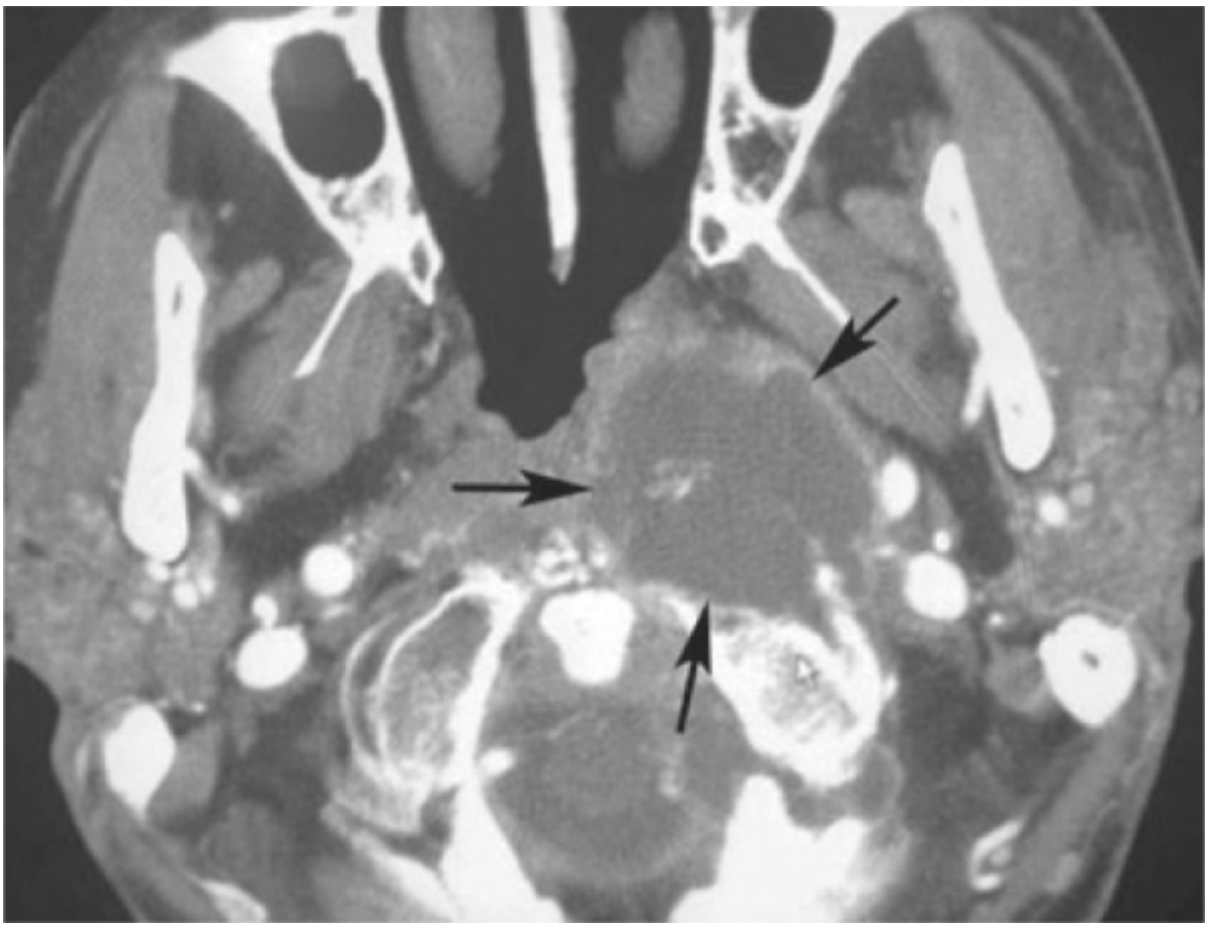

Figure 79-7 Chordoma involving the cervical spine (margins denoted by *arrows*).

PREOPERATIVE EVALUATION

Imaging of the spine is performed with computed tomography (CT) or magnetic resonance imaging (MRI), depending on the type of pathology. CT is preferred for assessment of bone pathology (bone destruction or osteophytes), whereas MRI is superior for delineating the level of cord compression from a herniated disc (see Fig. 79-1). A lateral plane film of the neck is sufficient to assess possible displacement of spinal hardware, such as a screw impinging on the esophagus. If perforation of the esophagus is suspected, a barium esophagogram is obtained. An esophagogram or modified barium swallow is also helpful in assessing the severity and contribution of osteophytes to dysphagia. In addition to a complete neurologic assessment, evidence of spinal cord compression can be evaluated with neurophysiologic monitoring (electromyography and somatosensory evoked potentials). In patients with suspected metastases to the retropharyngeal lymph nodes, imaging with combined positron emission tomography (PET)/CT can be helpful in confirming the diagnosis and staging the extent of disease.

Cranial nerve function is ideally assessed preoperatively, especially function of the recurrent laryngeal nerves. If there is a history or evidence of unilateral vocal cord paresis, an approach from the same side is usually selected to avoid the risk of injury to the nerve supply of the normally functioning vocal cord.

PREOPERATIVE PLANNING

The anatomic relationship of the vertebral bodies to cartilaginous and bony landmarks is assessed on a lateral radiograph of the cervical spine or with CT or MRI (sagittal view) (see Figs. 79-1 and 79-5). The level of the upper cervical vertebrae is determined by their relationship to the hyoid bone. The level of the midcervical vertebrae is best judged by their relationship to the posterior cricoid cartilage and the thyroid cartilage. Because cartilaginous landmarks are not well visualized on MRI, the epiglottis is a useful landmark. The anterior ring of the cricoid cartilage is a readily identifiable landmark for localizing the lower cervical vertebrae.

Neurophysiologic monitoring of spinal cord function is performed intraoperatively when there is preoperative compression of the spinal cord or when surgery on the spine is performed. If severe compression is present preoperatively, a baseline study is performed after induction of anesthesia and before positioning. After positioning, the patient is reassessed to confirm that the compression has not become worse. Continuous

monitoring is performed throughout surgery.

Informed consent should include a discussion of the potential risks, benefits, and expected sequelae of surgery. For anterior approaches, the greatest concern is postoperative hoarseness or aspiration as a result of injury to the superior or recurrent laryngeal nerves. Some degree of dysphagia is expected postoperatively and can persist for months in a minority of patients.[7] The risk of infection or significant bleeding is negligible. Perforation of the esophagus or hypopharynx is a remote possibility, but the risk is increased when scarring is present and when displaced hardware or a large osteophyte is being removed. For lateral approaches, there is additional risk to the lower cranial nerves and sympathetic chain (Horner's syndrome).

Intraoperative image guidance with a navigational system is helpful for addressing pathology of the upper cervical spine and cranial base from a lateral approach but is impractical for lower levels. When a navigational system is used, a CT angiogram will provide good visualization of bony anatomy, as well as the course of the vertebral artery.

SURGICAL APPROACHES

Selection of a surgical approach is dependent on the location and type of pathology. An anterior approach is used for the treatment of cervical spondylosis and most other conditions. The laterality of the incision is not important. Arguments can be made for either side, depending on the level of exposure, handedness of the surgeon, risk of retraction injury of the recurrent laryngeal nerve, deviation of the esophagus, and previous surgery. Most right-handed surgeons find a right-sided approach to be easier for instrumentation of the upper cervical levels and a left-sided approach for instrumentation of the lower cervical levels. Transcervical approaches to the retropharyngeal lymph nodes can be either anterior (medial) or posterior (lateral) to the carotid sheath. A lateral cervical approach is reserved for neoplastic involvement of the upper cervical spine, especially if there is involvement of the vertebral artery.

The patient is orally intubated with the endotracheal tube taped to the contralateral side. Perioperative prophylaxis with intravenous antibiotics effective against skin flora is optional; 1 to 2 g of cefazolin is usually given. The skin is prepared with povidone-iodine (Betadine) solution. With an anterior approach, the neck is slightly extended by placement of a shoulder roll. It may be necessary to retract the shoulders toward the foot of the bed with adhesive tape when the neck is short and the shoulders obscure the tissues for a lateral radiograph (Fig. 79-8). With a lateral approach, the patient is rotated slightly to the contralateral side with padding under the ipsilateral shoulder and the head turned slightly away. Excessive flexion should be avoided because it would interfere with dissection of the neck.

Figure 79-8 Positioning of the patient for an anterior cervical approach. The neck is extended and the shoulder is retracted inferiorly with tape to avoid obstruction of a lateral cervical radiograph.

Anterior Approach

The level of the incision is dependent on the desired level of exposure (vertebral level). A transverse incision is made in a natural skin crease in the mid to upper part of the neck for C2 to C4 and in the mid to lower part of the neck for C5 to C7 (Fig. 79-9). The proposed skin incision is infiltrated with 10 mL of 0.5% lidocaine (Xylocaine) with epinephrine (1 : 200,000) and marked. After preparation, adhesive drapes are used to avoid placement of metal instruments around the surgical field. They may interfere with intraoperative imaging (lateral radiograph or fluoroscopy) to confirm the cervical spine level.

Figure 79-9 Skin incisions for approaches to the upper cervical spine (**A**) and lower cervical spine (**B**).

The incision extends from the midline to the anterior border of the sternocleidomastoid muscle. Subplatysmal flaps are elevated (Fig. 79-10), and dissection continues medial to the sternocleidomastoid muscle and lateral to the strap muscles (Fig. 79-11). The internal jugular vein is identified and dissection continues medially (Fig. 79-12). Motor branches of the ansa cervicalis to the strap muscles are preserved when possible. In a patient with a muscular neck, transsection of the omohyoid muscle is sometimes necessary to provide adequate exposure of the lower cervical levels. The carotid sheath is identified, and blunt finger dissection medial to the carotid artery is usually sufficient to create a tunnel between the carotid sheath and esophagus and expose the prevertebral fascia

(Fig. 79-13).

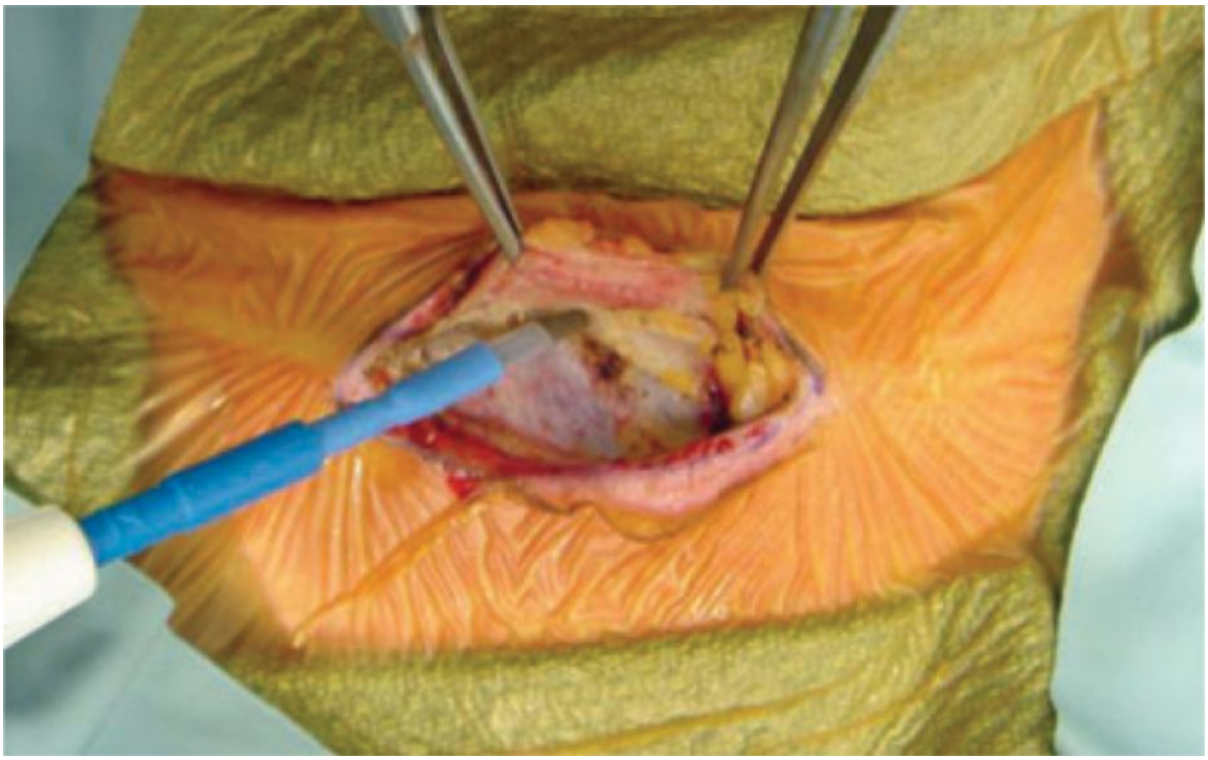

Figure 79-10 Subplatysmal flaps are elevated.

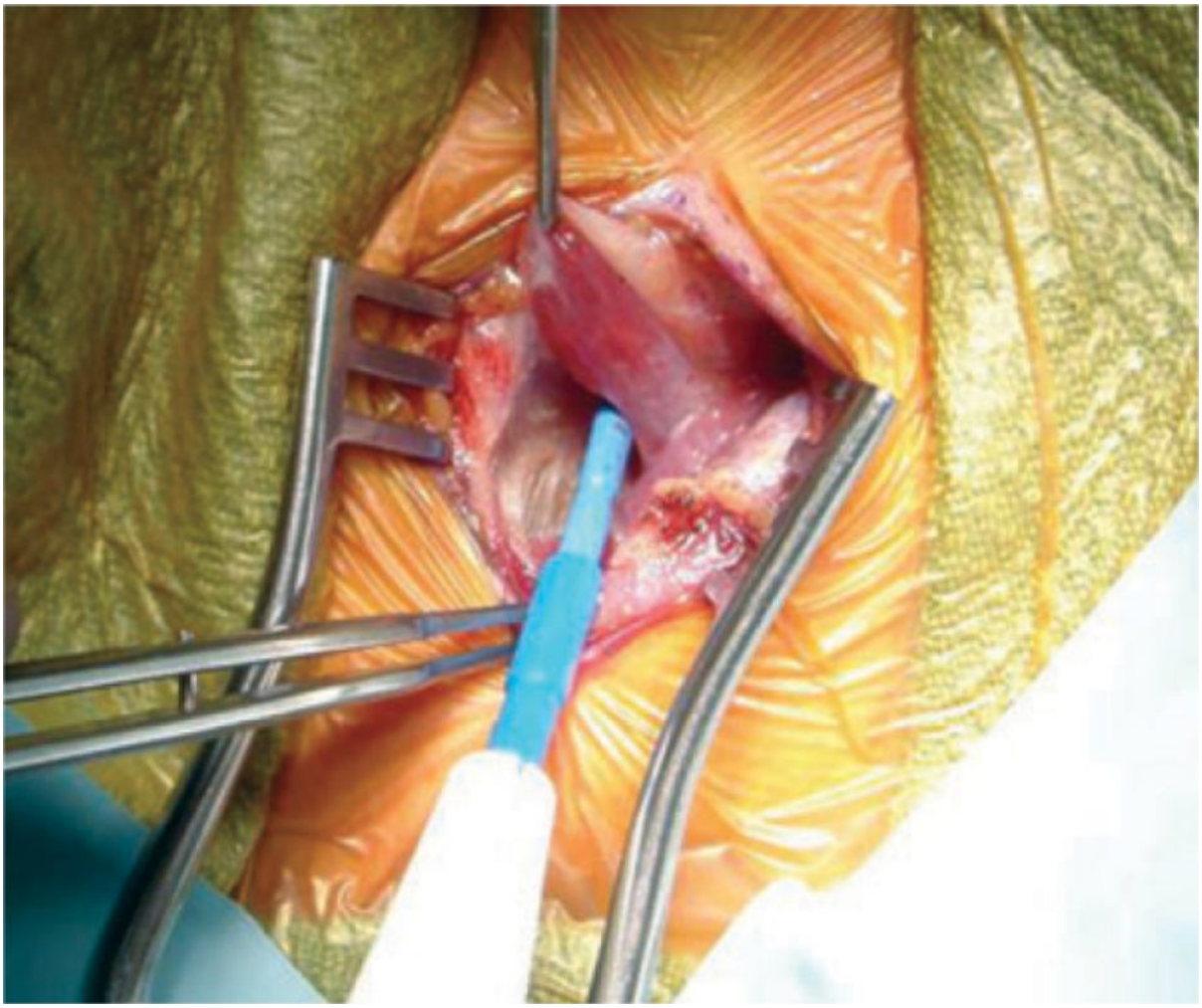

Figure 79-11 Dissection is performed between the sternocleidomastoid and omohyoid (forceps) muscles.

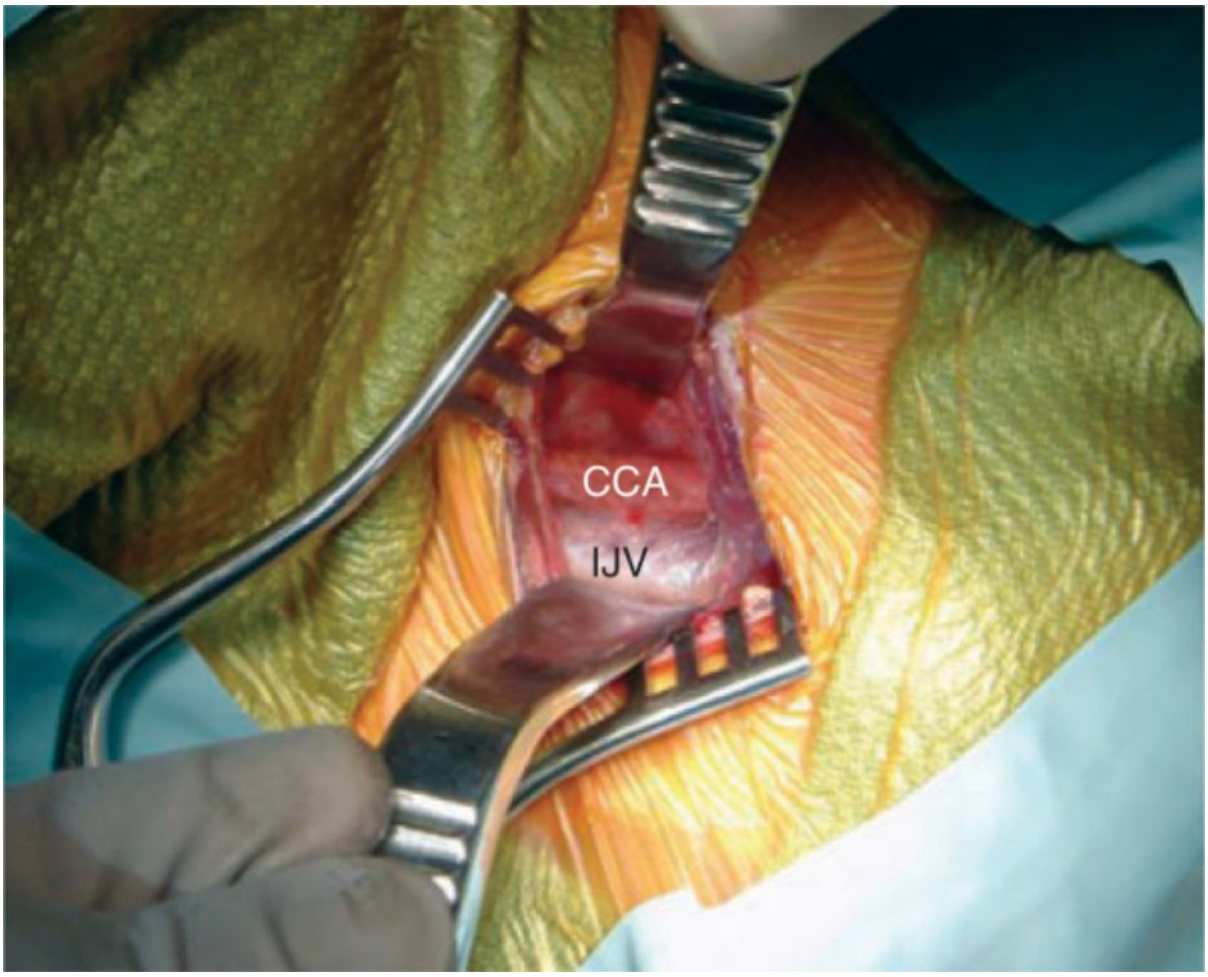

Figure 79-12 The internal jugular vein (IJV) and common carotid artery (CCA) are exposed and retracted laterally.

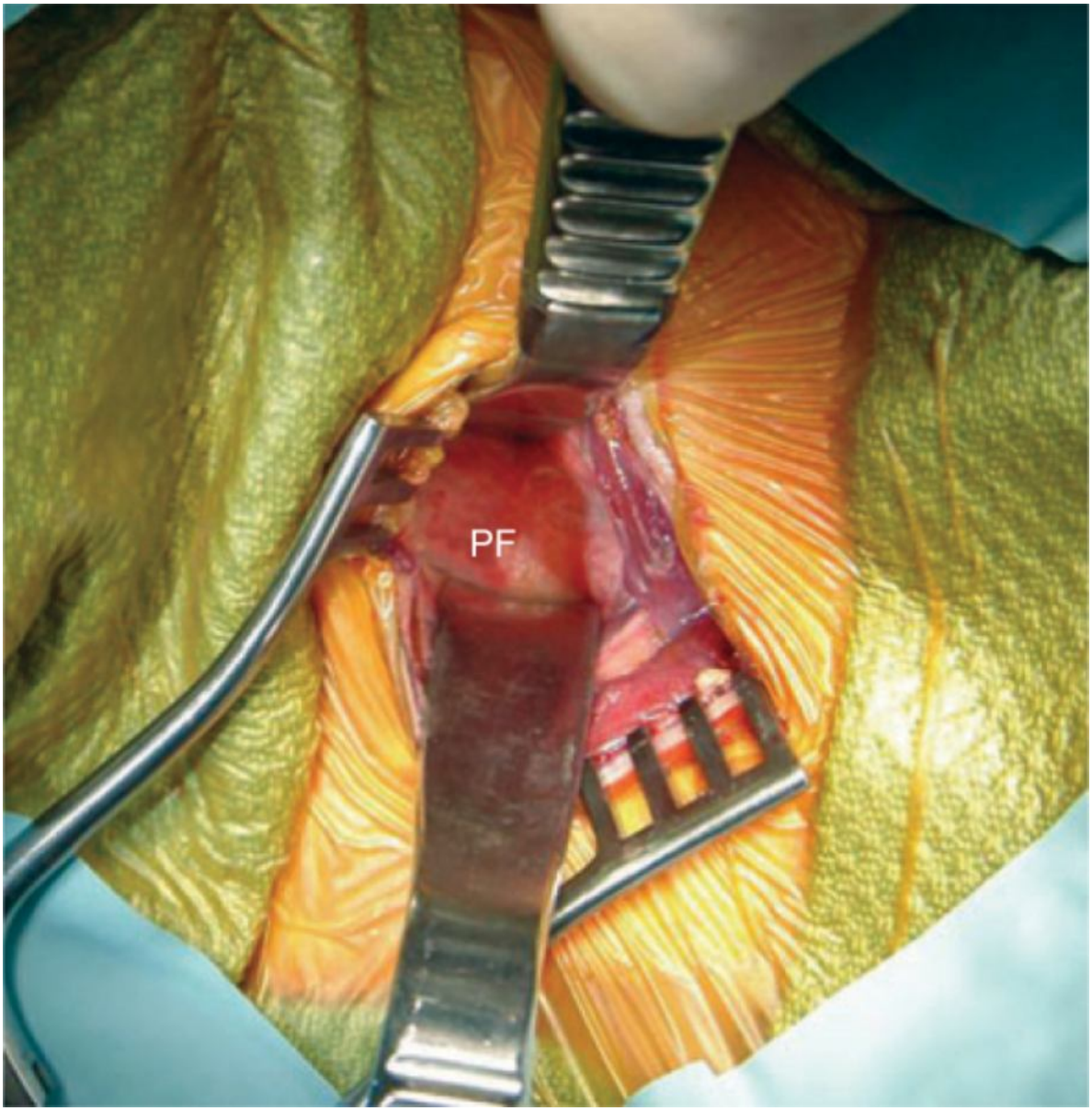

Figure 79-13 The retropharyngeal space is bluntly dissected and the larynx and esophagus are retracted medially to expose the prevertebral fascia (PF).

The length of the exposure is extended superiorly and inferiorly with appreciation of the course of the laryngeal nerves. With superior exposure, careful dissection is performed along the medial aspect of the carotid sheath. The superior laryngeal nerve crosses laterally to medially deep to the carotid artery and is closely associated with the superior thyroid artery. Once the nerve is identified, dissection of the retropharyngeal space can be performed deep to the nerve with gentle superior retraction. It is rarely necessary to identify the recurrent laryngeal nerve. A plane of dissection is maintained deep to the nerve and esophagus to avoid injury.

The larynx and esophagus are retracted medially and the prevertebral fascia is incised in the midline with electrocautery (Fig. 79-14). The edges of the longus colli muscles are elevated from the underlying vertebral bodies at the desired levels. Bleeding from veins on the surface of the bone is controlled with electrocautery. Excessive dissection laterally should be avoided because of potential risk to the vertebral arteries. The cervical spine level is confirmed radiographically by placing a spinal needle with a 1-cm “stair-step” bend at the tip in the intervertebral space (Fig. 79-15) and obtaining a lateral radiograph (Fig. 79-16). Self-retaining or fixed retractors are then placed (Fig. 79-17). Further decompression and fusion are performed by the spine surgeon.

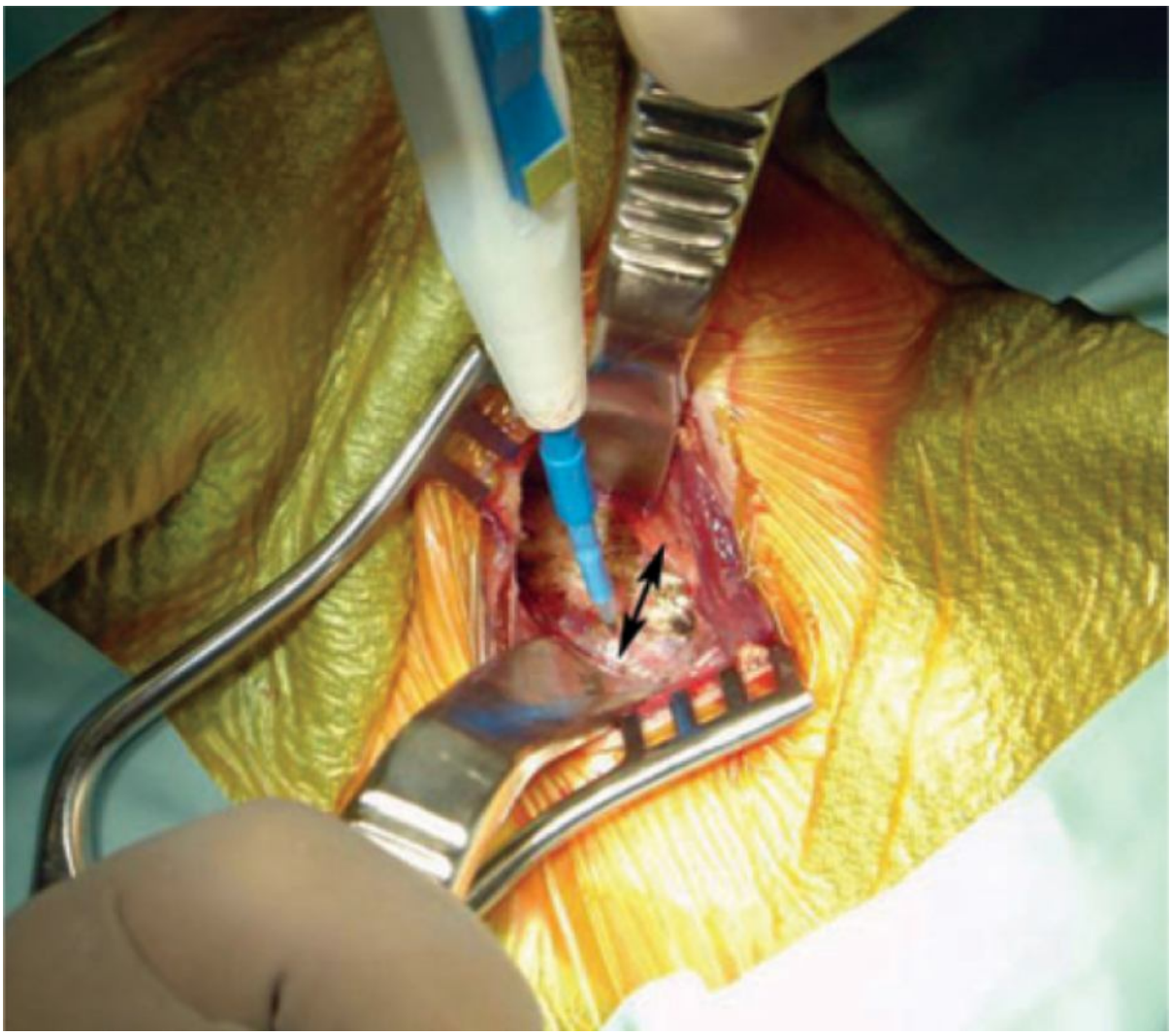

Figure 79-14 The prevertebral fascia is incised in the midline and the longus colli muscles *(arrows)* are elevated from the vertebral bodies.

Figure 79-15 A spinal needle with the tip bent in stair-step fashion is inserted into a disc space to mark the cervical spine level.

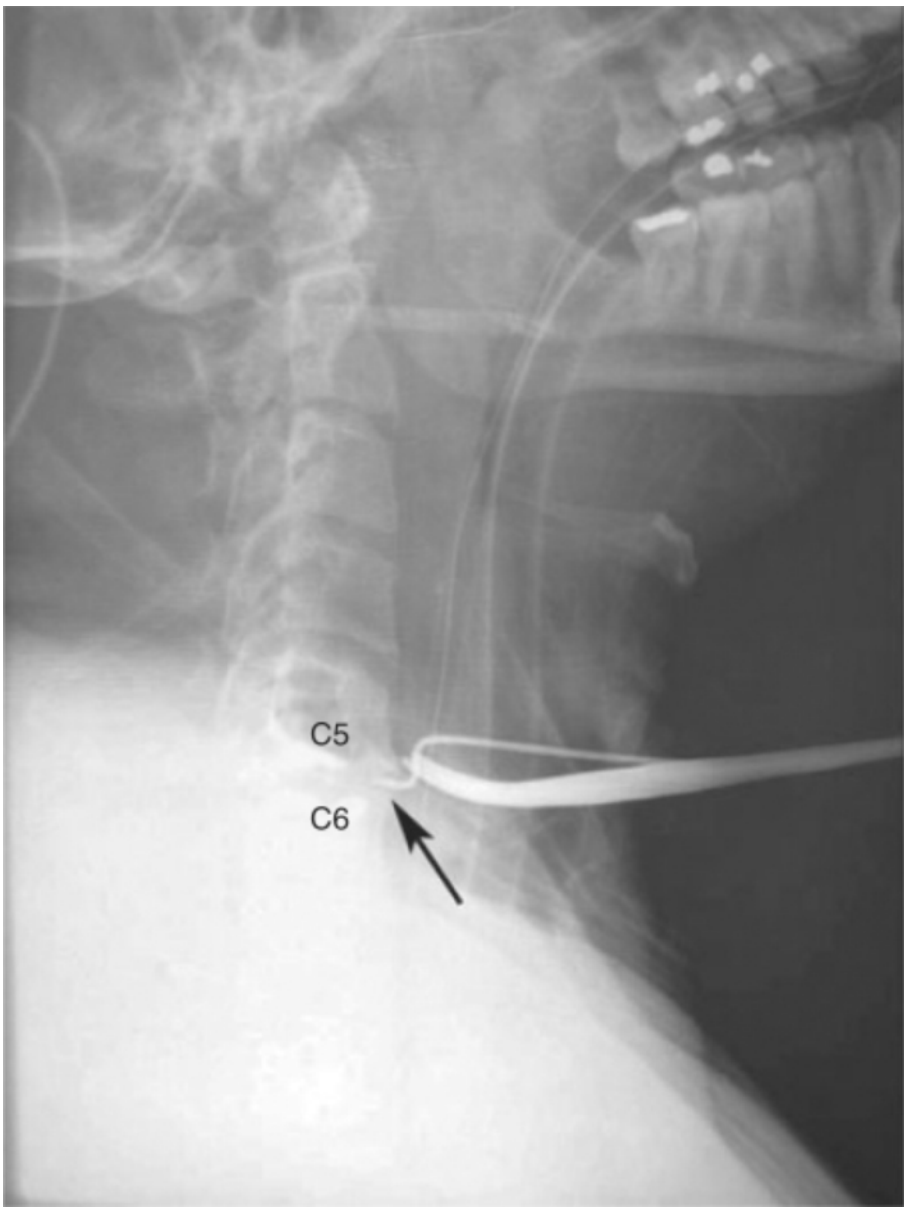

Figure 79-16 A lateral cervical radiograph demonstrates the spinal needle *(arrow)* in the C5-C6 disc space.

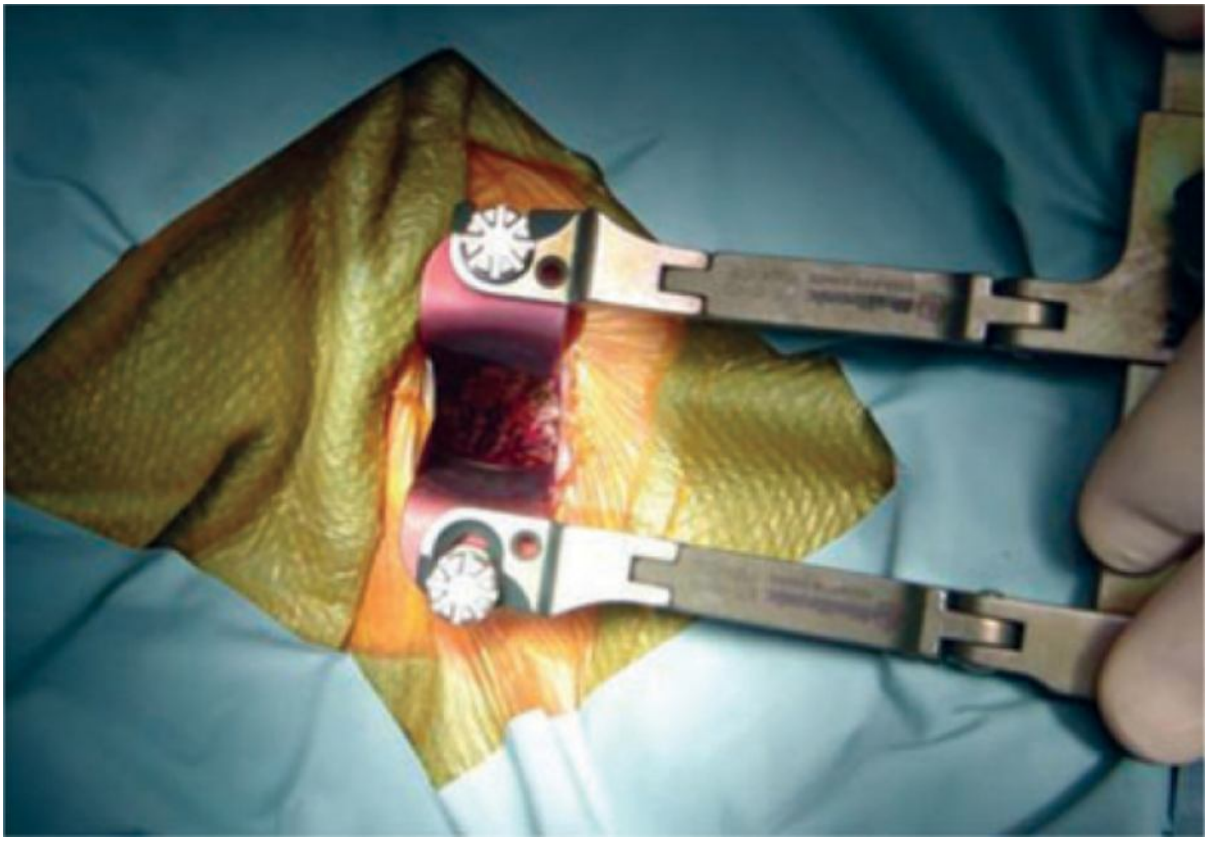

Figure 79-17 Self-retaining retractors are placed between the longus colli muscles.

Access to the retropharyngeal space for other disease processes is performed with the same technique. Although the retropharyngeal lymph nodes may be approached anterior or posterior to the carotid sheath, an anterior approach is recommended because there is less retraction of the carotid artery, less risk of injury to the sympathetic chain, and greater exposure (see Fig. 79-3). The sternocleidomastoid muscle and carotid sheath are retracted laterally and the digastric muscle and hypoglossal nerve are retracted superiorly. Transection of the descendens hypoglossi nerve may be necessary to mobilize the hypoglossal nerve. The superior laryngeal nerve is identified and a window is created between these nerves. The retropharyngeal lymph nodes are anterior to the superior sympathetic ganglion at the level of the transverse process of the atlas.[1]

Lateral Approach

The incision extends from the postauricular region across the upper part of the neck (Fig. 79-18).[2] Subplatysmal flaps are elevated and the sternocleidomastoid muscle is dissected along its anterior and posterior borders. The carotid sheath and lower cranial nerves are identified anteriorly and vessel loops are placed for retraction (Fig. 79-19). In the posterior triangle, the spinal accessory nerve is identified. The superior attachments of the sternocleidomastoid and trapezius muscles are detached from the mastoid tip and reflected inferiorly and posteriorly (Fig. 79-20). The occipital artery is tortuous below the digastric fossa and is usually ligated. The transverse process of C1 is identified and a plane of dissection is maintained lateral to this structure to avoid injury to the vertebral artery. The paraspinal muscles are detached from the transverse process to expose the area of the vertebral artery (see Fig. 79-4). A venous plexus and small fat pad provide useful landmarks for locating the vertebral artery. Further dissection of the vertebral artery requires great familiarity with the anatomy of the vertebral canal and is generally performed by a neurosurgeon. A posterior approach can be combined with an anterior approach medial to the carotid sheath if necessary.

Figure 79-18 Skin incision for a left lateral cervical approach. Auditory brain stem responses are being monitored.

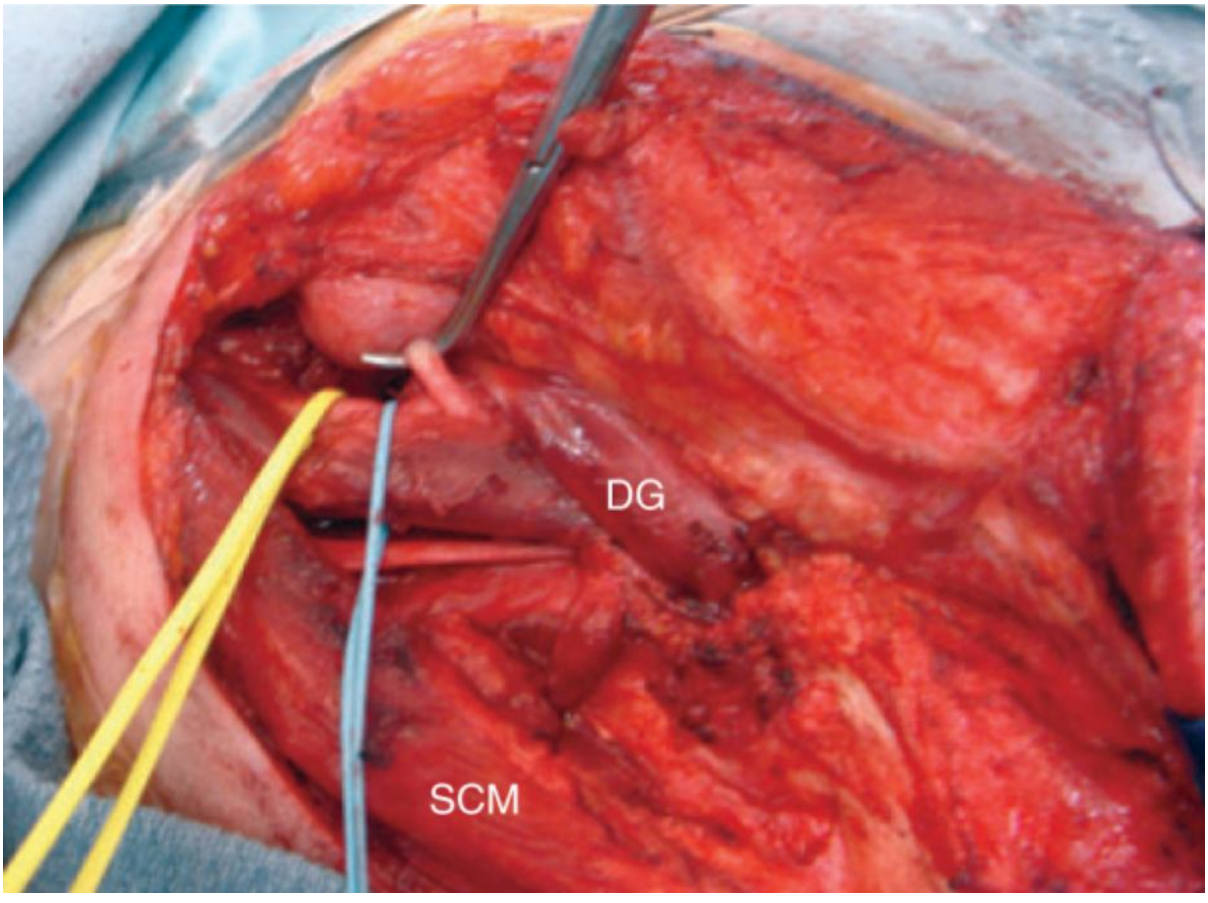

Figure 79-19 The vascular and neural structures are identified anterior to the sternocleidomastoid (SCM) muscle and inferior to the digastric (DG) muscle (left side of the neck): yellow vessel loop, carotid artery; blue vessel loop, internal jugular vein; curved hemostat, hypoglossal nerve.

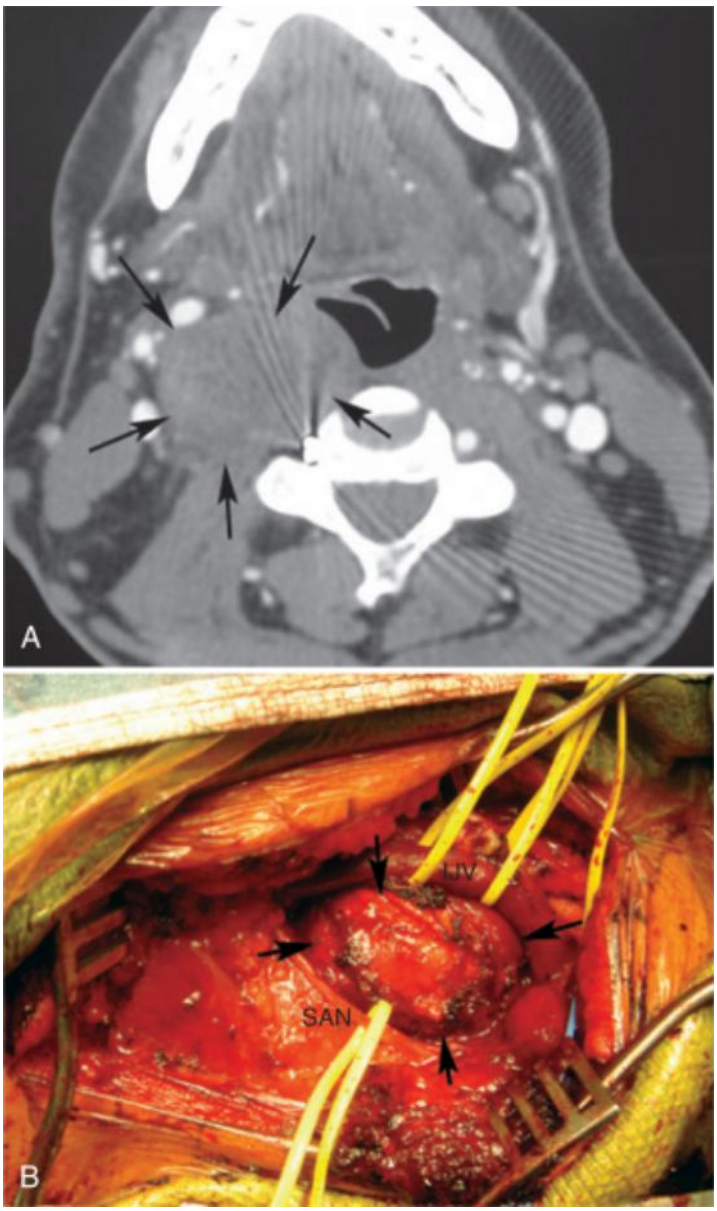

Figure 79-20 **A**, Chordoma of the right parapharyngeal space *(arrows)*. **B**, The chordoma *(arrows)* is approached between the internal jugular vein (IJV) and the spinal accessory nerve (SAN). The sternocleidomastoid muscle has been detached from the mastoid.

POSTOPERATIVE CARE

Postoperative care focuses on function of the lower cranial nerves. Transient hoarseness may be due to vocal cord edema. Hoarseness that persists for more than a week should be evaluated further by examination of the larynx to assess vocal cord function. A significant percentage of recurrent laryngeal nerve injuries after cervical spine surgery go unrecognized.[8] The patient should also be queried about aspiration. If complete paralysis is observed, options include observation, vocal cord injection if the symptoms are significant, and laryngeal electromyography to assess the degree of injury.

Transient dysphagia is to be expected, and most patients can accommodate a mechanically soft diet until it resolves. The incidence of postoperative dysphagia is 50% at 1 month, 32% at 2 months, 18% at 6 months, and 13% at 12 months.[7] Mechanisms of injury include laryngeal nerve injury, pharyngeal plexus injury, scarring of the pharynx, and obstruction by hardware. Persistent dysphagia should be evaluated with an esophagogram. A follow-up radiograph will usually be obtained by the spine surgeon to assess adequate placement and retention of the spinal hardware.

The following billing codes may be used for an anterior cervical approach to the cervical spine: 22554-62: *"spinal arthrodesis or fusion … incision is made through the neck, avoiding the esophagus, trachea, and thyroid … separate the intervertebral muscles"* and 22585-62: *"each additional interspace treated in conjunction with the code for the primary procedure."* The following billing codes may be used for treatment of a neoplasm requiring a lateral approach to the upper cervical spine and skull base: 61597: *"a transcondylar approach is used to expose*

the posterior cranial fossa, jugular foramen, or midline skull base" and 61615: *"excise a neoplastic, vascular, or infectious lesion in the posterior cranial fossa, jugular foramen, foramen magnum, or C1-C3 vertebral bodies."*

COMPLICATIONS

Improper placement of skin incisions can create problems for the surgeon. An incision that is too high runs the risk of injury to the marginal mandibular branch of the facial nerve. An incision that is too low is obstructed by the sternal head of the sternocleidomastoid muscle. If the dissection is too medial, the strap muscles and thyroid gland will interfere with the approach. Occasionally, an enlarged thyroid lobe is encountered and needs to be mobilized along its lateral margin. If the dissection is too far lateral, there is the potential for dissection lateral to the carotid artery with risk of injury to the vagus nerve and sympathetic chain (Horner's syndrome). If it is not detected, excessive medial displacement of the carotid artery by the retractors may result in carotid injury or ischemia. There is a greater risk of this mistake in patients undergoing surgery when postoperative scarring results in medial displacement of the carotid artery. If the dissection is too superficial, there is a risk of injury to the esophagus and recurrent laryngeal nerve.

Vocal cord paralysis secondary to injury to the recurrent laryngeal nerve may occur from direct nerve injury (transection, thermal injury from electrocautery), excessive and prolonged retraction, and overinflation of the endotracheal tube cuff. Animal models and clinical studies have demonstrated that there is a sharp increase in endotracheal tube cuff pressure when retractors are placed.[9,10] The recurrent laryngeal nerve is susceptible to ischemic injury at the point where it enters the larynx at the cricothyroid articulation. The risk of neuropraxia can be reduced by readjusting cuff pressure after retractors are placed. The anesthetist is asked to deflate the cuff and reinflate with the minimal amount of air necessary to achieve a seal, usually 1 to 2 mL less air.

SUMMARY

The anterior approach to the cervical spine provides wide access for a variety of pathologic processes involving the cervical spine and retropharyngeal space. The approach is limited by the superior laryngeal nerve superiorly and the recurrent laryngeal nerve inferiorly. Morbidity can be avoided by understanding the anatomy and minimizing retraction. Rarely, a lateral approach to the upper cervical spine is necessary for the extirpation of neoplasms. The key landmark in this region is the vertebral artery.

PEARLS

- The superior laryngeal nerve is deep to the carotid artery and in close proximity to the superior thyroid artery.
- Direct injury to the recurrent laryngeal nerve can be avoided by maintaining a plane of dissection deep to the esophagus.
- Transection of the omohyoid muscle improves exposure of the lower cervical levels.
- The retropharyngeal lymph nodes are found anterior to the transverse process of the atlas.
- With a lateral approach, the vertebral artery is deep to the transverse process of the cervical vertebrae.

PITFALLS

- In patients undergoing revision surgery, the carotid artery is medialized and there is greater risk of injury and dissection lateral to the carotid sheath.
- Most injuries to the recurrent laryngeal nerve are a result of excessive retraction.
- Endotracheal tube cuff pressure should be adjusted after placement of retractors to prevent ischemic compression of the recurrent laryngeal nerve.
- The retropharyngeal lymph nodes will not be encountered if the plane of dissection is too deep (in the danger space).
- Dissection medial to the transverse process of the vertebra may result in injury to the vertebral artery.